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INDEX TO VOLUME 113

January 1 to June 24, 1922

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McGRAW-HILL COMPANY, INC.
10TH AVENUE AT 36TH STREET
NEW YORK

Engineering and Mining Journal-Press

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V.113

INDEX TO VOLUME 113

January 1 to June 24, 1922

EXPLANATORY NOTE

Illustrated articles are denoted by an asterisk (*); abstracts by the letter "a"; editorials by the letter "e"; and news items by the letter "n", as indicated at the foot of every page.

This index is made comprehensive but concise. Pains are taken to bring together matter belonging to the same subject so that when a reader looks up an article he will also be referred to related data. Mines and mining companies mentioned in "News by Mining Districts" have been grouped for convenience under "Mines and Mining Companies."

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[illegible]
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Assistant Editors
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[illegible]
J. VOLNEY LEWIS
[illegible]
Consulting Editors

Volume 113 New York, January 7, 1922 Number 1

The War of Tariffs

THE LONDON *ECONOMIST*, in its issue of Dec. 3, observes cogently:

> "Just at a time when the world, if it is to recover from the waste and disorganization of war, should seek after the development of industry and the free exchange of commodities, the nations of which it is composed are doing their utmost to arrest development and to prevent exchange. The war of arms is turning into a war of tariffs. The nations are behaving as if to trade with them were the worst of injuries; they are raising walls of tariffs to keep trade away. All want to sell to export; but none, it would appear, want to buy, to import. How one can export without being paid for one's good by imports no one stops to inquire. That feverish confusion of mind which is a symptom of diseased nationalism impels them all, or nearly all, to strive after an economic self-containment, which, if it were possible, would result in economic death."

France, the editorial goes on to state, Belgium, Italy, Spain, the United States, Australia, Canada, South Africa, New Zealand, Sweden, Denmark, Peru, Bolivia, Chile, and Japan all have recently set new tariffs or are in process of doing so.

> "The first thing a newly constituted state appears to think of is how best it may hinder trade with its neighbors. Esthonia, Latvia, and Lithuania, those Baltic fragments split off from what once was Russia, have all set up new tariffs in the course of the past year. Rumania's latest effort in tariff revision dates from July last, as does that of the Jugo-Slav kingdom.
>
> "The delusion that protective tariffs 'safeguard' trade is one of the most persistent and dangerous of economic delusions, the more dangerous because superficially so plausible. Politicians everywhere, when confronted by depressed trade and unemployment, always fly to tariffs as to drugs, and refuse to realize that just as the human body pays in wasted vitality for drugs taken, so do 'protected' peoples pay in lost efficiency for the tariffs imposed upon them."

These conclusions are, of course, less applicable to the United States than to any other country; for the United States may survive with a great tariff Wall of China placed around it; but so far as we desire to be a commercial nation, exporting and importing, the principles of our economic welfare are the same as those of England and Germany, to whom the clogging of trade channels means economic death, whereas to us it means only serious disaster.

The United States Chamber of Commerce Tariff Report

THE COMMITTEE ON TARIFF PRINCIPLES of the United States Chamber of Commerce has submitted its report by a referendum to its members—to the Chambers of Commerce and other affiliated commercial organizations of the United States. This report first shows the unimportance of the tariff expedient as a source of revenue. It recalls that for the years 1918, 1919, and 1920 the customs revenue constituted only 5 per cent of the total revenue of the Government; "hence that source of revenue, which once played an important part in the cost of carrying on the Federal Government, has become an almost negligible factor, and tariff for revenue only would probably not now be advanced as a major party plea or as an economic consideration of vital importance to our people in lessening the burden of direct taxation."

The tariff, therefore, according to the report, is simply an industrial measure. The report accepts to a degree the principle of protection of American industries, and believes "that in framing tariff legislation and in the application of legislation full consideration should be given to the reasonable protection of American industries that are subject to destructive competition from abroad and that are, or promise to be, of benefit to the country as a whole or to any considerable section thereof." But it also points out that new conditions have arisen necessitating modifications in the old protective policy of the United States, and that "the United States, now a creditor nation with enlarged industrial development and expanded commerce in foreign markets, must therefore carefully adjust her tariff policies to her own changed relation to world affairs as well as to changed world conditions."

Trade Wars and Poison Gas

WE DO NOT ORDINARILY SEE *The Freeman;* by nature and tradition we are conservative, and *The Freeman* hailed the book on "Political and Commercial Geology," in which we had some private part, as radical, even though, as it observed, we did not know it. Of course, etymologically, and as we know *The Freeman* meant it, *radical* means (Latin *radix,* a root) going to the root of a matter—it is the same word as radish, which is a root—and we do not object to that; but we do not want to be suspected of complicity in the Wall Street bomb plot. So we are shy of *The Freeman.* Nevertheless, we are bound to say that an editorial handed us by a friend contains more than the glimmerings of wisdom.

This article discusses the limits of tariffs, or other artificial economic barriers, and actual economic reprisals, diplomatic contests, and finally armed conflicts which are the final stage of economic conflicts. It discusses the theory and dreams of a League of Nations, a World Parliament, or an Association of Nations, according to the hope of most of us. It discusses the hope of such an association or league, made potent, according to Senator Borah's vision, by an international judicial tribunal. *The Freeman* argues that the decisions of such a court would not work. (We know this has been true of The Hague tribunal):

> "Well, why not? Simply because there is an economic barrier between France and Italy, while between Pennsylvania and New Jersey there is none. . . . Probably Senator Borah would say in all good faith that the national

[illegible] of the United States is due to political agreement. [illegible] believe it, but it is due [illegible] first, [illegible] of production are the same [illegible] commodities [illegible] Pennsylvania [illegible] and [illegible] last.

[illegible] tural model, [illegible] tes of America. . . . [illegible] lf. Have we a United [illegible] founding fathers got [illegible] of conferences, and [illegible] Hardly. We [illegible] America because Potash and Perl- [illegible] New York, can [illegible] from the Hamsucket [illegible] usetts, and sell their finished product to [illegible] nski and Berkowitz in Seattle, Washington, all with- [illegible] custom house. A United States of Europe, or of the world, will form itself, and form itself to stay, as soon as similar conditions of trade are established in all the states of Europe, or of the world; and there is no other way whereby one can be formed."

This gives all of us beginners at least something to think about: To agree with or disprove. We must consider economic discriminations, reprisals, and trade wars as a source of actual wars; consider the relation of tariffs, import, export, or otherwise, to national animosities, and hence to battleships, and hence taxes, since nearly all our tax burden and the cost of our government is for war, past, present, and future. Let us cogitate, then, on the ultimate relation of tariff to taxes, and figure out where we get off cheapest in the end—you and I—when the final balance sheet is struck.

The Location of Tariff Walls

IF WE ASSUME as our own the prevalent world theory of taxing imports, while seeking for an outlet for our exports—if we assume that we must protect our own industries in order that they may not be ruined by competition from cheap labor and machine production in Germany, Japan, or England—where shall we build our tariff wall? On the Atlantic and Pacific Coast; on the Great Lakes and the Rio Grande, you will say. Not so: we have a reciprocity in commerce with Cuba; a Republican (and, therefore, a tariff-believing) President sought reciprocity with Canada, which was rejected by Canada, not from economic reasons, but through Chauvinistic politics. Examples like this will recall the evident fact that it is not our territory we are seeking to protect by tariffs, but our commercial life; therefore, obviously we set the protection wall around the boundaries of our commercial sphere. Once we acknowledge this truth, we must get the economist and the trade expert to delineate those misty confines according to his beliefs.

American enterprise has a great mineral industry in South America, in Brazil, Chile and Peru—a great industry in copper and iron, feeding its own United States industrial life. Shall we draw our economic boundaries for tariff purposes outside of these? Examination of the tariff will show that actually this principle is already accepted. The emergency tariff carries a duty on pig tin, but none on tin ore. This protects the tin smelters of our East Coast, and the American-owned tin mines in Bolivia. No voice has been raised for a tariff on copper, out of the universal clamor for a tariff on every metal and mineral. Why? Because of the vast American-owned copper mines in South America. Our copper-mining commercial boundary extends past the Atlantic seaboard into the Southern Hemisphere. We are slow to [illegible] the principle, but actually the same thing exists for zinc, and similar American-owned commercial interests in Mexico tend partially at least to offset the demands that have been made by purely domestic producers for a zinc tariff.

The wider our commercial boundaries grow, the more far-flung are our proposed tariff lines. For a real trading nation, like England, her tariff boundaries East and West, pass around the world and meet, and there are no boundaries.

The Doctrine of Free Exports of Minerals

THE INTERNATIONAL Chamber of Commerce, with which the United States Chamber of Commerce is closely associated, at its meeting in London June last, considered the question of the free movement of raw materials as distinguished from manufactured products. Here is a natural distinction which we would do well to bear in mind in our thought. Finally a resolution was adopted, which dodged the delicate question of import duties, but was able to secure the approval of the delegates of all the countries as regards export duties; and it accordingly recommended the abolition of export taxes by every government for a fundamental list of raw materials, including "Ores and mineral products; natural metals; precious metals; mercury; stone and earth; coal; and mineral oils." Certainly the mineral industry is sufficiently blanketed in this list. But it is the wording of the preamble which is of greatest interest to us:

> "Considering that every tax on export of raw materials must necessarily increase the cost of production and thereby hinder economic development and prevent economic restoration;
>
> "And that it is desirable to put a stop to, as far as possible, the rivalries between nations in their search for raw materials, to stamp out the cause of economic conflicts which may threaten peace, and to do away with the natural inequality arising from the fact that the riches of the world are unequally spread over its surface and to assure the rapid restoration of the world's commerce."

This lays down the principle of the *free movement outward* of raw mineral products. In effect this principle works in the interest of great manufacturing countries, and against the interest of countries possessing a great or almost monopolistic supply of natural mineral wealth. Chile must not levy, according to this, an export tax on her nitrates, nor Mexico on her petroleum, nor the Republic of Georgia on her manganese. The principle postulates that the natural raw materials of the world, such as the mineral wealth, are a common heritage or reservoir of power and wealth to which none may be barred access on the terms of ordinary trade.

Replaceable Drill Bits

THREE DIFFERENT ATTEMPTS are now being made to develop a replaceable drill bit. All are still in an experimental stage, but we believe a practical solution will be obtained in the not distant future. With an efficient replaceable drill bit, a set of standard drill-bit holders made from excellent metal, an alloy that is shock resisting, will form the equipment of each drill, and need be handled only a relatively short distance. The drill bits alone will make the journey to and from the sharpening shop on the surface. As the drill bits represent only a relatively small amount of metal, they can probably be made from a steel alloy which will be comparatively expensive but will be more efficient in drilling capacity. Thus there is the possibility of a considerable economy in drill steel and in handling steel. This is the incentive toward which the experimenters have been working.

Other attempts to make a replaceable drill bit have been made, but with the piston type of drill, used at the time, they were unsuccessful. With the hammer type of drill, the drill steel does not reciprocate, but is held more or less firmly against the bottom of the drill hole. This is a totally different condition from the piston type and it is not improbable that it is more favorable for the use of replaceable bits.

Anaconda has been experimenting with a replaceable bit invented by A. W. Hawkesworth. This bit has undergone a number of changes, and we are told has not yet been fully worked out. A general announcement or "story" appeared in the *Anaconda Standard* of Nov. 20, 1921, but insufficient details were given to make possible judgment as to its merits. Other experiments which we have known of for some time, are being conducted by the Vanadium Corporation of America and still others are being made by a Western inventor, and we have looked over his work. The subject is of great interest to the mining industries, and the hope is held out that success will reward one or more of the efforts here recorded. As soon as definite results have been obtained in this work, we will inform our readers.

The Latest Smoke Suit

SMOKE SUITS have been a common byproduct of smelting in recent years. They are all similar. The farmer owns or acquires land near a smelter, which he uses for agricultural or stock-raising purposes. Should the crop be a failure, or should the cattle die, it is most convenient to blame the smoke from the smelter. The latest suit was brought against the United Verde Extension Mining Co., and judgment was recently entered, awarding the plaintiffs a dollar apiece as damages, though the mining company will be obliged to pay about $1,600 in costs. This was the first time the matter has been brought before the courts in Arizona, though smelting districts in California, Utah, Montana, and Ontario have all been fertile fields for the "smoke farmer."

In most cases, the farmer is not sufficiently skilled in scientific agriculture to know the cause of his troubles. In some instances, the smelter fume is to blame, but more often disease is the cause, the land is unsuited to the crop raised, or the crop is not intelligently grown. State departments of agriculture can profitably devote some attention to this matter, and advise farmers wherein their troubles lie and what kinds of agricultural activity are the most promising.

In the recent case, the superior court of Yavapai County has shown wisdom in awarding only nominal damages. Even if all damage could be traced to smelter fume, in most cases the injured party depends upon those connected with the mining industry for his market, and were there no such industry he would be elsewhere. There are few smelters in rich agricultural districts.

WHAT OTHERS THINK

Orienting the Square Claim

There can hardly be a question that a square location with vertical side lines is neat, but to have these lines north and south and east and west is not best, if for only the one reason that few metallic, whether fissure veins or other deposits, run in these directions. The majority run nearer halfway between the cardinal compass points. You have shown in *Engineering and Mining Journal* of Oct. 22 what it is to locate a vein that runs crosswise of a square.

We now locate a vein with "300 ft. on each side of the center thereof."

The fairest way for the discoverer would be a square location as near parallel to the vein system as can be determined, and covering most of his find; i.e., he would have his "discovery" nearest his side line from which his vein dips. To pay $50 to hold a barren claim after five years is ridiculous.

The discoverer should have the preference. The other fellow, attracted by his find, should take what he can get.
EUGENE ANTZ.
Homestead, Ore.

Who is Apathetic?

A great number of technically trained and experienced men in this country are today out of work or have gone into another line, because they could not make a livelihood. This is true in the mining and metallurgical profession to a greater extent than any other, because the slump has been of longer duration there. But what is to be done?

Numerous attempts have been made to relieve the unemployed labor situation, but nothing has been done for the man who has trained and studied, giving up the best years of his life for a profession, and then is not permitted to continue, but is obliged to leave it to earn enough money to support his family.

Surely this is not a happy state of affairs. Does the *Journal* care? Will the majority of its readers care?
Denver, Col. J. P. VARIAN.

Standardization of Stamp-Mill Parts

I am anxious to learn how many dies or patterns would be required to cover the entire range of sizes used in gravity stamp-mill practice. In addition to the different weights of stamps, I understand that detailed dimensions vary for the same weights by different manufacturers. If this is so, if there are no standards, this fact would cause the forging plants and foundries to carry on hand a greater variety of dies and patterns, thereby increasing the cost of their products. It would seem that this one of many similar questions, would be interesting and instructive reading matter to both manufacturers and mining men.

The question of standardization of wearing parts for rock crushing and grinding machinery is one which is now being given due consideration by designing engineers. Their efforts are being applauded by purchasing agents. Every one should co-operate in this cause.
El Paso, Texas. F. N. FLYNN.

College of Mining—University of California

Historical Sketch—Relation to University—Analysis of Mining Course—Attendance Time Element—Cultural and Industrial Subjects Difficult to Include—Types of Mining Education

BY GEORGE J. YOUNG

Western Editor, *Engineering and Mining Journal*

TEN THOUSAND young people and a small army of professors and instructors can't get together in a place like the University of California without some evidence of their activity affecting both local and contiguous neighborhoods. This gets into our New Montgomery Street office chiefly as flotsam and jetsam in the daily newspapers. Recently we were informed that President Barrows deplored the gradual extinction of American humor. Forthwith the local editors proved to an edified public that that particular brand of humor was just as exuberant, potent and free from carbon on its spark plugs as it ever was.

Then along comes a column article headed by a picture of the Campanile, accompanied by a picture of the Lincoln bust which has found a home on a tall rough-hewn pedestal cemented to the south side of the tower. We are let into the secret that a considerable part of the Berkeley townspeople has entered objection to the ringing of the Campanile chimes, imported at considerable expense and thrust upon them without their special consent. The article contains the soothing suggestion that "the bells will mellow with age."

LINCOLN BUST FAILS TO PLEASE

Of the Lincoln bust, we are led to believe that an "artistic crime" was committed by both the place and manner of supporting the few pounds of bronze. In defense, we are authoritatively told that "art, to be art, does not necessarily meet with the approval of the public as a whole." President Barrows appears again, with the delicious and well-pleasing Californiaism that the student athletes of the University of California surpass the models used by the ancient Greek sculptors in physical perfection. President Barrows is alleged to have said: "Californians have been brought up here where the climate allows them to play their games all the year 'round. They are from a hardy stock of pioneers. They are called upon in competitive games such as will be played in the new stadium to give all they have in body and mind."

THE STADIUM "DRIVE"

The new stadium mentioned by President Barrows is to be built from the proceeds of a drive upon the public for $1,000,000 or more. The stadium drive was on the crest of the newspaper wave, and although some of our pessimistic business men under present conditions would look askance at this adventure, the interesting fact remains that there were enough people willing to see their names on brass plates, with an accompanying proprietary right to the seat, to subscribe to the plan of financing by the advance sale of seats to the games.

My scrapbook contains other interesting allusions to the university, but, it is unnecessary to spread them here as they will only serve to further bring out the point that the sparks that fly in the newspapers give no more idea of what is being done in a large university than the program of a vaudeville theatre does of the quality of the show itself. It is necessary, if one would really know about the modern educational processes, to become a part of them for a time at least, and even then only a superficial view can be obtained. Knowing this, I visited the college of mining of the university and endeavored to sense as far as practicable the influences upon and the work of this department.

Mining is associated with many other departments which in the aggregate constitute an exceedingly complex organization. As a part, it must account to the organization as a whole. Its individual initiative is thus made to conform to certain general principles which are more or less definitely established by the university. Its students work in various departments, some of which are definitely grouped together and others of which are merely tributary. This restriction tends to preserve a balance between the objectives of a single department and the ideals of the institution.

ADVANTAGES AND DISADVANTAGES OF CONTACT-EDUCATION

The mingling of a single group of students, having a specific objective, with numerous groups of students having other objectives has its advantages and disadvantages. The advantages are association with many different subjects, departments and persons, all of which contributes to the contact-education of the student in greater or less degree. The disadvantage is that, in the wealth of activities, classes, social, athletic, and otherwise, there is a dispersion of interest. This is one of the weakest points of a large university like California. Only extraordinary concentration could work out the binomial theorem in a three-ring circus. What must be the state of mind of a student with only a moderate ability to concentrate in the midst of the wealth of activities, apart from the classroom and laboratory, that appear to be the rule rather than the exception?

Are there sufficient compensations for this dispersion of interest to make it worth while for the average student? I do not think that the compensations are in themselves of sufficient value to the student, but he for the most part believes them to be. Student activities are here to stay. Unless there is a definite joining of faculty and student body in an earnest effort to control them, the objectives of the universities will be lost. At California, the plan of student government offers perhaps the best solution for the control of this troublesome feature, and the steps that are being taken will no doubt be of great interest to other universities. They are not, however, germane here.

ENTRANCE TO HEARST MEMORIAL MINING BUILDING

It is almost unnecessary to state that a good proportion of the student body are earnest worth-while students and that the faculty is as representative in ability as that at any other university of similar standing. I am unable to see any special difference in the student body here as compared with that in any other university marked by a large student attendance.

THE CHRISTY CURRICULUM

To understand the present status of the college of mining, it is necessary to go back to Professor Christy's time. Professor Christy died in 1914. He was a dominating personality, and held strongly to his principles. Under his administration the college maintained excellent standards. It was strongest in fundamental subjects and training and developed the technical side only in so far as the available time would allow. Thus the course was divided into two years of fundamental and two years of technical subjects. A single course was provided. Such students as wished to major in geology, either did not take the mining course or followed the mining course by post-graduate work in geology. During Professor Christy's regime, the university received the Hearst Memorial Mining Building. This building is the most costly building devoted to mining education that has ever been erected. During his time, the laboratories were quite well equipped, so that in appurtenances and facilities the college is abundantly supplied.

Succeeding this regime was a two-year interval during which steps were taken to split the single course into several specialties. Dean Frank H. Probert was then placed in charge of the college, and the curriculum took definite form, incorporating separate courses in mining, metallurgy, economic geology, and petroleum engineering. In all of these courses, the first year is the same, differentiation beginning in the second year and becoming more marked in the last two years. Thus, the student must decide at the beginning of the second year what course he is going to take. All of the courses are definitely prescribed and little elective work is allowed.

The present enrollment is as follows:

	No.	Average Age.
Graduates...	4	25.00
Seniors	35	22.47
Juniors	81	22.00
Sophomores	62	21.00
Freshmen...	52	......
	234	

	Per Cent
Mining option.....	56.52
Metallurgy option.	6.96
Economic Geology option......	6.96
Petroleum Engineering, option......	29.56

	No.
Residents	208
Non-residents.	15
Foreign	14
	237

More than half of the enrolled students elect the mining course; approximately a third the petroleum and the remainder are equally divided between metallurgy and economic geology.

Through the kindness of James Sutton, recorder of the faculties, I was given a table of the total annual enrollment of the college of mining beginning with 1897-98, up to and including 1921-22. The information is presented as a graph in Fig. 1. It is interesting in showing the erratic nature of the attendance at a well-established school in a large population center contiguous to the Western mining districts.

The steady increase in attendance up to the peak of 1903-4 was undoubtedly due to the increasing interest in mining which followed upon the discovery of the Klondike and the Nevada silver and gold districts. The year 1907 marked the beginning of a period of mining depression which, however, did not last long. Before this time, attendance fell off, and following 1907 rapidly declined. It is a matter of conjecture as to the exact cause. In my opinion, the most important is to be found in the more intensive development of Western mining schools which was taking place during the period and which naturally influenced the number of students who would be expected to go to the more centrally located schools.

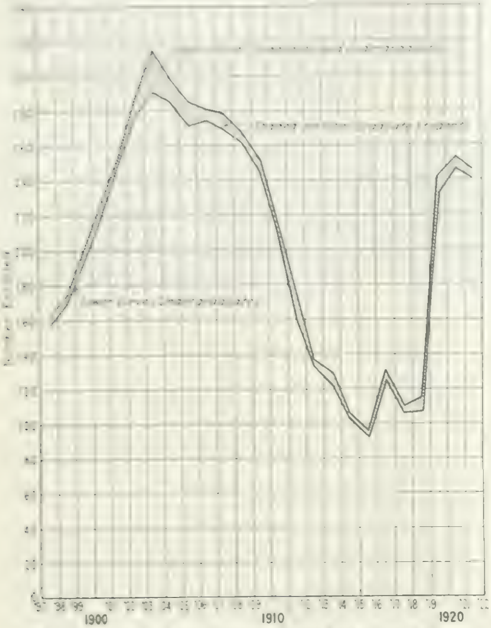

FIG. 1. ATTENDANCE CURVE—COLLEGE OF MINING

INFLUENCE OF THE WAR MANIFEST

The war activity accounts for the minimum portion of the curve. The remarkable increase following the war period was reflected in increased attendance in other schools. This increase in attendance was due to the realization, by young men, of the value of good training as a factor in success, and to the release of many young men from war and consequent activities. Already the attendance in the mining college is diminishing and probably will drop further in sympathy with the lessened activity in mining. The graph is illuminating in showing how difficult an administration problem is placed upon a school by reason of wide variations in attendance.

Inasmuch as the mining course represents a more or less typical four-year course, an analysis of it will be worth while. Limitations on space do not permit similar analyses of the other courses.

ENTRANCE REQUIREMENTS

Entrance to all of the courses is predicated upon a four-year high school course or its equivalent. All intrants are required to take an examination in English composition, and those who fail are required to repeat the examination at the next scheduled time. The required subjects for entrance are plane geometry, elementary algebra, algebraic theory, trigonometry, physics, chemistry, and geometrical drawing; the recommended subjects, algebraic theory including quadratics, solid geometry, freehand drawing, and foreign language.

The curriculum has been analyzed on the basis of the actual hours given to a subject while in classroom or laboratory. Classroom periods are, however, only fifty minutes in length, ten minutes being allowed to cover the campus between buildings. This entails a loss of about 264 hours from the given number of lecture and classroom hours. The laboratory period is three hours, and little time is lost here. A student is supposed to put two hours of study upon each classroom period. Some do it, but instructors are skeptical as to just what return is secured from this theoretical requirement. In the analysis which follows, discrimination is made between descriptive or courses dealing with principles and courses which are determinative or have to do with quantitative measurements of some kind:

			No. of Actual Hours
Hygiene—Lectures and reading in military hygiene and sanitation			16
Mathematics—Analytical geometry and integral and differential calculus			192
Physics—General physics lectures and recitations on mechanics, properties of matter, heat, magnetism, electricity, wave motion, sound and light, part determinative			192
Chemistry—General chemistry, lectures, laboratory and quizzes		256	480
Determinative—Wet assaying and simple gravimetric determinations of the type used in works laboratory; fire assaying of gold and silver ores		224	
Drafting—			
Conventional drafting restricted to needs of mining students		96	208
Descriptive geometry lectures and problems		112	
Surveying—Plane surveying lectures and field practice		160	434
Four weeks in summer surveying class		160	
Mine surveying and mine mapping, laboratory		114	
Mechanical and Electrical—			
Elements of heat power engineering		48	208
Direct current machinery, with laboratory		80	
Alternating current machinery, with laboratory		80	
Engineering Design—			
Analytic mechanics (engineering mechanics)		96	224
Elementary strength of materials		48	
Hydraulics, as applied in power plants or as of use in hydrography		48	
Graphostatics		32	
Metallurgy—			
Descriptive—general metallurgy lectures		32	192
Ore dressing lectures		32	
Iron and steel		32	
Determinative—Ore dressing laboratory		92	
Geology and Mineralogy—			
Descriptive—			
General geology—structural and dynamic	48	128	620
Economic geology—metalliferous deposits	48		
Descriptive mineralogy—occurrence and use	32		
Determinative (in part or all determinative)—			
Mineralogy and crystallography	172	492	
Introduction to petrology with determination of rocks by megascopic properties	128		
Field geology—lectures and field work	192		
Mining—			
Descriptive—			
General mining lectures	32	254	526
Mine rescue and first aid	30		
Economics of mining	48		
Mine equipment	48		
Mine development and mining methods	48		
Mine cost accounting	32		
Law of mines	16		
Descriptive and in part determinative—			
Compression of air and use of compressed air	160	272	
Mining machinery—experiments with drilling, ventilating, pumping machines	112		
Grand total			3,292

Of the total actual time, about 45 per cent is given to classroom work and 55 per cent to laboratory. This disregards gymnasium and military training, but includes approximately 8 per cent of time lost between classes. The approximate total time in the 128 weeks making up the eight terms of sixteen weeks each is 3,500 hours of lecture and laboratory instruction. On the basis of 39 hours per week there would be 4,992 hours in the 128 weeks, or about seventy (including the 8 per cent lost time between classes [illegible] per cent of the total time is utilized.

The interims between terms, after omitting 4 weeks given to summer surveying and 4 weeks for mining observations, leave 52 weeks, or 2,028 day-hours, at the disposal of the student. Adding to this the surplus day-hours during term time (1,492 hours, including, however, a certain number of hours for thesis or for the preparation of a report on summer mining observations) gives a total of 3,520 day-hours at the command of the student during the four years in which he is at college. The demand time for the whole period slightly exceeds 50 per cent of the total time of the student, not counting more than 39 hours per week. It will thus be seen that the student has at his option slightly less than 50 per cent of the day time in a 39-hour week throughout the four-year period. He has in addition Sundays, Saturday half-days and evenings in which to play, work at his studies, or earn his way.

In Fig. 2, the four divisions into which the total time in the four-year course is divisable are represented. Three of the time divisions are approximately equal, and the fourth is slightly smaller. In this visualization of the time element it seems to me that there is an important point for educators to consider. Would it not be valuable for the faculty of a given group to induct the students into the habit of efficiently using the time in excess of that required for formal instruction? Let the student look upon time as representing a money value of $1 per hour. This is a small value to put upon it when one considers that the four years in a college course are the culminating preparation for life's work. Perhaps, also, in this more economic use of a student's time will be found the solution of excessive "student activities" of the unproductive kind.

The course as a whole may be criticized in that it is deficient in any attempt to give added power to the student in written and oral expression, in language or in fundamental economics. Apparently there is time for a capable student to get instruction in such subjects, and it may also be inferred that there is sufficient practice in the various subjects to develop written and oral expression. I was also unable to determine how much of the course entails passive receptivity and study and how much really develops personal power in the student. My impression was that more could be done in developing personal power by a greater use of the quiz method and a liberal number of problems consistently distributed throughout the term time.

Elements of Current Study Course

Compared with the older course, there is less of fundamental subjects and more attention to mechanical equipment, and greater familiarity with compressed air, steam, and electricity is required. The geological and metallurgical are perhaps less strongly developed and the engineering element is about where it was. The course deals largely with the objective side of mining—practice, processes, rocks, ores and geological structure. A conscientious student could at the end qualify as an assistant to a draftsman, assayer, works chemist, surveyor, geologist, or, in minor capacity, to a superintendent. In other works, it is one step in advance of the vocational school in that it supplies service men and minor executives who may by diligent self-study, close observation, and experience under varying conditions qualify for greater responsibility and some eventually land in the higher consulting and operating positions.

Whether an attempt is made specifically to outline the study to be superimposed upon the work at college is not apparent in the outline of course. Just how much the university does in supplying inspiration and vision to its product, so that a fair proportion may in time develop into leaders of the kind required for the continuation of the industry, is also not apparent.

Is a course devoted so largely to the objective side of mining one that will stimulate vision and capacity? Does it leave the ambitious graduate with sufficient background to strike out in the direction of high attainment? It seems to me that the objective course leaves these questions largely to the student, and he must also plan his own study after he leaves college.

New System Emphasizes Services to Rank and File

We are prone to associate the idea of leadership with the university system. This ideal of leadership has been a part of it. It is so to a less extent now. There was a time when the proportion of students showing marked personal power was conspicuous. There are probably as many now or even more, but they are submerged by great numbers of students of ordinary ability. Perhaps the students of marked ability are not going into mining at all. Thus the problem of the university has changed, and it is no longer one of developing the leaders and letting the rank and file follow along, but now it has to take care of the rank and file and let the leaders take care of themselves. It is wisdom to plan a course to meet the needs of the greatest number and one that will range with the capacity of the average.

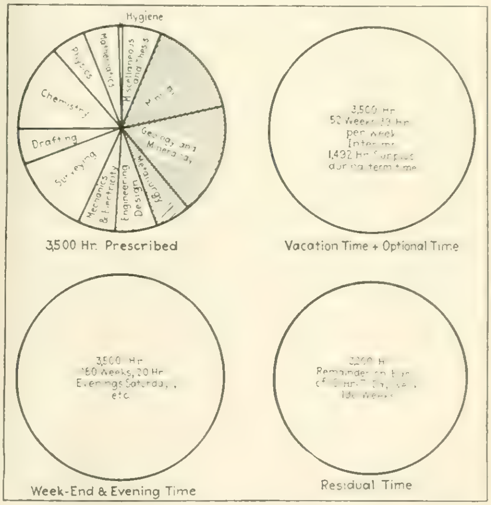

FIG. 2. APPROXIMATE GRAPHIC ANALYSIS OF TIME IN FOUR YEAR COURSE

Looking at the outline of the course, it would appear that the metallurgical element could be extended more thoroughly to cover the metallurgy of the major metals. It would also appear that the time allotted for the study of metalliferous deposits is hardly sufficient to more than introduce the subject. In engineering design, the basic subjects are given, but they are not threaded together in such a way as to give the student a clear conception of their use. To some extent they are made use of in thesis work, but I am informed by Dean Probert that the thesis is undertaken only by very capable students, and other students are required to write an extended report upon their summer mining observations.

The "human element" is covered to some extent, no doubt, in the courses, but no conspicuous attempt appears to be made to go into this subject thoroughly. Labor enters so largely into the mining industry that it would appear to me that the subject should be studied in many of its phases and presented to the student as thoroughly as possible. It is as fundamental as mathematics and should therefore find as definite a place.

ADVANTAGES OF CULTURAL DEVELOPMENT

Viewed as an engineering course, many subjects are lacking. Sociology, economics, psychology, history, all in relation to industry, find no place. Civil contact of industry, exemplified by regulatory legislation and business law, is absent. To attempt such subjects in a four-year course would be considered by some to be unwise. Nevertheless, they are essential to the engineer and must be self-acquired at some time in his career.

Much has been written and discussed about the cultural side of the engineer and the need to develop this. If familiarity with literature, foreign languages, political and economic history, together with ability to write and talk on various subjects is meant by this term culture, then it is obvious that the objective mining course described before, entirely overlooks this phase. Again, it is a practical question of the utilization of the students' time. If any time be given to it, something must be sacrificed. Some will see justification in not making this sacrifice in the fact that there is acquired more or less culture in living the life about us. The student's viewpoint must also be taken into consideration. Obviously, if the student is not interested in cultural subjects—and many of them are not—it would not be practicable to incorporate them in the course.

Engineers may plan a course which in their judgment is best for the young man entering college. Unconsciously or otherwise, they try to provide for their individual shortcomings and overlook considerations of practicability with respect to the younger man's point of view. Whatever is served up to the average, not the exceptionable, young man must be palatable.

CONSIDERING PERSONAL PREFERENCES

The objective course has been developed, partly by considering specific demands from the industry and partly by what the average young man wants or thinks he wants. If it starts him off in the industry, he is apparently willing to forego a more comprehensive attempt to prepare him for higher positions.

Thus it would seem that there is room for several different kinds of mining courses, one of which I will designate the objective course, the other the engineering course. The greater number will be served by the former and a much smaller by the latter. Whether by design or not, the College of Mining has elected to serve the former rather than the latter.

The College of Mining of the University of California has a background of achievement that compares favorably with that of the best of our mining schools. This has been the result of an objective course based upon the secure foundation of fundamental studies. As one of a group of schools committed to the four-year mining course, it has in recent years increased the practical value of its work instead of its horizon. It will probably be undisputed that a large proportion of its students have no immediate need for cultural and industrial science courses. On the other hand, a certain smaller proportion would have their future progress benefited by them. No one program can satisfy the capabilities of all, although it may serve the needs of the greatest number and be keyed to their pace. To provide for the very capable, the prescribed course should be made flexible. For the average student, on the other hand, a strong effort should be made to secure a proper utilization of the time, with the objective of securing thoroughness in whatever line of endeavor is attempted.

British Columbia's 1921 Metal Production Estimated

An estimate, based on such official returns as were available slightly more than a month before the close of the year 1921, places the value of the metal production of British Columbia for that year at $24,553,909. The 1920 output had a monetary value of $35,543,084, so that it may be expected that there will be a decrease for 1921 of about $10,989,175 or 30.9 per cent. A detailed estimate of the 1921 output and a comparison with the official figures for 1920 follow:

APPROXIMATE ESTIMATE OF THE 1921 METAL OUTPUT OF BRITISH COLUMBIA

WITH COMPARATIVE FIGURES FOR 1920

	Production, 1920		Estimate, 1921		
	Amount	Value	Amount	Price	Value
Gold, placer......	....	$221,600	...	$20.67	$220,000
Gold, lode, oz	120,048	2,481,392	106,000	......	2,191,020
Total gold......		$2,702,992			$2,411,020
				Cents	
Silver, oz.........	3,377,849	3,235,980	2,550,000	60.23	1,535,865
Copper, lb........	44,887,676	7,832,899	30,000,000	12.40	3,720,000
Lead, lb.........	39,331,218	2,816,115	43,000,000	4.08	1,754,400
Zinc, lb.........	47,208,268	3,077,979	45,000,000	3.83	1,723,500
Total.........		$19,665,965			$11,144,805

Laboratory Volatilization Experiments

In a study of the chemistry of the volatilization process, being conducted at the Intermountain Station of the Bureau of Mines at Salt Lake City, an experimental set-up has been designed and constructed for the measurement of equilibrium. Enough runs have been made to show the method of experimentation to be practical and capable of results. A series of experiments were carried on, dealing with chloride volatilization of lead, zinc and copper as chlorides, using chemically pure lead, zinc and copper oxides and sodium chloride as a chloridizing agent, the object being to ascertain whether sodium chloride reacts with the oxides named above, giving off the metals as chlorides. Laboratory voltilization experiments have been made at the Intermountain Station on the Yellow Pine ores, the purpose being to determine the effect of various thicknesses of orebody, rabbling, chloridizing, and the effect of varying the amounts of air over the ore in the furnace.

The Difficulties of Developing an Invention: The Story of the Cyanide Process

The Practical Demonstration of an Improvement Is Not Necessarily Followed by Commercial Adoption—World-Wide Use of Cyanidation Due to Indefatigable Work of Pioneers, Who Never Received Adequate Financial Reward

BY ALFRED JAMES

Annual Christmas Letter to the Profession

PROGRESS in the development of the metallurgy of gold and silver was not notable in 1921, and I have therefore decided to devote my annual letter to a consideration of what it really means to establish an improvement in practice. A pioneer in volatilization work calls attention to the difficulty encountered by almost every keen enthusiastic inventor: that of finding sufficient financial support. A patent for however brilliant or useful an invention is likely to be regarded by capitalists as a gamble rather than an investment. But the inventor is none the worse for having to rely mainly on his own resources, even for the development of a world-famous invention. It is indomitable keenness, proof against all discouragement, that develops grit and results of practical value.

INVENTIVE GENIUS SELDOM ADEQUATELY REWARDED

History shows that the royalties derived from even the greatest epoch-making invention are usually small recompense for the ingenuity, skill, patience, investigation, determination, cheery optimism, work and capital expended in bringing the invention to a successful issue, and in, what is still more, forcing its adoption on a public which generally requires some years of education as to the advantages to be gained. Hence it generally happens that the fourteen years' protection granted in England on an epoch-making invention covers little more than the period of incubation, nursing, and developing to adolescent capacity.

Possibly the epoch-making inventions of the day are propulsion of vessels by steam turbines, radio-telegraphy, airplanes, and wave transmission of power. To discuss the first: After fourteen years of incessant effort and skillful striving, Parsons found himself at the end of his patent life with little more than his expenses. The history of Marconi is widely known. It was not until after many years of ceaseless ingenuity and untiring brilliant invention that the shareholders financing Marconi received a single penny on their money invested. The Wright brothers were never reported as entertaining royalty or as marrying European princesses, and I understand Constantinescu has not yet received serious reward for the civil use of his inventions.

But apart from the smallness of the remuneration, another feature stands out strongly: that but for the invincible enthusiasm and dogged determination of the inventor every improvement would be the failure in practice it is at first almost universally pronounced to be by those learned in the art. It is, therefore, of the utmost value to the industry that the connection of the inventor with the working of his invention should be obtained, maintained, and encouraged.

Professor Elihu Thompson says: "Publish an invention freely, and it will almost surely die from lack of interest in its development. It will not be developed, and the world will not be benefited."

It is essential that sufficient inducement be offered to obtain that fostering care which provides the main difference in results between many a successful process and previous attempts to accomplish the same purpose by similar or even well-nigh identical means. It is for this reason that so-called "anticipations" are pernicious. Disinterred from the dust and cobwebs of antiquity, unexplored except for the purpose of an action at law, they by-pass the main wealth and value of a patent—the toil, expense, skill, perseverance, and grit expended in its development. The anticipations were absolutely valueless from the lack of these adjuncts—ideas are cheap; it is work which develops fruitfulness.

I hope to live long enough to see infringers thus relying on a prehistoric "anticipation," not merely treated with derision, but mulcted in a penalty for their failure successfully to employ, prior to the introduction of the contested invention which taught them the way, the anticipation they later bring forward as their defence in an action for infringement. Whence derived the infringers their valuable knowledge; from the patent or from the anticipations? The inventor today is unjustly treated: the world over, the patent law is unfair to him on this point. A better plan might be to deal with an invention as with a copyrighted book: reward the inventor for life with a small royalty from users; but the invention must first establish its novelty. Once established the state should uphold it.

Industry everywhere must be made to realize the cost in time, money, skill, enterprise, courage, and keenness that is required to develop successfully an epoch-making process, and I therefore intend this year to deal specially with what should be now a matter of history—viz., the forcing on the industry of the cyanide process. Many inaccurate statements appear from time to time in the writings of learned men who have obtained at second hand the history which is not within the scope of their own experience. I therefore published many years ago in the special twenty-first anniversary number of the *South African Mining Journal* an authoritative account from, and substantiated by, the official records. I am convinced that greater publicity should be given to that account.

FAILURE OF ANOTHER PROCESS LED TO EXPERIMENTS WITH CYANIDE

One has to go back to 1886 to appreciate the effort of the parties mainly responsible—Messrs. Wright, Verel, and Gow, of the Cassel Gold Extracting Co. In that year this company found itself faced with the sudden disappearance of inventor and secretary and the collapse of a process which could not be made to work. The board, undeterred by the flight of the inventor, determined to make the process work. It was found that instead of being a cheap method of gold extraction, it was in reality an expensive way of producing bleaching powder by the electrolysis of salt solution, to which lime was from time to time added. At this time J. S. MacArthur wrote an article to the technical press showing how the process should be worked. The board therefore secured Mr. MacArthur's services, which resulted, however, in no improvement in results. MacArthur brought forward a little thing of his own, the extraction of gold from ore by solutions of ferric chloride. But this method proved to be not feasible in practice.

Still undeterred and anxious to press forward the process, the board next investigated MacArthur's suggested process of the use of solutions of cyanide of potassium. And now, with success apparently at hand, fresh difficulties and worries arose, to be overcome only by a display of such enthusiasm and bravery as but few men have shown under similar conditions, either before or since. The board had already dispatched an unsuccessful expedition, consisting of Messrs. Feldtmann and MacArthur, to the property of the St. John del Rey Co. to fulfil a contract entered into for the old process, and, undismayed by the lack of results, resolved on sending out a number of expeditions to introduce the cyanide process and to educate the mining community to an appreciation of its advantages. The first expedition (the Messrs. McIntyre) was sent to Queensland; the next to New Zealand (Mr. McConnell). From these two expeditions little that was tangible resulted. The Messrs. McIntyre demonstrated on concentrates and pyritic ores in iron pans, and Mr. McConnell erected a successful ore-treatment installation at Karangahake; but all this work attracted no users except for Dr. Scheidel's small concentrate plant at the Sylvia (1890).

EARLY WORK METALLURGICALLY SUCCESSFUL BUT NOT GENERALLY ADOPTED AT FIRST

The lack of success of these two expeditions, from the point of view of forcing a process on an industry or gaining adherents, in no way damped the ardor of the board. Before long a fresh expedition was planned to Africa (in the latter part of 1888), and a year later MacArthur was also sent off on an expedition to America. This latter expedition of MacArthur's was not a success; indeed, it was not until some years later, after the process had accomplished great things in Africa and New Zealand, and Dr. Scheidel had proceeded from the latter territory to California, that the application of the process in Mexico and the success of cyaniding at Mercur compelled the attention of the mining interests of the United States.

It will thus be seen that, of four expeditions, one only, the African, was successful in gaining adherents, and even then a further expenditure of time, money, and energy was necessary to force the process into general use.

Let us look into the history of the African introduction. A study will serve to show the enthusiasm, skill, courage, capital, and business energy necessary to convert even a successful demonstration into a general adoption. The pioneer in Africa[1] arrived toward the end of 1888, and in accordance with his instructions at once proceeded to Lydenburg, Barberton, and the Horo mines, in Swaziland, it being the intention of the board to demonstrate the process in either the first- or last-named district. Certain investigations were made by the pioneer which decided his future course of action; but his visit to Barberton and his investigations at the United Pioneer (Moodies) caused J. H. Cordner-James to form a local syndicate, at the outset consisting of J. M. Buckland, W. W. Webster, and himself, to acquire the African rights of the process. This step was the first real encouragement received by the keen and determined Scotsmen who had been so long pushing the process, and it undoubtedly was the cause of the subsequent demonstration being on so large and effective a scale.

THE FIRST TRIALS OF THE CYANIDE PROCESS ON THE RAND

From Barberton the pioneer came to the Rand, and after an examination underground, possible mainly owing to the extreme courtesy and kindness of the late Hermann Eckstein, of well-nigh every mine of note (over eighty) in the district, from the Nigel to Blaauwbank and Malmani, he settled down to conduct a series of experiments in an assay laboratory at the Langlaagte Estate, placed at his disposal, entirely without charges for laboratory, stores, or labor, by the liberality and shrewd foresight of Mr. (now Sir) J. B. Robinson. The investigations completed, the African pioneer returned to Scotland to consult with his board as to the offer made by the local syndicate to purchase the South African patents. This was subject to the success of a public demonstration of the process to be held at Johannesburg, and the pioneer designed the necessary installation and brought it to Johannesburg early in 1890.

Meanwhile, one of those worries which daunt the most enthusiastic inventor cropped up in the matter of patent rights. On his original arrival in Capetown the pioneer had found that Dr. Wernher von Siemens (represented by E. Lippert) had a patent for a cyanide process, with electrical precipitation, dated only a month after the MacArthur-Forrest patent. Young and inexperienced, the pioneer did not deem it necessary to worry his board with such disquieting information; he decided on the spot to raise an action for the revocation of the Siemens patent. That such an action had never before been brought in the colony, and that his attorneys proved also to be the Siemens attorneys in no way disquieted him. His attorneys had to choose between the two clients and to proceed with the action. This step was most fateful to the future of the South African patents, for on his arrival at Pretoria he found that some local difference of opinion as to the difference between the Taal and High Dutch had caused the postponement of the acceptance of the MacArthur-Forest application until a month after that of Siemens, who thus had prior rights in the Transvaal. Nothing daunted, a similar action—but with apparently less ground—was raised at Pretoria to that started at Capetown, and a report made by letter to his board as to the condition of affairs and his consequent action.

The result is distinctly interesting. The Cape courts decided in favor of MacArthur-Forrest, as the true and first inventors; and the Transvaal court, although in this case Siemens had the prior date, decided to follow the decision of the old colony. I am informed that these were the first two patent actions in South Africa. On so little hung the fate of the introduction of the cyanide process into the Transvaal!

The demonstration plant, referred to previously, was erected by arrangement with the Salisbury company, at its battery. The enthusiastic encouragement given to the process by the manager, R. A. Michell, is gratefully remembered by those who were naturally very appreciative of the slightest expression of approval in those early days. It is only fair to refer also to the attitude of the press and to the value of the publicity and encouragement freely and cheerfully extended to the pioneer of the process. Dormer, of the *Star;* Rathbone, of the *Mining Journal;* Piet Davis, of Maritzburg, were towers of strength. They awoke the interest of the community, and, indeed, prepared the way for the subsequent adoption of the process.

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[1] Mr. James modestly refrains from personal references to himself [illegible] article, but he was "the pioneer."—EDITOR.

I have had naturally much experience with the daily, the financial, and the technical press in four of the five continents. Great publicity has been given at great length to my technical writings and to my work (whether I wished it or not), but never in all my professional career have I known of a single instance of payment for press services so generously and spontaneously rendered.

By April, 1890, the demonstration plant at the Salisbury was ready for action, and early in May Mr. MacArthur, whose presence it was considered would be of especial value to the syndicate at this juncture, arrived at Johannesburg, where the demonstration took place, the pioneer having first run one hundred tons through the plant so as to have the staff acquainted with their duties and the plant running smoothly.

The success of the demonstration is well known. Later, in 1895, Hennen Jennings reminded me that the results then being obtained at the Crown Reef were precisely those obtained by him and J. R. Williams (afterward famous for his successful process for treating slimes by decantation) in 1890 at the demonstration; but the fact remains that, excepting the manager (Mr. Michell) of the property on which the plant stood, no one adopted the process!

INVENTORS MUST OVERCOME PREJUDICE IN FAVOR OF OLD PROCESSES

This should be well considered and taken to heart by all persons fathering a new process, as it is just one of the difficulties by which an invention is faced. Practically every epoch-making invention is pronounced a failure at first, wherever exploited, and it is only the invaluable enthusiasm of the inventor and his financial associates which enables them to survive this adversity and ultimately to force the process on the industry.

The Gold Recovery Syndicate, which had contracted to purchase the patent rights, thus found itself, in the latter half of 1890, with no backing and no adherent other than Mr. Michell, but for whom the syndicate would have had the demonstration plant left on its hands. Mr. MacArthur had returned to Scotland, taking with him his check in payment of the plant, and it was left to the syndicate, with which was associated the pioneer, to take other and still more vigorous measures to force the adoption of the process. That these measures were taken was due mainly to the keenness and decision of W. W. Webster, who determined to spend his last penny, refusing to be discouraged, rather than fall short of complete success.

It was at this juncture that a Scotsman connected with one of the local banks came to their aid. Funds were thus obtained by which advantage could be taken of the liberal terms on which Hennen Jennings offered a block of valuable Robinson tailing, thereby enabling himself to obtain greater knowledge of the practical working of the process.

Up to this time the process had been described as for refractory ores and concentrates only. The demonstration was limited to the treatment of material of this nature. An installation was now designed by the pioneer for the treatment of tailing by percolation. This modification in the method of carrying out the process involved a change from the agitation of small charges in cylinders fitted with paddle agitators to the gravity percolation in large tanks of considerable quantities of material, and was so novel as to induce Mr. MacArthur's greatest friend on the Rand to state that the process was a new one and ought to be named jointly after MacArthur and the pioneer; but this suggestion never appealed to the latter.

The invention had been completely and thoroughly worked out by MacArthur and his associates; probably no invention has been placed before the public more completely and thoroughly developed. The fact that the carrying out of the invention, as originally put into practice, in Australia, New Zealand, America, and South Africa, had failed to induce a single adherent (other than Dr. Scheidel, with his small concentrate plant at the Sylvia) to adopt the process, made it obvious that our *modus operandi* was wrong. The adoption of gravity percolation made the process commercially successful and of world-wide acceptance, spreading from South Africa to New Zealand and India, with later adoption in the United States and in Western Australia, where inappropriate methods of introduction had caused a setback.

The new plant at Johannesburg was built by Messrs. Tarry in December, 1890, under my supervision, being laid down according to the plan of operations carried out by Messrs. Webster (manager), Gaze, and Darling. The plant did not meet with the approval of the authorities in Glasgow, who had sent out a plan of a small (8 x 6 ft.!) square Tharsis tank as one to be followed, and it gave me no little satisfaction to be able to reply, to a letter prognosticating failure, with an account of the great success of the plant. Within two months of the starting of operations, the plant was showing a profit of over £2,000 a month on an original outlay of about £3,000, the African Gold Recovery Co. was formed, and Mr. MacArthur was sent out by the new company to arrange for the local conduct of its operations.

Not even yet, however, was the process forced on the industry. The new company decided to continue the profitable operation of the treatment of tailing on its own account. New contracts were accordingly entered into with other companies, such as the Crown Reef and the Meyer and Charlton; and then at last the companies decided to adopt the process, and the fight was won.

EARLY HARDSHIPS OF THE DEVELOPERS OF THE PROCESS

After five years' hard work, involving the training of many metallurgists, the erection of a cyanide manufacturing works to prevent the supply of cyanide to the mines being restricted, the dispatch of six expeditions, the fighting of two lawsuits, and the carrying out of much chemical research, such as the use and effects of cyanide, alkalies, oxidizers, lead salts, and alkaline sulphides, the manufacture of cyanide by various processes, and the expenditure of over £100,000, an epoch-making process of the greatest success had been forced on an industry.

It is only a fair conclusion to state that but for the expenditure of so much dourness and determination, of so much patience and encouragement, of so much business common-sense and foresight, and last, but not least, of so much capital, the discovery of MacArthur and the Forrests, and of their financial associate, Morton, would not have been made available to the industry for many a year, but would have laid fallow as a non-pursued chimera with the unfollowed-up ideas of Faraday, Bagration, or the more practical processes of Rae and Simpson.

THE QUESTION OF REWARD TO THE PIONEERS

And what of the reward offered by the industry as remuneration for so much enterprise, effort, and success? This question can scarcely be left to the industry. As to whether, after the result of the action taken by them—a result which, in view of the decision of the English Appeal Court, would have conceivably been different had the Transvaal been at that time a British colony, with right of appeal to the Privy Council—the mine owners might have felt called on to make some remuneration to the patent owners who had so fostered the introduction of the process, one can understand that after the expense, worry, bitterness, and exhaustion of a prolonged fight a feeling of relief at the result would predominate over all other sentiments. But surely it behooves the industry in its own interest to see that the result of the challenging of the MacArthur-Forrest patent is not to deter other inventors from putting forward their methods in the Transvaal. Such a result appears to have already involved the Witwatersrand in an annual loss far greater than the royalty it would have been necessary to pay had it not challenged the patent.

WHY NOT A PENSION FUND?

There is one other matter which arises from the consideration of the effect of the severing of the interest of the pioneer group in a new process. Those who have grown gray in the working of the new process may feel that they have not the prospect of a retiring pension for their old age. Such a thing might have been relied on had a pioneer company still continued its ownership to the usual period of patent expiry. Nine years ago I suggested that the greatest gold field in the world could be large hearted and could perhaps pardon a suggestion that a small contribution from the mines of a fraction of what they had saved in patent royalties would suffice to establish a fund, called, say, the Cyanide Pioneers' Pension Fund, from which all cyanide pioneers in charge of plants from the earliest days of the process (first plants at each mine) who continued in the industry, not necessarily as cyaniders (they might have since become managing directors, consulting metallurgists, reduction officers, samplers, or assayers) might, on their retiring after twenty years' service, become entitled to draw a pension of, let it be assumed, £300 a year for life. I regret that my proposition met so little response on the part of the South African mine controllers. I trust to live long enough to see it adopted.

It has never been realized that the industry, the world over, has had the free use of an apparatus which has stood the test of time, and is still used practically unaltered, but which was designed for and first used on the Robinson tailing plant. This box could have been patented. Originally, gold was precipitated from its cyanide solution by zinc shavings placed in chloride of calcium tubes; subsequently earthenware pots were used for a similar purpose. For the Salisbury demonstration plant teak boxes of four compartments were used, each compartment having a cast-iron box, with perforated bottom, which could easily be withdrawn to facilitate the cleaning-up operations for demonstration purposes. For the Robinson plant, however, a box of novel type was specially invented. It had a series of compartments with a space for the inflowing solution, which was conducted by a baffle to the bottom of a large compartment in which was placed an easily removable tray on which the zinc shavings rested, and up through which the gold solution percolated, with a downward movement through baffle channels only.

At the bottom of each compartment was a space for gold precipitate, and connected to the bottom of each compartment was a pipe, or channel, for drainage and cleaning-up purposes. For a generation that box, except that it is now frequently made of steel, has been well-nigh universally adopted for the recovery of the precious metal. A royalty of £20 a box—such as is freely given for a cone or tube mill feeder—would not have been at all excessive. Probably ten thousand of such boxes have been used on the Witwatersrand alone; a small gratuity or recognition per box placed to the credit of a Cyanide Pioneers' Fund should have sufficed to make comfortable, for the period of their lives, those pioneers (first men on first plants of mines only) who may now find themselves seeking rest after the completion of their thirty years' toil.

Collecting Diamond-Drill Sludge

In a paper prepared for the February, 1922, meeting of the A. I. M. E., R. D. Longyear describes methods of taking care of diamond-drill cores and collecting the sludge. Allowing the sludge to run into a tub and overflow should not be done unless there is no tendency for concentration. A sludge box with baffles is an improvement but the best method is to run the return water into three or more barrels through a pipe or launder. When one barrel is filled, the pipe is swung to the next barrel, and so on. After the material in the first barrel has settled sufficiently so that the clear water can be siphoned off, the barrel is again filled. The process is continued until the end of the interval to be sampled. All of the material is then poured into one barrel and allowed to settle further. After all of the clear water has been drained off, the residue is removed, slowly dried over a fire, quartered, and sacked. The number of barrels used depends on the time necessary for the material in suspension to settle. When this method is used, the hole must be in such condition that all of the cuttings are washed to the surface. On one of the large copper deposits in Arizona, this method gave remarkably accurate results even though less than 50 per cent of the core was recovered. Later test pits and mining operations checked the drill sampling within 0.005 per cent in carbonate ore and 0.05 per cent in sulphide ore. A bit recovering a 1⅛-in. core was used. The choice of sampling methods must depend on the engineer's judgment of the character of the material to be sampled. In case of doubt, it is better to err on the side of accuracy than to risk getting a worthless sample.

State Taxation of Mines

Varying Methods Employed—General Property Tax Makes Valuation Necessary—Ability To Pay Should Be Considered—Inequitable Distribution of Burden Hurts Mining Industry—State Residents Profit Most from Mineral Enterprises

BY MCK. W. KRIEGH

Written for *Engineering and Mining Journal*

MINES AND MINERAL PROPERTIES in different states are subject to dissimilar systems of taxation, varying rates, and divers methods of valuation. The general property tax or ad valorem system prevails; but, in some states, mines, including idle and unprofitable properties, are subject to ad valorem tax on the value of their mineral content, and, in addition, are required to pay a tax on their output. In other states a differentiation is made between producing and non-producing properties, the producing being taxed both on output and surface value of the land and improvements thereon, and the non-producing only on surface value and improvements; and in still others, a production or severence tax is levied in lieu of the general property and other taxes.

Some of the states impose excise, income, and capital stock taxes, which add to the tax burden upon the mining industry. When a new and increased tax is imposed, it is because additional revenue is needed, and the local taxing authorities make a survey of the taxable resources of their respective jurisdictions, and usually pounce upon the one which will yield, at least temporarily, the largest amount of revenue. In many of the mining states the burden upon mines is wholly out of proportion to that imposed upon other taxable property, and is being increased without regard to the injurious results which may accrue both to state and nation.

GENERAL PROPERTY TAX NECESSITATES VALUATION

The general property tax is the common designation applied to all direct taxes upon property, real and personal which are apportioned and levied by substantially the same methods. Under existing laws, general property taxes are levied without reference to benefits conferred upon or enjoyed by the taxpaying property owner. Where the tax burden is heavy, as in practically every state, there is a constant struggle between different groups to have the burden shifted, and this is accomplished, when one group gains control of the legislative or administrative machinery, by the adoption of different methods of determining what constitutes taxable property and different bases of valuation for different classes of property. In all mining states where the general property tax serves as the principal source of revenue, owners of mining properties are confronted with the vexing problems of valuation and unequal adjustment of taxes.

The measures of valuation in the different states are many and varied, and there is much conflict of opinion as to what represents value or what value means. The Arizona law defines "full cash value" as "the price at which the property would sell if voluntarily offered for sale by the owner thereof and not the price which might be realized if such property was sold at a forced sale." The Illinois law provides that "in valuing any real property on which there is a coal or other mine, or stone or other quarry, the same should be valued at such a price as such property, including the mine or quarry, would sell at a fair voluntary sale for cash." The Kansas statute defines taxable value as "the true value in money . . . determined by the assessor from actual view and inspection of the property." It must be assumed, of course, that a Kansas assessor, after giving the mining property the "once over," can instinctively determine its true value in money.

MISSOURI LAW DEFINES "CASH VALUE"

The Missouri law requires mining properties to be assessed at their "true value in money," and the Missouri tax commission in its biennial report for 1917-1918 declared: "There is nothing uncertain about the meaning of 'actual cash value,' 'its value,' 'its true value in money,' or the method of determining it. It is not necessarily what was paid for the property; nor what it would now cost to reproduce; nor what it would sell for at a forced or auction sale; or in aggregate with the other properties in the community; it is not necessarily to be determined from the income it produces; nor the pleasure it gives the owner; nor the price he may demand for it. It is the usual and customary selling price at a private sale, under normal conditions, when a ready, willing, and able seller deals with a ready, willing, and able buyer in the community where the property is located."

Other state laws define value as the rate at which the property would "be taken over for a just debt due from a solvent debtor" or "sell at a fair and *bona fide* sale on private contract" or "sell for at a fair, free, and well advertised sale," or "sell when sold in such manner as property is usually sold," or "sell at court sales for partition."

METHODS OF VALUING MINERAL PROPERTIES VARIED

As mines and mining properties are not usually bought and sold in the same manner and under the same conditions as other property such criteria of value are rarely available. Therefore, the valuation of a mineral deposit or different classes of deposits is in each state a special problem, and the taxing power of one state will adopt annual gross and net proceeds of producing mines as the measure of their value; another will capitalize the value of net earnings averaged for a past period of years at fixed percentages for different groups or classes of mining property, or another will attempt to determine the present value of its mines by capitalizing estimated future profits.

For the purpose of this article, "value" may be defined generally as intrinsic and extrinsic worth, determined in terms of money. Is it possible to determine the value of a mineral deposit in terms of money? If mines were ordinarily the subject of barter and sale, the answer might be unqualifiedly in the affirmative; but the elements which enter into the determination of value represented by a body of ore or mineral in the ground are not easily comparable to these which fix the surface value of real estate, the going value of a business, the economic value of a public utility, or the commercial value of an article or commodity used in trade, which constantly are changing hands for a monetary consideration.

To have a commercial value, a mineral deposit must possess certain characteristics as to quantity, quality, availability, and demand which make it capable of profitable utilization. These elements cannot be easily determined, even by those who possess expert knowledge, and therefore there is introduced the element of extraordinary risk, which must be taken into account in any undertaking involving the development of such a property. An examination of the conditions prevailing in different states leads to the conclusion that a method of valuing mines in Alabama, Illinois, Michigan, or Minnesota might not be feasible for the valuation of mines in Arizona, Colorado, Idaho, New Mexico, Utah, Wyoming, or other Western states.

ABILITY OF MINES TO PAY MUST BE CONSIDERED

In assessing mines, consideration should be given to their ability to pay. Mines which may have been able to pay a very heavy tax in 1917, 1918, or 1919 may now be unable to pay any tax whatever, or even to bear the cost of retaining a sufficient personnel to guard their property until a future demand for their product will enable them to resume operations.

Under a system which uses the average production basis as the measure of valuation for determining tax liability, many non-operating properties are severely penalized, their taxes amounting literally to confiscation of their property on account of the fact that in taking the average production for a past period, particularly for the war period just passed when mines were producing heavily, a high tax is assessed this year when they are producing nothing at all. The same thing is true of mines which are taxed under the ad valorem system. The ore in the ground is measured and a value is placed thereon, based on the estimated value of future profits. The mine may be unable to operate because there is no sale for its products, but it is still subject to a tax sometimes as high as that which would apply if it were operating at a profit. A few mines, in order to pay their taxes, are forced to continue production, and thus are compelled to take out of their properties only such ore as may be produced at a profit. This results in an enormous waste of low-grade ores.

EXCESSIVE AND DISCRIMINATORY TAXATION RETARDS MINING

The development of the mining industry is essential to the prosperity and development of every mining state. The fact cannot be ignored that there has been an enormous flow of capital, population, and business into every mining state as a result of the opening of vast resources of hidden natural wealth and the growth of mining. Railroads have been extended throughout the mining regions, power plants have been erected, agricultural resources have been made available, and thus the mining industry has created permanent improvements which have added materially to the taxable wealth of the country. Therefore, the necessity for the adoption of a policy which will encourage further development instead of causing waste and depression is evident, and any state which follows a policy of penalizing its mines by imposing on them an excessive and discriminatory tax burden may add so materially to their production costs as to make the extraction and utilization of a large portion of their ores prohibitive.

TAXATION SHOULD NOT CHECK PRODUCTION

One of the first conditions which should govern in the taxation of mining property is that the method of taxation adopted should bear as lightly as possible upon production, so as not to check the flow of profit from which taxes must be paid and the community maintained. Another condition which should be observed in the framing of a tax law is that the tax to be imposed should bear equally upon all classes and individuals, so that no citizen or group is given an advantage or placed at a disadvantage as compared with others. A third condition which should be a controlling factor in the enactment of a tax law is that it should be in certain terms, easily definable and understood, to prevent arbitrary, corrupt, or tyrannical methods of administration on the part of officials. None of the taxation and revenue systems now in force in the various states meets all of these conditions.

THE TENDENCY TO DISCRIMINATE AGAINST MINES

An analysis of the situation, particularly with respect to state and local taxes, shows that there is a growing tendency in certain states to discriminate against mineral properties and mining enterprises in the enactment and administration of the tax laws. This tendency is disclosed in the movement within some states to impose upon the mining industry different forms of taxation, methods of valuation, and exorbitant rates for the purpose of obtaining a greater amount of revenue from mining property and mining operations than is obtained proportionately from other property and other businesses or industries. The result has been to curtail mining and discourage the development of mineral resources, and is reflected in decreased production, reduced capital, closed mines, wasted ore, and unemployed labor in mining districts.

The tendency toward extravagance in state and local expenditures; the demand for tax-free state and municipal securities which encourages the increase of state and local indebtedness; the prejudice existing in many of the states against non-resident corporations, stockholders, and property owners; the general lack of understanding and non-application of scientific, equitable and economic principles in the administration of tax laws, and the absence of local restraint upon the taxing power in determining the assessment of natural resources whose products are not consumed locally—all these contribute to the difficulties which are encountered by individuals and corporations engaged in the business of mining.

It has been recognized that unscientific and varying methods of taxing mining property in different states and the adoption of new methods of obtaining state revenues without giving due consideration to the relation and effect which such methods may have upon the local industries of the state as compared with similar industries of other states, and without relative consideration of the tax burden as a whole, have resulted in an enormous tax burden which does not spread equitably over every unit of industry and in the creation of a situation where properties in different states cannot be operated on equal terms. That this whole subject might be reviewed by the Government, Senator William H. King, of

Utah, has introduced a joint resolution in the United States Senate, requesting the President to call a conference of representatives of the Federal and state governments to consider questions relative to Federal and state taxation. In addition to the consideration of the relation between Federal and state taxation, co-operation between Congress and the states in the laying of and levying of taxes will be considered, as well as the matter of duplicating and conflicting Federal and state taxes and the means for the accommodation of such conflicts. It is hoped that out of this movement there will be evolved a more equitable plan of mine taxation, and that a fairer and more consistent attitude on the part of the general public and the taxing authorities toward the wasting industries may be promoted.

CAPITAL DIVERTED BY FEDERAL TAXATION

Federal taxes do not now constitute a direct oppressive burden upon the mining industry, as they fall only upon taxpayers who are enjoying "net profits"; but indirectly they have an important bearing upon every mining enterprise. The high excess profits and surtax rates have caused vast sums of liquid capital to be diverted from normal channels of investment, including mining investments, into tax-exempt securities issued by municipal, state, or Federal authority, and this capital, needed for replacement, exploration, development, and expansion of industry, is thus removed from the industrial investment pool from which it could be drawn under normal conditions.

The period of depression following the Great War has intensified the disturbing effect of high Federal taxes, which, during the war, increased approximately 1,000 per cent over pre-war rates. However, increased state and local taxes are of the most vital concern, because they are not uniform, as are Federal taxes, vary widely in different states, and do not spread equitably over taxable resources irrespective of class or conditions, even within the confines of each of the states.

SHORT-SIGHTED FOR STATE TO BURDEN MINING UNDULY

Any state which imposes an onerous tax burden upon its natural resources whereby production is checked, exploration and development work is discouraged, capital is diverted from the state, and costs cannot be reduced to meet depressed market prices is pursuing a short-sighted policy, is defeating the principles of conservation, and is destroying potential wealth from which future revenues would be derived. This is particularly true of timber and minerals. Laws should be enacted which will adequately safeguard and conserve these rapidly dwindling natural resources, instead of statutes which permit and encourage the speedy exhaustion of timber without any provision for reforestation, and compel the dissipation of mineral reserves, by forcing the exploitation of mining properties, at the same time preventing the development of low-grade orebodies and the discovery of new deposits.

RESIDENTS OF STATES PROFIT CHIEFLY FROM MINING VENTURES

In justification of discriminatory taxes imposed on the mining industry, it has been contended that natural resources have been exploited mainly for the benefit of non-resident stockholders. To refute this contention it is only necessary to examine the expenditures made by mining companies for wages, fuel, power, freight, supplies, miscellaneous, and taxes within the state. Such an investigation will show that the net surplus left for distribution of dividends to stockholders as a return of capital based on the probable life of the property and as a return of interest on the investment is startlingly small.

That investors in mining properties are entitled to a return of their capital before the properties are exhausted, and that they are entitled to a fair return as interest on their investment, must be conceded by all. Yet it is doubtful whether the annual net earnings of mines, averaged for lean and prosperous years alike, ever will equal the annual loss of capital expended in mining operations. It has been estimated that for every successful mining undertaking there have been ten failures; and the failures represent lost capital which can never be recovered by those whose fortunes were hazarded. States are quick to take advantage of the successful venture, regardless of the years spent by the prospector in seeking the deposit, the money spent in exploration, or the prosperity which is thereby brought to the community; but no encouragement is offered in the event of failure.

In the preparation, enactment, and administration of tax laws, as well as other laws affecting the mining industry, it should be remembered that mineral resources have national and international aspects which have an important bearing upon the economic condition of the country as a whole, and any maladjustment of the tax burden which retards development and limits production is certain to be injurious to the nation.

Sweden's Metal and Mineral Production In 1920

The Swedish Commercial Board has issued a summary of the metal and mineral production of Sweden in 1920. The total production of iron ore was 4,519,112 tons (metric?) or 9.3 per cent less than 1919. The output of other ores and their values is shown in the following table:

	Tons	Kronor
Silver and lead ore	2,901	845,197
Molybdenum ore	0.6	5,400
Wolfram (tungsten) ore	30 5	74,736
Copper ore	1,136	42,530
Manganese ore	14,926	1,312,483
Zinc ore	47,674	2,466,870
Graphite	7	520
Sulphide ores (pyrites)	107,326	3,457,091
		8,204,827

The output of non-ferrous metals was as follows:

	1919 Kilograms	1920 Kilograms
Gold	21	7
Silver	620	359
Lead	827,448	862,850
Copper	3,558,292	1,288,874
Zinc	2,320,538	5,759,500
Sodium metal	109,936	165,096

Bureau Studies New Jig in Zinc District

At the Mississippi Valley Station of the U. S. Bureau of Mines at Rolla, Mo., in connection with the study of mill problems of the Tri-State zinc district, a new type of laboratory jig to study the nature of the ore and various products in the mill circuit has been built. A study has been made of the importance of sizing and other jigging principles, as well as a study of the nature of the ore and the various products in the mill circuit. The development of a chat jig of semi-commercial size may be undertaken. Laboratory equipment is being installed in the Miami, Okla., School of Mines for this investigation.

BY THE WAY

No Local Chapter Here

Robert Benchley, in his new book "Of All Things," discusses the plight of a writer who came to New York from a Middle Western town to make his fortune. "I was already discouraged. I knew no one in the Big City, and had been counting on my membership in the National Geographic Society to find me friends among my fellow-members in town. But I soon discovered that the fraternity spirit in the East was much less cordial than in my home district, and I realized, too late, that I was all alone."

An Arsenical Romance

Forty men with $100 apiece are wanted at once by A. Fenninger, who is, or was, stopping at the De Soto Hotel, Denver, Col. Mr. Fenninger knows where two and a half millions in gold and silver were buried long ago by the early Spaniards and wants help to go and find it. This treasure was hidden 150 years ago in the "wilds of the Arkansas Ozarks" in the White River country, but until Mr. Fenninger found the key, carved in stone, to an ancient map while hunting last fall, its whereabouts was unknown. The tale as he told it recently to the *Rocky Mountain News* runs as follows:

> Mind you, I knew nothing of any treasure in the country when I went to Eden's bluff. I was simply on a vacation, out squirrel hunting. Across the river from the bluff and a quarter of a mile east I was pursuing a squirrel and stumbled upon a stone slab, hidden in the tall grass. The slab was covered with strange hieroglyphics. I scraped the dirt and moss from the inscriptions and called a native to see it. Then I heard the story.
>
> I learned that I had accidently stumbled upon the key to the paper map, for which the Spanish government had made extensive search twenty-two years ago, and learned the story of the buried bullion.
>
> Fearful lest the enraged Indians capture back their treasure, the Spanish constructed an underground labyrinth of tunnels and concealed the gold in them.
>
> Years passed. Then, close to the opening of the nineteenth century the Indians, again reinforced, made another and more terrible onslaught upon the Spanish settlers. The white men were unprepared, and a massacre followed, only one youth escaping the murderous redskins.
>
> As near as I can make out, nearly 100 years passed before a regular searching party set out after the gold. They came from Spain with the ancient map and scoured the district in the vicinity of Eden's bluff, but without the stone key to the map, which they were unable to find, they were unable to tell that the gold was far underground.
>
> Ten years or so ago a party of Americans, natives of Arkansas, becoming acquainted with the fact that the immense treasure was buried in the country, began searching blindly for gold.
>
> Accidentally they fell upon the covered passageway to the tunnel and began digging into the gravel. They found a mass of half-rotted timbers interlaced in the dirt, barring further digging. A hole was chopped through and the debris caved in, striking far below with a hollow sound.
>
> One of the men was let down the hole on a rope to investigate. In a few minutes they heard him calling frantically to be pulled up. The man was brought to the surface, muttering in a delirium, and he died two days later without being able to tell what he saw.
>
> Now, said Mr. Fenninger, the natives of this part of the Ozark mountains are very superstitious. This incident wholly unnerved them for further attempt to recover the gold, and even now one could not hire them to venture near the death hole.
>
> It is plain to a scientific man what caused the gold hunter's death. *The action of the damp earth upon such a mass of gold must necessarily generate a great amount of arsenic gas.* It was this gas which killed that man.
>
> By the means of that stone slab covered with hieroglyphics that I stumbled upon while squirrel hunting, I discovered three other stone maps in the fifteen-acre tract east of Eden's bluff, and these maps led me to the old shaft, now caved in and covered with weeds.
>
> My partner, who now owns the land there, and I started to dig again and found unmistakable evidence that this was the main entrance to the old Spanish tunnel. We did not have equipment to penetrate far, and we needed apparatus to neutralize the effects of the arsenic gas generated by the rare gold below before we dared to go in the shaft.

Mr. Fenninger, therefore, has advertised for forty men with ready cash and promises to treat them right. After reaching Arkansas it wont take over twenty days to get the treasure out of the ground, he says.

Caution

A gentleman, thinking of buying a book on blowpipe practice, states that he first wishes to know about what per cent of metal must be in the rock to make the proper separation. We recommend his caution to others. Never attempt to separate the metal from its ore or the ore from its gangue until you first know that you have enough to make the result profitable. Never build a mill until you have ore enough to run it after it is built. Of course, there are exceptions: sometimes a little ore is sufficient to run the newly built mill until all the stock has been unloaded at a fancy figure and all the suckers caught. After this is accomplished it matters little whether the mill runs or not.

More Criticism

A miner's wife, Mrs. Tom McCulla, at the Britannia mines in British Columbia, writes that Mrs. Whitney's statue, "The Engineer," reminds her of one of the men she used to see on Market Street, in San Francisco, looking for "snipes," the position shown being absolutely like theirs as they hunted in the gutters. Mr. McCulla is very fond of chiclets, she adds, and uses them whenever he is in a gassy or smoky place.

Jeffrey A. Houghton, of Magdalena, N. M., calls the Whitney creation "an inefficient effort."

Talking of chiclets reminds us that Wrigley, of chewing gum fame, is said to have purchased a group of mines in the Joplin district for the customary half million dollars. This possibly foreshadows the announcement of a new use for lithopone.

The Old Miner

By Paul H. Keating

Take away the daily humdrum of this sodden life I've known, and replace it with another of a very different tone. Take me far from fuse and powder and the single-jack and drill. Write it out, Old Boy, I'm quitting and I'm going down the hill.

Take me where the wine is flowing and the lager is on tap, where the eyes and cheeks are glowing, and where no one cares a rap; while the strains of some sweet music will turn your head for fair, and it seems you must be dreaming in a world without a care.

Write it out, my boss, I'm leaving and I'm going on a souse that will make the feasts of Ceasar look like living with the cows. But it will not last forever so I'd like to ask you, When I am broke and cold and hungry can I have my job again?

HANDY KNOWLEDGE

A Method for Measuring Leakage in Compressed Air Lines

By **Walter S. Weeks**

Written for *Engineering and Mining Journal*

This paper is a discussion of a method for determining the number of cubic feet of free air that leaks from an air line each minute when the receiver pressure is held constant at the usual mine pressure. The measuring device is the low-pressure-orifice meter that is ordinarily used for testing compressors. A sketch of this meter and its connections to the receiver is shown in the figure.

The meter is connected to the receiver in the air-compressor room. The air flows from the receiver through the valve *A* into the tank *B* and then out through the orifice *F*. At the point *D* the pressure is taken with a water manometer *E*. The temperature in the tank is taken with a thermometer at *C*. The orifice is carefully made with a smooth, rounded inner surface. A complete description of the meter, with a chart for quickly determining the flow, is given in an article previously published.[1]

The leakage is determined as follows: Close the valve *L* on the air line so that there is no connection between it and the receiver in the compressor room. Select one compressor (if there are several compressors) whose capacity is greater than the leaks. Adjust this compressor so that it will not unload at the pressure at which the test is to be made.

Now, run this compressor and discharge all of the air through the orifice. Adjust valve *A* until the compressor holds exactly the desired pressure. When the pressure remains constant at this value, a reading of the meter shows how much air the compressor will deliver at that pressure. This amount will be constant as long as the receiver pressure is constant.

Now, open the valve on the air line to the mine. The air line and meter are now in parallel. Adjust valve *A* until the pressure in the receiver is constant at the desired value. The compressor is now delivering the same amount of air that it was delivering when all was discharged through the orifice, but some of the air is leaking from the air line and the rest is going through the orifice. A reading of the meter shows how much is passing the orifice. The difference between the first reading and this reading is the amount that is leaking from the air line.

Example: The air is measured as free air.

	Cu.Ft. per Minute
Meter reading, all air through orifice..................	500
Meter reading, meter in parallel with air line..........	300
Leakage 500 — 300 = 200 cu.ft. per minute.	

If the air line is very long, it will take a little time to determine whether the air pressure in the receiver has become constant.

Let it be assumed, for example, that the air line consists of 20,000 ft. of 6-in. pipe and that the receiver in the compressor room has a volume of 1,000 cu.ft. The total capacity will be 5,000 cu.ft.

Let it be further assumed that the value to the orifice has been adjusted so that the compressor will deliver 10 cu.ft. more air each minute than is discharged through the leaks and through the orifice. This excess air will increase the pressure. How long will it take this excess air to increase the pressure 1 lb. per sq.in.? Assume the barometric pressure to be 15 lb. per sq.in. absolute.

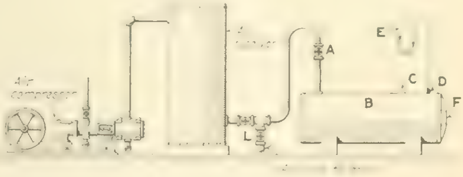
$$V_{at} = \frac{(P_1 - P_2)\ V}{15}$$

For derivation and discussion of this formula see the article[2] in the June 11 issue of *Engineering and Mining Journal.*

V_{at} is the free air necessary to change the pressure.
$(P_1 - P_2)$ is the change in pressure.
V is the volume of the receiver and line.
Units are cubic feet and lb. per sq.in.

$$V_{at} = \frac{1 \times 5{,}000}{15} = 333$$

Now, if it takes an increase of 333 cu.ft. of free air to change the pressure 1 lb., it will take the excess of 10 cu.ft. per minute thirty-three minutes to produce this change. It will actually take less time than this because the compressor puts hot air into the line, whereas this formula assumes constant temperature.



ARRANGEMENT OF APPARATUS FOR TESTING AIR LINE

A good recording gage can be easily read to the nearest pound, and smaller changes can be detected, so in this test if one watches the gage for fifteen minutes one could probably tell whether or not the pressure was constant. Obviously, the larger the air line the longer one must watch the gage.

Suppose the purpose be to determine the leakage in a large underground receiver. First, run a test on the leakage of the line with underground receiver disconnected. Then run a test on the air line and receiver together. The difference in the two amounts of leakage is the leakage in the receiver.

Assume that the volume of the line, the surface receiver, and the underground receiver is 30,000 cu.ft. How long will it take an excess of 10 cu.ft. per minute to raise the pressure 1 lb?

$$V_{at} = \frac{1 \times 30{,}000}{15} = 2{,}000$$

It will take the excess about 200 minutes to raise the pressure 1 lb. A change might possibly be detected in an hour.

While a test is being run all conditions must, of course, remain constant. The compressor must run at constant speed and all the valves in the mine must be be kept closed.

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[1] "Testing an Air Compressor," by Walter S. Weeks. *Mining and Scientific Press*, Vol. 116, p. 479. April 6, 1918.

[2] "Air-Receiver Calculations," by Walter S. Weeks. *Engineering and Mining Journal*, June 11, 1921.

THE PETROLEUM INDUSTRY

Prospecting for Oil With the Diamond Drill

BY J. S. MITCHELL

Written for *Engineering and Mining Journal*

DURING the last year or two there has been a gradual change in the method of prospecting and developing new oil lands. For many years this class of work was left almost entirely to "wildcatters," the larger companies buying the oil as it was produced or taking over the wells or properties after they reached the producing stage. The oil industry owes much to the wildcatter. Had it not been for him and his unbounded optimism the oil industry would have lagged many years behind its present state of development. Much ridicule and abuse has been heaped upon the head of the wildcatter. He is a shrewd foresighted business man when the oil comes in, but in failure has a good chance of being called a fool or a swindler. The pioneer in oil prospecting, like the gold prospector who takes to the hill with grubstake and burro, is sure to be followed, when a discovery is made, by promoters and confidence men who are little concerned about prospecting, their chief aim being to sell stock in their particular enterprise. When the promotion is on a large scale, a well is sometimes drilled. The well is generally large in order to take care of the enormous flow that is promised. In locating the hole, geology and engineering study are of little importance but in some miraculous way the hole is known to be just above the oil sands when more money is needed.

LIMITATIONS FOR PERCUSSION-TYPE DRILLS

In the past the average depth of holes was much less than it is today. As the depth of hole has increased the drilling equipment has been enlarged and strengthened to handle the greater load, but in most respects the standard or rotary rig has undergone little change. For depths up to 700 or 1,000 ft. in formation favorable for its use the percussion-type drill is more efficient than any other, but in very deep holes the cost mounts rapidly due to the necessity of using casing not only to hold back caving material but to cut off water when encountered. When water stands in the hole the blow of the tools is retarded through the cushioning effect and friction on the line. Where it is desired to carry a hole to a great depth the usual practice is to start with very large casing in order to provide for a number of lines to be set as conditions demand. When long heavy lines of casing are necessary and the working strains are greater, more accidents occur resulting in considerable delay and expense fishing for casing or lost tools.

The rotary drill in sand or very soft formation attains great depths without long lines of casing by using mud fluid to plaster the walls and through its weight counteracts the inward pressure of the walls of the hole. In drilling through formation that contains little hard rock the rotary drill is most efficient. It is at its best when drilling for oil sands of known depth so that casing can be set at the proper time and avoid the danger of sealing off the sands with mud fluid. In prospecting virgin territory where the depth of the oil sands is unknown the driller must be careful to avoid passing through oil without knowing it. In some instances in Texas, oil sands have been located by analysis of cuttings taken at fixed intervals while drilling, although there was nothing to indicate that the drill had passed through oil.

SYSTEMATIC EXPLORATION REQUIRED AT PRESENT TIME

Luck played a much larger part in the prospecting of the past than it does today. The hit or miss method is gradually giving way to a systematic study of geological conditions. Forced by a combination of circumstances to take a hand in exploration and production, the larger companies are bringing to bear that same painstaking study and investigation that have accomplished such wonders in oil refining. Deep work in remote sections of this country or foreign lands called for expenditures that could only be provided by strong companies, and these companies, realizing that their future depended on new fields to take the place of depleted territory, are building organizations for conducting exploration work on a large scale. For much of this work in unproven fields the diamond drill has the advantage over other types as it is a much lighter outfit and produces a core of all solid material penetrated. It is possible with the core to identify the various strata beyond a doubt, thus determining whether or not the hole is in favorable formation and at what point oil would be reasonably expected. Diamond-drill holes of from 4,000 to 6,000 ft. in depth are not uncommon and the possibilities of trouble in drilling great depth is not increased in the same ratio as with cable tools, neither does the weight of outfit for greater depth increase in the same proportion. This is an important consideration particularly in remote sections. A cable rig equipped with casing for a depth of 3,000 ft. weighs from 125,000 to 250,000 lb., depending on the formation. In the fields south of Tampico, Mexico, rotary outfits with cable equipment and camp added have amounted to 250 tons. Moving this amount of equipment through rough country and drilling one prospect hole 2,500 ft. deep means an outlay of around $150,000 for operating costs.

A diamond drill outfit complete for a hole of the above depth will weigh from 50,000 to 60,000 lb. and if equipped with sectional boilers may be knocked down for handling on mule back. In principle the diamond drill resembles the rotary drill more than the standard rig. Hollow flush coupling rods are used and the drill itself is a self-contained unit so arranged that the rods are rotated and raised or lowered by a hydraulic cylinder acting direct from the line of rods. The hoist is also an integral part of the machine. In the larger size both the hoist and the hydraulic feed cylinders are capable of handling from 30,000 to 40,000 lb. of drill rods. When drilling at great depth all excepting about 900 ft. of rods is carried by the hydraulic cylinder and at no time is the full weight permitted to rest on the diamond bit. The rotating speed averages around 250 revolutions a minute and the feed from five to eight feet per hour while drilling solid rock. In soft material a fish-tail bit and mud fluid are used the same as with the rotary. The drilling speed or rate of advance in loose material is somewhat less than the rotary, but the speed in hard rock is greater than either the cable or rotary rigs, and the harder the rock, the greater the advantage in cutting with diamonds.

PER FOOT COST OF DIAMONDS LOW

The initial cost of diamonds is high, but the cost per foot of drilling is comparatively small. The bit usually consists of eight stones weighing from 2½ to 3 carats each. The best grade, which is the most economical to use, sells at $125 per carat, making a cost of from $2,500 to $3,000 for the bit. The per foot cost for diamonds in ordinary oil formation averages between 25c. and 30c. The diamonds are the black, apaque, non-crystalline variety known as carbon and are found only in Brazil. These are set in a soft-iron bit by drilling and cutting holes of suitable size and shape, then drawing the metal close around them with caulking tools. All stones are set to cut on the face, but four are set to cut clearance on the outside and four to cut clearance on the inside.

One criticism of the diamond drill in oil work that is often made is that it does not drill a large hole. There is no mechanical reason why it cannot drill a large hole, but in prospecting or drilling to locate oil, a two-inch core from a three-inch hole will give as much information on geological conditions as a large hole and will give far more information than the non-coring type of drill regardless of size of hole. Drilling a larger hole would call for larger and heavier equipment, which is unnecessary when it is desired to prospect with a view to locating an oil pool rather than prepare for a larger production. In exploration work, the important thing is to locate oil. The diamond drill is primarily intended for work of this kind and particularly well adapted for it, as it furnishes absolutely accurate data of underground conditions at a minimum cost.

Some of the diamond drills now on oil drilling are equipped with fittings for four-inch casing and drilling in with 3⅝-in. bit, although this is not the maximum size that may be used. It is large enough to take care of considerable production. The production of the majority of wells can be handled easily through a four-inch pipe. In the Mexican field where pressures are high a four-inch pipe will take care of from 25,000 to 50,000 bbl. of oil a day, depending on depth, temperature, percentage of gas and viscosity. Just how much the size of pipe has to do with the production of the well is difficult to determine. In a pumping well there is little advantage in having a casing larger than necessary to take care of production. In a high-pressure well the size of casing will have some effect on production, but the amount of flow depends more on the porosity of rocks or capacity of channels leading to the point of contact with the casing. The friction in the larger casing is less, but if the flow to the casing is less than the capacity of the casing a smaller line will serve as well. If the size of casing determined the production of a well, an eight-inch well would produce four times as much as a four-inch well and this is certainly not the case.

One reason that it has been the practice to drill large wells is that neither the rotary nor the standard rig can drill a hole smaller than six inches efficiently, and with the standard rig it is necessary under some conditions to start holes twenty inches in diameter in order to provide for the necessary lines of casing to cut off water. Assuming a hole is enlarged at the bottom a casing is simply a flow line to the surface, and there is no good reason why it should be larger than the surface flow line, except in pumping wells where the casing must be large enough to operate the pump properly. One interesting feature of the diamond drill is the method employed for controlling high gas or oil pressures when drilling or removing rods. An oil saver or packing box is provided with a series of cup leathers designed for high pressure. The rods, having flush joints, pass through the packing box, making a safe, tight joint to take care of any pressures that may be encountered suddenly. When it is desired to remove the rods under pressure a sheave wheel is attached to the top of the rods. The hoisting rope is passed through a sheave at the floor, then over the sheave on the rods and the end of the rope attached to the floor on the opposite side of the machine. The rods are then allowed to rise under control of the hoisting brake and are removed in ten-foot sections, being held by the chuck while each length is removed. With this arrangement it is possible to raise the bit to a point between the valve and the packing box, after which the valve is closed and the packing box removed.

The application of diamond drills to drilling large holes has been given some consideration, but in all probability the maximum size will be somewhere between four and six inches. From a purely mechanical standpoint it is a simple matter to increase the size of hole, but this would mean a heavier outfit and consequently higher operation and transportation costs. The field of the diamond drill is in prospecting; or in drilling producing wells where a casing of about four inches will take care of production. It is particularly well suited to deep prospecting and it is in these fields that it will be generally used. Where a large hole is desired, and oil is known to exist, such as in offsetting wells, drills which cut large holes are better adapted.

It is not claimed for the diamond drill that it is destined to supplant the rotary or standard rig in all classes of work. There is a field for each, but the diamond drill is rapidly establishing itself as an aid to geologists in conducting oil exploration work accurately and intelligently, and up to certain limits it will be used for drilling producing wells. This is particularly true of deep work or when drilling in remote sections where roads or facilities for transportation are poor. Diamond drills are used in the oil fields of Illinois, Oklahoma, Texas, Wyoming, Washington, California and Mexico. Although the formations vary from the soft upper strata in Mexico to the hard lava in Washington, no unusual difficulty has been encountered in completing holes in any of these fields. The deepest hole drilled to date was to a depth of 5,000 ft. in southern Oklahoma. This work was done on contract by the Sullivan Machinery Co.

Book Reviews

The Metallurgy of the Common Metals. Fifth Edition. By Leonard S. Austin. Cloth; 6 x 9; pp. 615. 1921. **John Wiley & Sons, Inc.,** New York. Price, $7.

This book is a descriptive treatise on the essentials of metallurgical practice in the United States. The introductory chapters on general metallurgy are devoted to short discussions of fuels, refractories, ore dressing, metallurgical furnaces, combustion, metallurgical thermo-chemistry, roasting, and concentration. Some of these chapters are necessarily very brief, and the subjects are mentioned only to show their application to or effect on the metallurgical processes discussed further on in the book. Following this introduction come sections on gold, 107 pages; on silver, 50 pages; on iron and steel, 66 pages; on copper, 107 pages; on lead, 54 pages; and on zinc, 27 pages. The remainder of the book contains chapters on plant and equipment and their costs and on the business of metallurgy.

The need for a work of this kind is shown by the fact that the present volume is the fifth edition, the first having appeared in 1907. Since then many improvements, including both additions and eliminations, have been made, so that now the book gives a good general idea of present American metallurgical practice. It is evidently designed principally for student use or for general reference purposes, for the treatment is not sufficiently thorough to be of much value as an aid to the operator. However, it is surprising how much material, on such a variety of subjects, can be included in a book of this kind. Not only are processes described, but many descriptions of individual mills are given, types of machinery are illustrated and briefly mentioned, costs are liberally presented, and Professor Austin even has something to say on economics, the handling of men, accounting, and company organization. Students should be taught to give some attention to all of these matters. Many of the chapters are concluded by a paragraph giving a useful summary—an excellent feature.

The best of books covering a wide range of subjects offers many opportunities for criticism by specialists, but there are some things which are hard to excuse. Never before have we seen a technical book containing so many evidences of general carelessness in its preparation. One would think the proof was read by an office boy, so numerous are typographical errors. Many of the figure references lead the reader on a wild-goose chase. The climax in this respect was reached on page 388, when reference is made to Fig. 29 as an illustration of a hand-reverberatory roaster. Fig. 29, on inspection, proves to be a cut of a "tailings sampler" printed upside down. Hundreds of other minor errors distract the reader's attention like a swarm of gnats. Weightier errors are less numerous. Costs, though freely given, are sometimes meaningless because the date is not given. There is a tendency throughout the book to describe a process in terms of the practice at a particular plant without letting the reader know that the description is not general. The capacities of machines, analysis of materials, and other such data are for this reason usually expressed within much too narrow limits.

In other ways the information given would be improved by statement in less detail. That the United Eastern mill cost $133,539.09 is no doubt interesting to a bookkeeper, but we cannot refrain from the thought that possibly one of the carpenters stole two pounds of nails to build his chicken house and that the cost should really have been $133,538.98. The citing of such detailed data is particularly noticeable when the information given is not up to date. Porcupine metallurgists will be interested to hear that the Hollinger mill "treats 499 tons of $20 ore daily, recovering 93 per cent of the gold." But perhaps we are giving undue emphasis to these details.

After all, the book is not an unwelcome addition to our library, and we shall no doubt find it valuable many times for reference. E. H. R.

Battlefields of the World War. By Major Douglas Johnson. Cloth; pp. 648. Oxford University Press, American Branch, New York; 1921. Price, $7.

The title page states that this work is a study in military geology. As such, it would be difficult to overpraise the masterly and patient delineation of surface physiographic and geologic features, the influence of each upon military operations, and the story of the military operations themselves related from the physiographer's point of view. The book is a history of military operations, and in so far may be classed as a systematic history of the operations on the several battle fronts studied.

Major Johnson's book will doubtless be worthy of the position of a classic, as a basis of study for future students; then students will be, first, students of military science, for whom the book is evidently primarily intended; next, perhaps, to the historian, for it presents a new analysis of history; and hardly less, perhaps, to the physiographer himself, who, though he will find here no treatise on physiography, nor any statement of new findings in that science, will be enlightened and instructed by the revelation of the vast influence of the minor wrinkles of the earth's surface on the destiny of mankind, and will be urged to a closer scrutiny of them and their origin.

J. E. S.

Technical Papers

Air-Lift Pumping—*Engineering* for Sept. 23 (35 Bedford St., Strand, London, W.C. 2, England; price, 1s. 4d.) contains a four-page article devoted to theoretical conditions concerning air-lift pumping and the results of experiments made with a view to ascertaining the most efficient design for an air-lift pump for lifting acid mine liquors in the mine of San Domingos, in the south of Portugal. In the latter part of the paper the installation finally adopted is described, and lists of tests are given showing that it is quite possible to get pump efficiencies with air lifts of between 60 and 70 per cent.

Keno Hill, Yukon—A report on the silver-lead ore deposits of Keno Hill, in the Mayo district of the Yukon, forms a portion of the Summary Report (Part A) of the Canadian Geological Survey, for 1920. (Obtainable on request to the Survey at Ottawa.) The ores are rich and the veins numerous, but their depth is problematical.

Mineral Fuels—"Part II, Mineral Fuels," has recently been published as Bulletin 716, "Contributions to Economic Geology," by the U.S. Geological Survey, Washington, D. C.; obtainable on request. The issue contains a number of short papers describing areas on which probably no other report will appear. Maps and illustrations are included. Contents are as follows: "Geology of Alamosa Creek Valley, Socorro County, N. M."; "The Upton-Thornton Oil Field, Wyoming"; "The Mule Creek Oil Field, Wyoming"; "Natural-gas Resources Available to Dallas and Other Cities of Central North Texas"; "The Lance Creek Oil and Gas Field, Niobrara County, Wyoming"; "Coal in Eastern Idaho"; "Coal in the Middle and Eastern Parts of San Juan County, N. M."; and "Character of Coal in the Thomas Bed Near Harrison, W. Va."

Oil Shales—An eighty-page book entitled "Oil Shales" has been prepared by H. B. Cronshaw, and is published by John Murray, Albermarle St. W., London; price, 5s. net. The issue was prepared under the direction of the Mineral Resources Committee of the Imperial Institute, with the assistance of the scientific and technical staff. The contents include the occurrences, characters and uses of oil shales, and sources of supply in the British Empire and foreign countries.

Roasting Furnace Development — In *Mining and Metallurgy* for December (29 W. 39th St., New York; price, $1) Arthur S. Dwight has a five-page article on the evolution of mechanical roasting in which is described some of the early difficulties of hand roasting as well as a few comments on the development of the O'Hara, Brown, Ropp, Wethey, Spence, McDougal, Pearce, Brückner, H. & H., Godfrey, and Dwight-Lloyd furnaces.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Geological Organizations Meet at Amherst, Mass.

Society of Economic Geologists, Geological Society of America, Mineralogical Society of America, Paleontological Society of America and Association of State Geologists Hold Three Days' Session—New Officers Elected—Summaries of Papers

THE SOCIETY OF ECONOMIC GEOLOGISTS held a most successful meeting at Amherst, Mass., Dec. 28-30, together with the Geological Society of America, the Mineralogical Society of America, the Paleontological Society of America, the Association of State Geologists, and other organizations. The following officers of the Society of Economic Geologists were elected for 1922: President, Waldemar Lindgren; vice-president, Ralph Arnold; new councillors, James F. Kemp, and C. K. Leith. Charles Schuchert was elected president of the Geological Society of America for 1922.

The presidential address of the retiring president of the Society of Economic Geologists, Dr. R. A. F. Penrose, Jr., was on the subject "The Society of Economic Geologists, Its Sphere and Its Future" and outlined the scope and necessity of the society, its international character, and the growth of the profession of economic geology. A vote of thanks was given to Dr. Penrose for his "energy, devotion, and wisdom during his incumbency as president."

J. E. Spurr, speaking for the Committee on Political and Commercial Geology of the society, called the attention of members to the work which is in progress under the auspices of the Mining and Metallurgical Society of America, on the subject of a national policy for the efficient management of our mineral reserves. A motion was then carried by the meeting to ask the secretary of the society to call the attention of each member to the importance of the subject, and ask his aid.

CLEAR WRITING ADVOCATED

Dr. George Otis Smith, Director of the U. S. Geological Survey, read a paper on "Plain Geology," which embodied a plea for the use of plain English and the elimination of complex and unnecessarily ponderous terminology in geologic writing. Many amusing instances were given where the translation of sonorous terms in a manuscript to the simple equivalent, revealed behind the term only an insignificant thought.

Dr. Waldemar Lindgren read an interesting paper by himself and Prof. E. S. Bastin on "The Geology of the Braden Mine, Chile." At the Braden is a volcanic chimney or pipe some thousands of feet in diameter, breaking through andesite porphyry. The ore deposits occur on the margin of the pipe, fading away into the andesite. The ores are predominantly of copper, with much tourmaline in the gangue. A high-temperature deposit very near the surface is demonstrated. The commercial ores of copper have been concentrated from this early mineralization by descending waters. The period of enrichment (chalcocitization) was earlier than the development of the present mountainous topography, and the enriched zone is now in process of destruction by the active erosion.

WALDEMAR LINDGREN

METHODS OF TEACHING ECONOMIC GEOLOGY

Prof. E. S. Bastin read a paper on "Stressing Economics in the Teaching of Economic Geology." The relation of ore deposits, their distribution and exploitation, to commercial and political problems and policies were brought out, as was the need of including these aspects and considerations in instructing students in the important phases of geology. The development of the knowledge of these truths under the stimulus of the World War was touched upon, and the growth of a literature instanced by the volumes on "Strategy of Minerals" edited by G. O. Smith, "Political and Commercial Geology," edited by J. E. Spurr, and "The Economic Aspects of Geology" by C. K. Leith, was sketched out. The aggregate production of minerals in the world in the last twenty-five years has probably been greater than in all previous human history. Therefore, in teaching geology, full attention should be given to the relation of mineral resources to mankind.

A series of interesting and constructive papers on the general subject of oil production were presented, by Prof. Roswell H. Johnson, Orren W. Skirvin, and Robert B. Bossler. Prof. Johnson's paper ("The Oil and Gas Section of the Course in Economic Geology"), referred primarily to the teaching of these problems to students. He believed that a course in oil geology should consider the chief supply factors governing value, the conditions causing financial losses and failures, and reserves. Each of these divisions was analyzed and discussed. Mr. Skirvin's paper ("Experimental Study of the Invasion of Oil into a Water-Wet Sand"), discussed the relation of capillarity to the invasion by oil or water of a sand, and showed that experiment had demonstrated that in such invasions the fluid was contained in the larger pores, so that the rôle of capillarity was much reduced over what it was currently supposed to be. Mr. Bossler's paper discussed "Results Obtained by Improved Methods of Extracting Petroleum." The processes of flooding as conducted in the Bradford Pool were discussed, and those of dewatering in the Petroleum Center-Oil City region; and some data were given on the Smith-Dunn process. The principles underlying these methods were discussed; and also the effect of well spacing per acre on well yield, and some of the various methods of initiating a flood.

Prof. L. C. Graton, of Harvard University, read a brief paper on the "Probable Origin of Certain Vein Structures." He referred to "brecciated" veins, or the inclusion of angular rock fragments in vein material. He believed it was generally held that these fragments were the result of shearing or dislocation of the two walls; but the phenomena of the discharge of broken rock fragments into mine drifts by spalling — in the lower levels of the Calumet and Hecla copper mines—led him to question whether such a process might not take place in vein fissures also. Reverting to the theory that in certain cases vein fissures may have been held open by the pressure of the vein-forming fluids, he queried whether such discharge of broken rock fragments might not take place also under these conditions, at a certain critical elevation, with decreasing pressure of overlying rocks.

Prof. Waldemar Lindgren, of the Massachusetts Institute of Technology, read two short papers. One, on "A Recent Hot Spring Deposit in Bolivia," described a tufa deposit around a hot spring. The tufa contains much barite and manganese oxide (psilomelane) and, what is very unusual, up to 2 to 3 per cent of tungsten, probably in a colloidal state within the psilomelane. Certain other veins in the vicinity carry a certain amount of the tungsten mineral hübnerite. The springs have a moderate temperature, and are a mile or two away from important tin mines. Prof. Lindgren also read a short paper on "A Suggestion for the Terminology of Certain Ore Deposits" in which a number of new and precise terms, mainly of Greek derivation, were proposed for ore deposits—such terms as pyrometasomatic, mesothermal, etc. In the discussion opinion differed as to the advantage to be gained by further nomenclature.

Ore Deposits of Leadville, Col.

On Thursday, at the afternoon session, G. F. Loughlin, chief of the Mineral Resources Division of the U. S. Geological Survey (who is at the final task of bringing to a completion the Leadville monograph, which has been in course of preparation for nearly thirty years, first by S. F. Emmons, and then by J. D. Irving), presented a very interesting paper on the "Ore Deposits of Leadville, Colorado." Mr. Loughlin pointed out that previous to the heavy post-mineral faulting at Leadville, there were pre-mineral reverse faults of slight magnitude, as notably instanced in the Maid fault, discovered by Spurr in 1907, and its probable extension, the Tucson fault, detected by Leadville engineers in 1910. These faults have served as channels for the ascending ore-bearing solutions, and ore deposition has taken place especially where they were dammed back by difficultly previous layers, such as porphyry sills, etc. Fissure veins were also described, passing above into bedded replacement deposits. The heavy post-mineral faulting was outlined, and finally the question of the ore-reserves of the district was discussed.

Replacement Deposits at Homestake

J. J. Runner read a most suggestive paper on "The Gold-Bearing Cummingtonite Schists of the Black Hills." The gold ores of the Black Hills occur largely in this folded bed of cummingtonite schist, which is a replaced magnesian limestone. Tourmaline is a frequent gangue mineral of the ores, which are referred, by Mr. Runner, to a magmatic origin, and believed to be part of the phenomena attending the intrusion of the nearby Harney Peak granite. Mr. Runner's description indicated that the Homestake gold ores are high-temperature replacement deposits of magmatic affiliations.

W. C. Bowen, in a paper entitled "Petrographic Notes on the Franklin, N. J., Zinc Ores," dealt with the problem of the genesis of these most puzzling deposits. His results militated against the theory that these deposits have been altered by pressure and heat from some original, probably sulphide, form. Discussion revealed, however, a wide divergence of opinion as to this problem.

Prof. E. S. Bastin read a paper on "Primary Native Silver Ores Near Wickenburg, Ariz., and Their Bearing on the Genesis of the Silver Ores of Cobalt, Ontario." The Monte Cristo mine at Wickenburg contains rich ores in which native silver is associated with cobalt and nickel arsenides. Study of polished ore specimens shows that the native silver, which is the dominant silver mineral, is wholly primary. This instance strengthens the belief that the native silver of Cobalt also is primary, as has been held by several writers, although the earlier view was that these were secondary, and the result of alteration of surface waters.

Continuous Mapping Plan Advocated

F. W. De Wolf, State Geologist of Illinois, read a paper on "The Need of Expediting Topographic Mapping of the United States." He called attention to the economy resulting from the use of topographic maps in the prosecution of public works, such as road-building, drainage, municipal water supply, irrigation and other public engineering projects; and pleaded that the program of the U. S. Geological Survey in completing its topographic map of the United States should be assisted as much as possible. For this purpose the Temple bill has been introduced into Congress, providing for a continuous program sufficient to map the country in about twenty years. Every effort should be made to offset the expected economy plea by the proof that it will be truer economy to hurry the work. On the conclusion of Mr. De Wolf's talk, a motion was passed by the meeting, asking the secretary of the society to call the attention of members to this matter.

At the Friday (Dec. 30) meeting of the society, an interesting paper was presented by M. E. Hurst on "A Study of the Supergene Processes at Neihart, Mont." This rather cryptic title preceded a clear demonstration of the primary origin of the rich silver mineral polybasite at Neihart. Discussion brought out the growing perception of the error indulged in by many geologists that rich silver sulphides were necessarily secondary, and due to secondary enrichment, although Spurr had early shown that at Aspen the polybasite was primary, and that rich primary silver sulphides (including polybasite) were more important at Tonopah than the secondary silver sulphides, a conclusion which was afterward checked up by Bastin. The discussion further showed that this common error was being corrected largely by the work of students of ores under the microscope.

H. C. Boydell described "Some Etching Tests on Pyrrhotite"; an interesting paper by Sydney H. Ball was given by A. M. Bateman, editor of *Economic Geology;* T. L. Watson, State Geologist of Georgia, presented a paper on "Geology of the Virginia Emery Deposit"; and R. W. Stone of the U. S. Geological Survey discussed "The Domestic Magnesite Industry in 1921."

The retiring president of the Geological Society of America, Prof. J. F. Kemp, took for his theme the growth of the present almost universally held magmatic theory of ore deposition, and traced its development, largely through the studies and writings of Kemp, Lindgren, Spurr, and other investigators, to its present general acceptance.

Tri-State Branch of American Zinc Institute Elects Officers

John W. Newton, of Miami, Okla., manager of the Commerce Mining & Royalty Co.'s properties in Oklahoma, was chosen president of the Tri-State branch of the American Zinc Institute for the coming year by the recently elected board of directors. D. F. Haley and E. Elam Hall were chosen vice-presidents, and Richard Jenkins, secretary-treasurer.

Mr. Newton has had wide experience in the Tri-State field. He succeeds A. M. Gaines, manager of the Kanok Metal Co., who was not a candidate for reelection. Mr. Haley is manager for the Chanute Spelter Co., a subsidiary of the American Metal Co., and Mr. Hall is manager for the Service Belt Co. and an ore buyer for the Athletic Smelting & Refining Co. Mr. Jenkins has been secretary of the organization since it was started and is given credit for a large portion of the success that it has achieved.

The following committees were named by the new president for the coming year: Roads—Charles Wells, C. E. Hall, M. W. Latimer, F. N. Bendelari, and F. C. Wallower; hospital—A. M. Gaines, M. F. Owen, and W. H. Trapp; program—P. R. Coldren, H. B. Cobban, M. W. Latimer, D. F. Haley, and J. G. Horgan. Other committees will be named later.

New Mines Experiment Station at Minneapolis

Ground was broken for the new Mines Experiment Station of the University of Minnesota and the North Central Experimental Station of the U. S. Bureau of Mines on Dec. 17. This will be, without exception, the best laboratory in the world for the study of iron and manganese ores. The building is of factory type construction, and no pains have been spared in making it convenient and flexible. It is not in the least ornate or elaborate, but is designed for the purpose of furnishing suitable laboratories that will not become antiquated as time advances. C. H. Johnston, of St. Paul, Minn., is the architect. The entire building and mechanical equipment will cost approximately $300,000, $20,000 additional being available for laboratory apparatus and equipment. The general arrangement includes laboratories, offices, ore bins, and sampling, screening, and crushing machinery. A ten-ton elevator connects all floors. The general construction is brick and concrete, steel and slate roofs, and concrete and asphalt mastic floors. The mechanical equipment includes high- and low-pressure steam lines, high- and low-pressure air lines, high- and low-vacuum lines and pumps, and the building is provided throughout with gas and electricity.

Duty on Crude Oils Decried by Fertilizer Interests

Every effort has been made by the fertilizer industry to impress on the Senate Finance Committee its contention that the movement for a duty on crude oils is inspired by the producers of the Midcontinental fields and that these oil producers would not be able to extend their market greatly, even if they were granted the rate of duty which they are asking. On the other hand, it is contended that such a duty would add materially to the costs of preparing fertilizers and in that way affect the general prosperity by discouraging further their use.

C. H. MacDowell, the president of the National Fertilizer Association, pointed out to the committee that during the past season there was a decline of 50 per cent in the use of fertilizers. This, he pointed out, means a primary loss of 2,000,000 tons of freight to the railroads in the South alone, to say nothing of the potential crop tonnage, which such a quantity of fertilizers would develop.

A duty on oil, it was declared, not only affects costs through increasing the amount necessary to pay for fuel at fertilizer plants, but it adds to the cost of phosphate rock, as oil is used as fuel by companies conducting phospate operations.

Introduction of fuel oil in industry, said Mr. MacDowell, greatly stimulated the use of Mexican oil, to the advantage of both producers and consumers, but since the heavy crude of Mexico is much better adapted for fuel purposes than is the lighter and better quality oil of the Midcontinental field, it is certain that this business can not be acquired by the midcontinent producers. He expressed the opinion that the present demand for a duty on crude oil arises from the fact that the general industrial depression has caused a decrease in the consumption of domestic oil. The period of depression is passing and Mr. MacDowell tells the Finance Committee that unquestionably the oil industry shortly will regain the position it occupied not more than a year ago, when demand exceeded supply, and when there was no point or purpose in having a tariff imposed on imports.

MEN YOU SHOULD KNOW ABOUT

Charles Stewart, ex-Premier of Alberta, has been appointed Minister of the Interior and of Mines in the new Canadian government.

J. H. Stovel, mining superintendent for the E. J. Longyear Co., has been made manager of the mining department, effective Jan. 1.

A. W. Ambrose, chief petroleum technologist of the Bureau of Mines, is making a short field trip to California, in connection with the oil leasing work.

J. A. Campbell, former M. P. for Nelson, Manitoba, has been appointed acting Commissioner of Northern Manitoba in place of **R. C. Wallace**, who has retired from the position.

Francis C. Lincoln, director of the Mackay School of Mines, and **S. C. Lind**, superintendent of the U. S. Bureau of Mines experiment station, of Reno, are inspecting the mines of southern Nevada.

H. H. Hill, superintendent of the petroleum experiment station, Bartlesville, Okla., is in Washington at the present time, obtaining information relating to the investigation which he is conducting with **F. B. Tough** concerning the price for Salt Creek, Wyo., crude oil.

Edwin Higgins was elected president of the California Metal and Mineral Producers Association for the ensuing year at a meeting of the Board of Directors held Dec. 28. Other officers elected were as follows. **W. J. Loring**, first vice-president; **P. C. Knapp**, second vice-president; **W. G. Devereux**, third vice-president; and **Rober I. Kerr**, secretary-treasurer.

H. F. Mason has resigned as petroleum economist of the U. S. Bureau of Mines. Mr. Mason inaugurated some three years ago the compilation of the bureau's monthly statistics of the production and consumption of the various refined petroleum products, and has built up this work to its present state of efficiency. He is leaving the Federal service to accept a position with the American Republics Corporation in New York. His successor will probably be **Harvey J. Lowe**, of Houston, Tex., now an engineer with the Humble Oil and Refining Co. Mr. Lowe has been associated with various branches of the oil business for a number of years and was formerly purchasing agent for the Oil Issues Co.

Mining and metallurgical engineers visiting New York City last week included: **M. H. Bissell**, Bryn Mawr, Pa.; **R. G. Hall**, Namtu, Burma; **W. A. Waldschmidt**, Cambridge, Mass.; **K. S. Twitchell**, Estanbas, Portugal; **Chester A. Fulton**, Baltimore, Md.; **E. N. Cooper, Jr.**, Camp Hill, Pa.; and **A. D. Harvey**, Merrick, N. Y.

SOCIETY MEETINGS ANNOUNCED

New York Section of A. I. M. E. will hold the January meeting on Jan. 11 at the Machinery Club, 50 Church St., following the regular informal dinner. The subject of the evening will be "Compulsory Licensing of Mining Engineers," the speakers being B. B Gottsberger and F. T. Rubidge.

American Electrochemical Society will hold its spring meeting in Baltimore, Md., April 27-29. Preparations are being made for three sessions, in connection with this meeting, as follows: Electric furnace cast iron; gases of the electrochemical industries, and electromotive chemistry.

OBITUARY

Leonard Whitney, assistant superintendent of the Katherine mine, at Katherine, Mohave County, Ariz., was killed by the bursting of an 18,000 lb. flywheel of a new hoisting installation which had just been put in operation. Mr. Whitney was a former officer of the 331st Infantry, from Illinois.

John Ross, mining engineer of more than 30 years' experience on the Mother lode of Nevada, died on Dec. 25 in Sparks, Nev. Mr. Ross was active for years in the development of the Keystone and Mahoney mines, and was also one of the principal developers of the famous Unionville properties.

Charles F. Jennings, for 14 years purchasing agent of the Utah Copper Co., died at Salt Lake City, Dec. 27, following an operation. Mr. Jennings was born at Laramie, Wyo., in 1873, and received his education in the public schools and university of that state. He came to Utah in 1897 and became a member of the purchasing department of the Oregon Short Line R.R. in which capacity he remained until 1907, when he joined the staff of the Utah Copper Co.

De Bermiere Whitaker, vice-president and general manager of the Bethlehem Mines Co., a subsidiary of the Bethlehem Steel Co., died on Dec. 25 at Santiago, Cuba. Mr. Whitaker, who was fifty-two years old, was born in Enfield, N. C., the son of the late Judge Spier Whitaker, and was educated at the University of North Carolina. He went to Santiago in 1898 as chemist of the Spanish-American Iron Co., and later became superintendent of the Juragua Iron Co. He was placed in charge of the consolidation of the two concerns when they were merged under Bethlehem control.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

Announcement during the week that Anaconda, Butte & Superior and Tuolumne would resume production in the near future was at once the most important and most cheering event in many months. Other companies joined with them in effecting a reduction in wages. Men are reported to be flocking into Butte

Anaconda in the same week is said to have received its first order for the new copper shingles that it proposes to turn out in quantity.

Stockholders of the Ray-Hercules Copper Co., which controls the Arizona Hercules company against which the Empire Trust Co. recently secured a judgment, have been advised of a plan for reorganizing the company. The old stock will be wiped out, it is said.

A wage reduction of about 50c. per shift has been announced by the Hollinger, Dome and McIntyre companies at Porcupine, Ont.

The trial of the Iron Cap-Arizona Commercial apex suit has ended. The decision, it is expected, will not be handed down for some time.

Three Companies Will Resume Production at Butte

Anaconda To Have Output of 5,000,000 Pounds Copper Monthly by Feb. 15 —All Wages Reduced

It was officially announced in Butte, Mont., on Dec. 29 that the Anaconda Copper Mining Co., the Butte & Superior Mining Co. and the Tuolumne Copper Mining Co. would start work Jan. 16 preparatory to resuming production. Anaconda officials explained on Jan. 2 that four of the company's larger mines would resume Jan. 16 and that by Feb. 15 they hoped to have production under way at the rate of 5,000,000 lb. of copper monthly, or approximately 20 per cent of a normal of 25,000,000 lb.

Butte & Superior, it was said, expected to start shipping zinc concentrates within a few days from its stock pile to Anaconda's electrolytic plant at Great Falls and would start its Black Rock concentrator by Jan. 10 or Jan. 15. The same company also announced that it would gradually increase its working force to 1,000 men.

Anaconda's zinc plant at Great Falls and the arsenic plant at the Washoe reduction works have already resumed. It was said that the Washoe smelter would probably start on a limited scale during the first week of the year.

All companies in the district have joined in an agreement to make a horizontal wage cut in all classes of mine, mill and smelter labor of 50c. per shift, making $4.25 the basic wage for miners. Men are said to be flocking back to Butte but most of them are inexperienced so that in any case it will be some time before production can be resumed at capacity. Mine forces in the Butte district will be increased gradually up to 10,000 men and men are being put on as fast as they apply.

The East Helena plant of the American Smelting & Refining Co. will treat residues from Anaconda's zinc plant under arrangements recently concluded, which will necessitate additional furnace capacity. It is expected that an additional furnace will be started soon.

Porcupine Mining Companies Cut Wages Jan. 1

Hollinger, Dome and McIntyre Announce Decreases Equivalent to 50c. Per Shift

One of the most important events of the Porcupine camp in Ontario during the past year was the recent posting of notices by the Dome, McIntyre and Hollinger companies that commencing Jan. 1 wages would be reduced 6c. an hour, or approximately 50c. per day. This will give drill runners $4.75 per day, which is 25 cents higher than the Cobalt scale. To date only one mine in Kirkland has posted a cut in wages, but in view of the action at the Porcupine mines there is no doubt that a general cut will, very shortly, be put into effect in Kirkland.

The effect of this action will be widespread. Not only will it permit the mining of lower-grade ore in both Kirkland and Porcupine, but it will be a material inducement to go ahead with the opening up of new properties. One of the deterrent factors in the developing of prospects has been the high wages which had to be paid. Taking into consideration the boarding houses, which inevitable show a loss on small operations, the daily cost for miners would run from $5.50 to $6.

Freight Rates on Lead Bullion Lowered

Effects Product Shipped From Tacoma, Kellogg, Northport, and Montana Smelters

New freight rates have been announced on lead bullion and other smelter products from Tacoma, Kellogg, Northport and Montana smelting pionts, effective as from Jan. 5, 1922. The rates have been approved by the Interstate Commerce Commission and are as follows: To Pittsburgh, $13.25; Cleveland, $13.25; Indianapolis, $12.75; Chicago, $12; St. Louis, $11.40; Kansas City and Omaha, $10.80; St. Paul, Minneapolis and Duluth, $9.

Plan To Reorganize Ray Hercules Before Stockholders

Old Stock Wiped Out—New Company To Be Called Ray Hercules Mines, Inc.—Robert Linton in Charge

A plan for reorganizing the Ray Hercules Copper Co. has been put before the company's stockholders. The Empire Trust Co., of New York, recently took judgment by default in its foreclosure suit against the Arizona Hercules Copper Co., controlled by Ray Hercules, the amount being over $3,577,000. The new company will be known as the Ray Hercules Mines, Inc., and will have an authorized capital of $1,000,000 first mortgage 6 per cent bonds and 1,200,000 shares of stock of $5 par value.

Creditors of the present company and those directors who advanced the company money to complete construction and development, aggregating $2,287,562, are to be given $1,000,000 in first mortgage 6 per cent bonds and 250,000 shares of stock in the reorganized company.

It is said to be impossible to avoid wiping out the present stock of Ray Hercules, of which about 1,500,000 shares are outstanding, but the holders will be offered 750,000 shares of new stock of $5 par on cancelation and surrender of their present stock in the ratio of one new share for every two shares now held at $1 per share on or before Jan. 31, 1922.

Proceeds of these 750,000 shares of stock, up to the amount of $500,000, is to be placed in the treasury of the new company for working capital and, after $500,000 has been so provided, not more than $200,000 of such funds is to be applied to the payment of the old company's notes to enable the creditors to liquidate an equal amount of indebtedness guaranteed by them. If sufficient stock for these purposes is not subscribed for, the creditors reserve the right to purchase from the treasury of the new company at $2 per share sufficient of the unsubscribed stock (but not more than 100,000 shares) to liquidate this indebtedness of $200,000. Any portion of the 750,000 shares not so taken by the stockholders of the old company at $1 per share or by the creditors at $2 per share may be disposed of for corporate purposes at the discretion of the directors of the new company.

The remaining 200,000 shares of the authorized capital of the new company will be held in the treasury for conversion of the bonds at $5 per share.

Robert Linton, president of North Butte, is managing director of the company. Mr. Linton estimates the ore indicated by churn drilling and underground work, in ground wholly or partially developed, to be 3,916,000 tons averaging 2.42 per cent copper. From this has been mined 172,000 tons of ore averaging 2.20 per cent copper, leaving the net available ore 3,744,000 dry tons averaging 2.43 per cent copper.

Spain Gives Up Control of Mines at Almaden

By Cable From Reuters to "Engineering and Mining Journal"

Madrid, Jan. 2—A statement issued by the Ministry of Finance announces that the contract concluded with a London firm for the sale of quicksilver from the Government owned Almaden and Arrayanes mines lapsed on Dec. 31. The board of management of the two mines alone will henceforth control the sale and have full powers to conclude agreements with other centers producing quicksilver at the minimum price for a period not exceeding six months.

Japan Maintains Connections With Siberia

Yokohama, Dec. 10—For the first time in history, communication will be kept up this winter between the main island of Japan and the port of De Castri, on the Siberian mainland, 800 miles north of Vladivostok, and opposite the north end of the island of Sakhalin.

The "Otomaru," a Japanese naval ice-breaker, will be kept in regular service between Aomori, Japan, and the ports of Alexandrovsk (Sakhalin), and De Castri. From De Castri, the Japanese will maintain sledge service 100 miles further north to Nikolaievsk, at the mouth of the Amur River.

Nikolaievsk was the seat of the massacre of Japanese subjects in May, 1920, and the maintaining of the winter service will effectually prevent any recurrence of such an event.

Temiskaming Laboratories' Work To Be Continued

The Minister of Mines has announced that operations will be continued at the Temiskaming Testing Laboratories in Cobalt. This plant was taken over by the Government more than a year ago, and is a combined sampling and assay office. It has been of great benefit to the Cobalt companies, as it is the only sampler in Cobalt for high grade ores.

New Diamond Field Opened in British Guiana

Promising Area Opened on Kurupung River—Washers Producing 100 to 200 Carats Per Day—Rush Follows to District

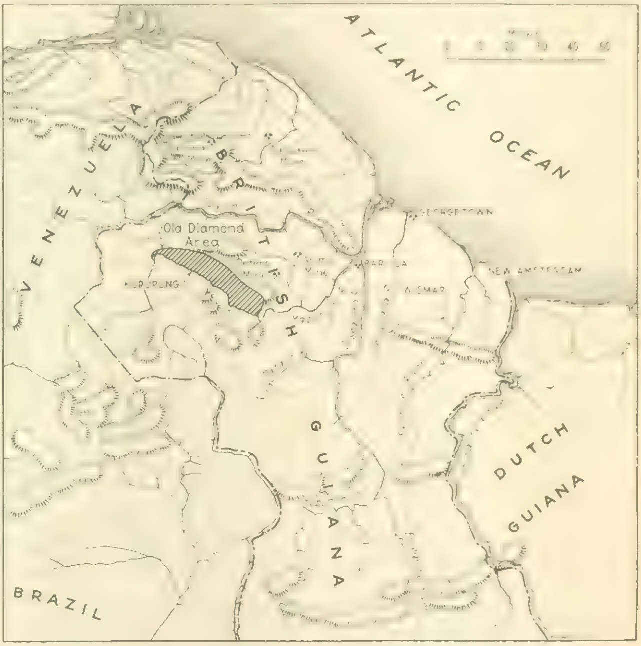
Georgetown, Nov. 16.—Early in October, 1921, news began to filter down to Georgetown, from the interior, of a new area of very promising diamond territory, that had been opened up on the Kurupung, a branch of the Mazaruni River. Largely owing to unemployment on the coast lands, caused by the slump in both the sugar and rice markets, a rush for the new field naturally followed.

The latest reports received are that the Kurupung is proving a bonanza and washers are already returning to town with the first stones from the new area. According to these early arrivals, single washers are producing from 100 to 200 carats per day. Men from the adjoining gold and diamond fields, Meamu, Perenong, Eping and Saranamue have abandoned their old claims and rushed to the new district. It is estimated that at least 8,000 men are now working along the Kurupung and the Government has taken steps to police the new camps.

A new record stone, weighing 29¾ carats, has been found and is now being brought down to Georgetown. The previous record stone was the "Gushway" diamond, weighing 27½ carats, found several years ago, which was noted owing to the amount of litigation which it produced.

Several new buyers have arrived so that there are now eight licensed buyers purchasing stones in Georgetown. It is rather hard to ascertain the prices being paid as dealings are carried on privately between the individual buyer and the washer bringing down the stones. Package stones or "run of mine" have been sold at from $10 to $25 a carat, while selected stones have brought from $40 to $60 per carat, it is said.

The Customs reports give 79,733 carats of diamonds exported this year up to Nov. 10 as against 19,175 exported during the same period of last year.



NEW DIAMOND REGION OPENED IN BRITISH GUIANA

The diamond fields of the colony are being worked almost entirely by the native black, as the difficulties of access and the health conditions have discouraged organized capital from entering the industry. The transporting of supplies to the new district will undoubtedly be the controlling factor in its development. It takes from two to three weeks to haul boats carrying supplies up the rapids of the Mazaruni to the mouth of the Kurupung and at this slow rate the amount of stores that can be taken in by a boat crew is comparatively small.

Metallurgical School Started at Jamshedpur

Bombay, Dec. 2—The Tata Iron & Steel Co. is opening a metallurgical school at Jamshedpur with the object of training young men to take the place of imported labor at the furnaces.

Anaconda Gets First Order for Copper Shingles

Washoe Foundry Superintendent Describes New Product—Company Now in Market, It Is Announced

By A. B. KEITH

The Anaconda Copper Mining Co. has recently accepted its first order for copper shingles and from the number of inquiries being made enthusiasm is running high as to the outlook for this venture of the company. John Gillie, manager of Anaconda's mines, in an address to the board of directors of the Butte Chamber of Commerce, said that if the market for these shingles measured up to what they expected, half of the copper production of the whole country would be utilized in their manufacture. Formal announcement was made that the Anaconda now is in the market and is ready to supply the trade with either copper or zinc shingles.

Harold Blake, superintendent of the foundry department of the Washoe smelters, in the course of an address to the chamber, submitted interesting figures pertaining to this latest product of the Anaconda, stating that the initial cost of copper shingles over wooden was only about twice that for the wooden article, but when it was taken into consideration that the life of the wooden shingle averaged only about ten years while that of the copper was 100 years, or really as long as the foundation of the building endured, the material advantage in favor of the metal shingle was obvious. Again Mr. Blake pointed out that in case of a fire there was no salvage value whatever to a wooden shingle whereas it was 60 per cent for the copper shingle, represented by the value of the metal. In the case of slate, asbestos or tile, the copper shingle had a material advantage in the first cost, he said, and further, the laying of copper shingles required no particular skill and twice the area could be covered in a day than with the wooden shingle. Against this the service of a skilled artisan was required when a roofing of slate, asbestos or tile was to be laid.

This copper shingle, which is of 9-oz. sheeting, makes a roofing weighing only 84 lb. to the square (100 sq.ft.) in place, and is probably the lightest substantial material which may be employed for roofing purposes. This weight compares with 600 lb. for Johns-Manville Color-Blende asbestos; 75 to 1,000 lb. for slate and 1,200 to 2,000 lb. for tile. In the matter of roof trussing the lesser weight of the copper will make for considerable economy in construction costs. The copper shingle is not applicable to flat roofs, he said, but to meet this need the Anaconda is producing a copper sheet with a tinned edge to permit of soldering. The duplicate of the copper shingle is being manufactured in zinc, the initial cost of which is only 15 per cent over the wooden shingle, and when the latter has been painted or stained, this margin is further reduced. The company also plans to make sidings for bungalows, buildings, warehouses and in fact, for any sort of construction, with the same argument as to durability applying as pertains to the metal roofing, expedition in building and a reduction of the fire hazard.

Through a process of oxidation the company's metallurgists have achieved some very skillful results, enabling the fixing of a color ranging from a very dark green to a brownish red, with the added quality that this variation of hues can be varnished by scrubbing the metal with a solution of salammoniac, which will leave the sheeting the beautiful green color so characteristic of copper roofs observed near the sea coast.

The new shingles are 18-in. long by 6 in. wide and will be laid the long way horizontally. The 9-oz. material is recommended by the Anaconda for copper roofing, and with the shingles come copper nails and such roofing auxiliaries as flashings, valleys, hips, verges and spouts, as desired. Copper roofing should cost around $22 per square f.o.b. Anaconda, Mont., for the 9-oz. sheets. The shingle is known as "Anaconda Roofing" and is 99.95 per cent copper.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Placing of Duty on Pyrites Strongly Opposed

Thought That Sulphur Producers Would Profit—No Protection Needed by These, It Is Said

Apparently the Finance committee of the Senate has been convinced that iron pyrites should stay on the free list. There is powerful opposition to any duty on this basic chemical raw material. The best point made by the opponents of a pyrites duty was a quotation from a report by the United States Tariff Commission to the effect that the serious competition which domestic pyrites producers face comes from American sulphur rather than from imported pyrites. It was pointed out to the committee that American sulphur has made such inroads on the use of pyrites that less than one-fourth the prewar tonnage now is imported. The price of sulphur has declined to the point where foreign pyrites can no longer compete with it, it was argued, except at points highly favored in the matter of transportation, such as Atlantic ports. A tariff on pyrites, the Senate committee was told, would have the effect of prohibiting further importations, but sulphur and not domestic pyrites would be substituted unless sulphur producers should advance their prices greatly. The point was made that a tariff on pyrites would be a standing invitation to domestic sulphur producers to add the amount of the duty to the price of their product. Evidence that the domestic sulphur industry does not need protection was laid before the committee in the form of an official report showing that American sulphur has displaced the Sicilian product in the important Scandinavian markets and is being sold extensively in England, France and Germany.

Tariff on Asbestos Sought

The Association of Asbestos Mines of Arizona has submitted a brief to the Senate Finance Committee asking that a flat duty of 20c. per lb. be placed on all asbestos ore and fiber. The belief is expressed that the better grades of Arizona fiber which go into the yarns upon which the manufacturers receive a protection of $1.68 per lb., cost at least 30c. per lb. more to prepare and produce than does the fiber produced by Kaffir labor, while the so-called Arizona No. 2 fiber costs at least 20c. per lb. more to deliver.

Over Half of Railroad Tonnage Mine Products

Class 1 Roads in Third Quarter Carried Over Quarter Billion Tons —140,000,000 From Mines

Considerably more than half of the freight tonnage handled by the railroads of the country during the third quarter of 1921 was made up of commodities classed as "products of mines." The total amount of revenue freight handled during that period by the class 1 railroads, which handle 99 per cent of the traffic was 252,456,817 tons. The commodities produced at mines furnished revenue freight to the amount of 139,947,089 tons. The detailed figures, which are those of the Interstate Commerce Commission, show an increase over the second quarter of more than 15,000,000 tons of mine products moved.

The tonnage of mine products originating on railroads in the eastern district during the third quarter was 71,940,328 tons; in the Pocahontas region, 12,618,966 tons; in the southern district, 15,434,360 tons; in the western district, 39,953,435 tons. A significant feature of the figures is that the iron ore movement in the western district totalled 13,619,045 tons.

NEWS BY MINING DISTRICTS

London Letter

Mozambique Company Reports—Russo-Asiatic Consolidated's Property in France — Geduld Proprietary Increases Reserves

BY W. A. DOMAN

London, Dec. 20—According to the annual report of the Mozambique Company for the calendar year 1920, mining in the territory did not make much headway. The value of the gold produced was £40,031, and of the silver, £103, a total of £40,134, as compared with £20,610 in gold, and £57 in silver, in 1919, or £20,667 in all. From one standpoint this is satisfactory, but fewer mines were working, and only thirty-eight prospecting licenses were issued as against 222 in 1919. The Edmundian copper mine produced 132 tons of copper valued at £15,500, and the tin output was about 21 tons, of an estimated value of £4,555.

The Russo-Asiatic corporation appears to be making good progress with its base metal property in the south of Franch. According to a circular just issued, the Villemagne Concession lies in the departments of the Gard and Lozere, a highly mineralized district containing, among others, the well-known lead and silver mines of Malines, which have a long record of dividends and are still in operation. There is a strong east and west lode on the Villemagne Concession, outcropping at intervals for several miles, and there is a plentiful showing of zinc blende. Under the former French company, which worked with rather primitive methods, nearly 5,000 tons of concentrates was produced in 1913 and 1914, averaging 55 per cent lead, and 20 oz. silver per ton. According to the records of the French company, there were 500,000 tons of ore developed in the mine, containing, so far as can be ascertained, from 6 to 8 per cent lead, and 3 to 4 oz. silver; certain portions are high in zinc, running from 15 to 30 per cent. A geological survey of the concession has been made, and over a length of 4,000 ft. seven bore holes have been sunk, all of them uncovering ore, from 7 to 20 ft. wide, and assaying 8 per cent lead, 10 per cent zinc, and 5 to 6 oz. silver. New horizontal orebodies have been discovered, replacing some of the sedimentary bodies, and giving very substantial assays in all three metals. It is estimated that with lead at £22 per ton, zinc at £26, and silver at 3s. per oz., a milling mixture would yield a profit of £2 per ton. Already 1,000,000 tons of ore have been proved, and further boring is expected to prove the existence of several millions more.

The El Oro Mining & Railway Co. announced at a meeting a few days ago that through its investment company it had secured a twenty-five year lease on a silver mine belonging to the Noria Development Co., in the state of Zacatecas, and upon an adjoining mining area upon terms giving the investment company an interest of 60 per cent, and, in certain eventualities, 72 per cent of all profits derived from its operation. The Noria is described as a developed mine.

The Mexican Corporation is making an issue of £380,000, 10 per cent seven-year convertible notes, repayable at 120 per cent. The money is largely required for working the Fresnillo mine. The milling capacity is to be increased to 75,000 tons monthly, and the profits are to be divided thus: 20 per cent to be retained by the Mexican Corporation until the excess expenditure (up to $800,000) in constructing the plant over the original estimate has been amortized, the remaining profit to be divided equally between Mexican Corporation and the Fresnillo company until a sum of $5,000,000, including the $800,000, has been received by the Mexican Corporation. According to the corporation's engineers, the Quarry orebody contains a minimum of 4,000,000 tons of ore in sight, with good possibilities of extension.

A cablegram just to hand from Johannesburg states that in the Geduld Proprietary mine the reef has been cut in No. 6 level crosscut from Shaft No. 7, the value being 2 oz. over 28 in., with the reef not yet fully exposed. This development is in the rich area of the property which has been opened up hitherto on No. 7 level, as No. 6 level had not been started. The importance of the cablegram lies in the fact that the high-grade ore met with on No. 7 level extends up to No. 6, and consequently adds greatly to the value of the mine.

Those interested in the tin-winning industry are beginning to hold up their heads again, for the price of the metal has recovered to over £171. That figure is not sufficient to make it possible for work generally to be conducted at a profit, but it gives promise of improvement, and the share market is rallying. Stocks in the East are gradually undergoing reduction, though fresh supplies are being created.

The Malayan Tin Dredging Co. ran four dredges in the twelve months to June 30, a total of 24,927 hours, dredging 3,258,200 cu.yd., 46.32 acres, as compared with 2,558,500 cu.yd. in the preceding year. The average value of the ground was .48 *katis*, in contrast with .39 *katis*, the result being an output of 939 tons against 594 tons.

[The *kati* is a Chinese weight equal to one and one-third pounds.]

Johannesburg Letter

An Executive's View of the Labor Situation—Strike at Crown Mines Spreads — Mining Regulations Changed—Diamond Companies Retrenching — Zululand Coast Surveyed

BY JOHN WATSON

Johannesburg, Nov. 29—The annual meeting of the Johannesburg Consolidated Investment Co., (the parent company of the house of Barnato) was held on Nov. 23 in Johannesburg, Prof. J. G. Lawn, joint managing director, presiding. In the course of an address, referring to the gold premium, he said the average price at the beginning of July, 1920, had been £5 4s. per fine oz.; the price rose steadily to £6 1s. 4 d. in November and again fell to £5 2s. 8d. in May.

The efficiency of white labor had been reduced by a shortening of the hours of work and the granting of regular holidays, amounting to four weeks per year for underground workers. This was just, according to Prof. Lawn, but it must not be forgotten that the industry has paid and is paying for such concessions. Unfortunately, there was no reciprocal keenness or loyal service on the part of the workers, he said. The constant and unending agitation and hunt for grievances, the constant harassing of the mine managers and other officials, the frequent sectional strikes, were all evidences of the position. There was great talk of co-operation and mutual bargaining; but it had mostly been one-sided. It had been a case of concession after concession on the part of the mines until the position had become well-nigh impossible and only sustained at all by virtue of the gold premium. There were more white workers employed in the industry than were necessary, which added greatly to working costs. These surplus workers were thrust upon the industry by government regulations, and by agitation and threats on the part of the European employees. It would be much cheaper, said Prof. Lawn, for the industry to support these surplus white men in idleness at the coast than to keep them at the mines.

A strike which started at the Crown Mines on Nov. 10 over the dismissal of a shift boss who was a member of the Mine Workers' Union has grown in dimensions. The union appealed to the Chamber of Mines for a board of reference. An inquiry held by two government inspectors disclosed the cause of the dismissal, upholding the company. All the miners at the property came out Nov. 25. The general manager, A. J. Walton, replied by giving notice to all men on strike that they were discharged from the company's service as from Nov. 25. On Nov. 29, 461 other European workers were unable to work and the management had been compelled to give them notice. The Minister of Mines, F. S. Malan, has been in Johannesburg, trying to patch up a peace, so far without success.

The sub-committee on the amendment of the mining regulations sat at the New Law Courts, Johannesburg, on Nov. 15, when the Prime Minister, General Smuts, again presided. Certain new regulations drafted by the government mining engineer, Sir Robert Kotze, were discussed and after slight alterations were agreed to by the Mine Workers' representatives, also by the Chamber of Mines. The effect of these alterations will be to allow each working place, before the commencement of a shift, to be examined by a competent miner, who shall make it safe to work in. The effect of this and other changes will be that the white miner and his "boys" will get a better start each morning and thus increase the efficiency of the native underground worker.

The output of diamonds in the Union fell from 2,156,900 carats in 1913 to 905,300 in 1920. The value per carat increased up to 1920 when there was a fall. The De Beers company during the last year or so, has spent over £1,000,000 in maintaining 1,000 employees on non-productive work. Now, their funds are reduced to the danger point and the board will be compelled to retrench, remembering as far as possible the claims of their old employees. Further retrenchment is also taking place at Jagersfontein diamond mine in the Free State, where it is said working expenses are to be curtailed by one-third; this will probably mean a reduction of of wages of several whites and the discharge of a number of natives.

A survey was recently made of the Zululand coast near Kosi Bay by government representatives. Another party has also been surveying on land. In recent years, several large collieries have started operations in the Vryheid district. A railway line from Kosi Lake in a southwesterly direction along the watershed between the Umkusi and Ponzola rivers would reach the railhead of the existing line to Vryheid within a distance of 120 miles. The mouth of the Kosi River is in British territory in the northern part of Zululand, known as Amatongaland and is only about 70 miles (as the crow flies) south of Lourenco Marques (Delagoa Bay) the latter being in Portuguese East Africa.

COLOMBIA

The British Platinum & Gold Corporation began operations with its first dredge on Dec. 1, 1920. To July 31, the end of the company's year, 177,000 cu.yd. was dredged, for a gross value of platinum and gold of £26,723, the average per cu.yd. being 36.32d. and the field cost 9.97d. Platinum ranged from £17 to £20 10s. per Troy ounce, and contributed £25,177 to the total.

CANADA

British Columbia

Premier's Tramway To Be Running Soon—Bunkers Described

Stewart—The aerial tramway to the Premier mine has been completed and will soon be in operation. There is still some work to be done on the bunkers at the dock. The tramway is 11½ miles long, contains 46 miles of cable on which there are 125 7-cu.ft. buckets. The traveling speed is six miles an hour. Ten tons of ore per hour can be handled over the line. Three telephone lines have been strung along the route, two for operation purposes and the other for the use of the company. Three men will be employed walking over the line continuously. The power necessary will be generated at the mine.

The bunker has a capacity of 1,500 tons. The bunker itself is about the center of a three-story building, 210 ft. long by 36 ft. wide, and containing about 400,000 ft. of lumber. The top floor is taken up by the tram terminal which runs into it a distance of 150 ft. Trap doors have been let into the floor, through which the ore will be dumped from the buckets to the bunker. On this floor ahead of the terminal rails is a large space to be used for incoming freight and in front of this again there are two sleeping rooms and a large office. An inclined elevator will be operated by a 10-hp. Fairbanks-Morse gasoline engine which is also installed on this floor. The elevator is so constructed as to permit the delivery of freight from the dock to each of the floors of the building. The second floor is confined to the bunker itself and makes provision also for considerable warehouse space. The first, or ground floor, is devoted to the conveyor belt, on either side of which is space for the storing of 1,000 tons of concentrates. A 20-hp. Fairbanks-Morse gasoline engine operates the conveyor belt, which runs the full length of the building from behind the bunkers. The transfer of ore across the dock is provided for by another belt which lifts when not in use. A Delco plant has been installed for lighting purposes, capable of carrying at least 100 average-size lamps. The work has been done by Riblet Brothers, of Spokane, under the superintendence of L. H. Graham.

Alice Arm—A lower tunnel is being driven on the Esperanza property. Already it is in 110 ft. and ore is expected to be cut at 135 ft. Work is being continued during the winter.

The residents of Alice Arm are signing a petition to the Government asking that other companies be permitted to operate the Alice Arm-Dolly Varden railway next year in the event of its being left inactive by the Taylor Engineering Co. The explanation is that lack of transportation this year has seriously handicapped the development work on many properties of the upper Kitsault Valley.

Vancouver—The charges laid against E. J. Donoghue and C. P. Browning, of the Britannia Mining and Smelting Co., of criminal negligence in connection with the catastrophe that recently destroyed the mining community of Britannia Beach with much loss of life, have been dismissed. The magistrate observed that the Crown had not presented evidence to show who was in control at the time of the disaster and there was nothing to indicate that anyone had thought there was danger. The water only once before had come to the top of the culvert, the washing away of which was alleged to have caused the flood. There did not seem to have been any lack of precaution. The company had exercised its best judgment and the only thing that could be charged was an error of judgment.

Ontario

Pending Bill To License Engineers Arouses Interest—Trethewey Silver Stockholders Asked To Ratify Reorganization Plan

Toronto—A great deal of interest is being shown over the proposed professional Engineers' bill, which will be presented before the Ontario Legislature at the next session of the House, early in 1922. The bill is somewhat similar in nature to that which is already in effect in several of the provinces of Canada and in a number of the states in the United States, and it seems to be received by considerable favor from the civil, mechanical and electrical branches. Considerable opposition has, however, arisen from the mining fraternity, and it is very doubtful if the mining engineers will endorse it. The mining engineers do not wish any legislation brought in which will interfere with the development of the mineral resources, or which will, in any way, lead to keeping out engineers from any country or other province. Another factor which the mining engineers take into consideration is that the average mining engineer, in addition to the purely mining side of his profession, usually has to undertake work which is ordinarily considered to belong to the civil and mechanical branches. As registration for the different branches would be in the hands of engineers appointed from these particular classes, the mining engineers feel that there might be some difficulty in their obtaining registration in all the branches, to which they feel they are entitled.

Cobalt—It is understood that the year's production of the Mining Corporation of Canada will be approximately $1,300,000. Additional machinery is being sent to the Haileybury Frontier in South Lorraine, which the company has under option. It is understood that development work to date has been very satisfactory.

A meeting of the shareholders of the Trethewey Silver Mines will be called in January to ratify the directors' reorganization proposal. The capitalization is 2,000,000 shares of $1 par, of which 1,600,000 have been issued. The new company will have the same capitalization, and will issue one share of the new stock for four shares of the old. This will mean an issued capital of 400,000 shares, with 1,600,000 shares in the treasury. The treasury stock will be offered to shareholders at 10c. per share and the money raised will be utilized to pay off the obligations of the company and build a small mill, without which it is impossible to continue profitable operations. The company owes about $40,000.

It is understood that the Lorraine Consolidated may be re-opened in the near future.

There were no ore shipments from Cobalt reported for the week ended Dec. 23.

Kirkland Lake—Notice has been given by the Minister of Mines that under Section 39 of the Mines Act all islands in Sesekinika Lake, in the Townships of Grenville and Maisonville have been withdrawn from staking or leasing, except all valid claims now existing.

It is understood that announcement will very shortly be made to the effect that the troubles arising from the power shortage in Porcupine have been solved, and that the camp will be guaranteed an adequate supply of hydro-electric energy. The full effect of this will not be apparent until 1923, but it will permit the mines to go ahead with the policy of expansion, which has been held up on account of the shortage of power.

It is reported that a rich surface discovery has been made on the property of the Lightning River Gold Mines, near Lake Abitibi.

Porcupine—On account of the power shortage, the Davidson has been forced to suspend underground operations, but it is understood that some diamond drilling will be done.

The seventh hole has been drilled on the Rochester property, which is under option to the Nipissing. It is understood that results to date have not been encouraging.

Satisfactory results are said to have been obtained by the Gold Islet and Peninsula properties on Night Hawk Lake, near Porcupine. On the former property 2,800 ft. of diamond drilling was done and a shaft sunk 100 ft. On the Peninsula drifts have been run on the ore at 100 and 200 ft. levels.

Underground operations have been resumed by the Hayden property.

Shareholders of the Vipond-North Thompson have ratified the proposal to sell 475,000 shares of treasury stock at 15c. a share to a syndicate headed by H. B. Wills.

An electric mining plant has been ordered for the Porter Gold Mines, near Goudreau, in the Soo district. Power will be secured from the transmission lines of the old Magpie iron mine, about six miles distant. Two shafts are being sunk by hand, one of which is down about 20 ft., and very high assays are being reported.

Nipissing is investigating a gold prospect in the vicinity of Sault Ste. Marie.

ARIZONA

Mining Company Objects To Flood-Control Dam—Awaiting Decision in Iron Cap Suit—Judgment Given Against Schuylkill

By JAMES H. McCLINTOCK

Phoenix—The state, county, city and others interested in construction of the Cave Creek flood-control dam have been warned by the Amalgamated Copper Mines Co., through its attorney, Joseph F. Morrison, against entry on the ground of the corporation, this with allegation of probable damage to a group of mining claims, said to be of value. Construction of the dam is to be pushed, with filing of a damage bond, if necessary, as the structure is declared essential to insure the safety of the western part of Phoenix, inclusive of the capitol.

Three court reporters are working on the 500,000-word transcript of the Iron Cap-Arizona Commercial trial at Globe, the result to be submitted to the presiding magistrate, Judge Sam Pattee, of Tucson. Herman E. Zulch, of Oatman, is copying the engineering exhibits, of which thirty-one were submitted by the Iron Cap and fifty-two by the Arizona Commercial, mainly comprising drawings of the geological strata and orebodies considered. The suit took eight days. No early decision is expected, in view of the mass of technical testimony of conflicting character.

In the Superior Court of Cochise County Harry F. Scott has been given judgment against the Dragoon Mountain Copper Co., earlier known as the Mining & Development Corporation of Arizona, a promotion of Martin Fishback of Benson. The award, of less than $1,000, is one of a number taken against the same property.

At Kingman, Frank A. Garbutt has secured judgment and order of sale against the Schuylkill Mining Co. for $342,400 and costs, the principal sum stated to have been advanced by the plaintiff to pay for the property and to advance its development. This was during a period when Ralph Cole was seeking to finance the corporation and during which he made several payments on the purchase price. The property affected, in the Chloride section, includes the Tennessee, Great Lead, Tennessee South, and Black Rock Springs lode claims and the mining and other property known as the Schuylkill millsite. The property is recognized as one of the largest lead-silver mines of the Southwest, opened to 1,400-ft. depth, with a railroad to the dumps and with fine surface equipment.

Miami—Inspiration is gradually increasing its operating force and is maintaining two underground ore trains, clearing the stopes and raises of ore that is being stored against the time of production.

Bisbee—Hoval A. Smith has returned from a trip to Europe, where he went to interest capital in the Mexican Chispas mine. He is accompanied by an English mining engineer, who will inspect the property.

CALIFORNIA

Idaho-Maryland Said To Have Recovered Eureka Lode—Engels Company President Seeking Proxies from Stockholders

By Our Special Correspondent

San Francisco—The close of 1921 brings with it little of new interest in the mining field. Conditions are slowly improving with increasing interest in gold mining although this interest appears to be confined to smaller and desultory operations. Recently a new gold dredge built by the LaGrange Gold Dredging Co. was launched at LaGrange preliminary to undertaking dredging operations on the Tuolumne River.

Local reports from Grass Valley credit the management of the Idaho-Maryland with the announcement of the recovery of the Eureka lode in the bottom of the Dorsey winze. Another discovery upon the lowest level of the mine, said to be an excellent pay shoot, was also announced. Since the unwatering and reopening of the Idaho-Maryland by the Bulkeley Wells interests, a conservative campaign of prospecting and development has been under way. It is expected that this will result in milling some time in 1922.

From the Masonic district in Mono County encouraging activity is reported and hopes of mine and claim owners run high.

That discoveries are still possible in the Grass Valley district is indicated by the prospecting of a new ledge which was formed in a grain field near Newton by Arthur Maule. Returns from a small ore shipment were stated to be satisfactory.

The gold production of California is expected to be approximately $16,000,000 for 1921, a gain over the figures of 1920. Silver production will exceed $2,000,000 in value. Copper is expected to reach 12,000,000 lb., the product for the most part of the Engels copper mine.

An interesting situation has arisen in the Engels company. Henry Engels, president of the Engels Copper Mining Company, is seeking proxies from the stockholders of the company. In his letter the statement is made that the company has been badly managed; that it has entered into ill-advised contracts with the railroad and with the power company; that copper had been produced during a period of low prices when it would have saved the company money to have closed down. Against these charges the existing management appears quite capable of presenting an adequate defense, as many improvements in operating conditions have been made and the mine has been extensively developed. From diffused and scattered units, consolidation of plant has been effected and working costs reduced so that operations during the period when most other copper mines were shut down became possible. It is a matter of regret that differences between minority and majority interests have arisen.

NEVADA

"Big Ship" Burned at Tonopah—Tonopah Divide Sinking Below 1,200

Tonopah—Production for the district during the first fifteen days of December as shown by bullion shipments, was as follows: Tonopah Belmont $1[illegible], West End $59,000, Tonopah Mining Co. $[illegible], Tonopah Extension $49,500. Practically all of the mines in the Tonopah district closed down for two days at Christmas, and on Dec. 25 $5 Christmas checks were distributed to employees.

On the night of Dec. 23 the "Big Ship," probably the best known miners' boarding and rooming house in Nevada and which was purchased by the Tonopah Belmont about six weeks ago was totally destroyed by fire. Three miners lost their lives and thirteen were injured. The spread of the fire was so rapid that those having inside rooms found it difficult to escape. The "Big Ship," until its purchase by the Belmont company, had always been known as the home of the radical element in this district. It is thought that its destruction was due to work of incendiaries and a rigid investigation is now being made.

Divide—At the Tonopah Divide mine the 1,200 level stations have been completed and shaft sinking below the 1,200 level was resumed on Dec. 23. Development work was accomplished on the 2d, 3d, 8th, 10th and 12th levels with no changes reported.

Royston—The west crosscut from the bottom of the Betts shaft has picked up the continuation of the vein at only 20 ft. from the shaft. As noted last week, the shaft passed into the footwall at 42 ft. and was continued to depth of 53 ft. and a crosscut started to the west.

Carson City — Congressman S. S. Arentz and other Western Congressmen are reported to be trying to secure a modification of the regulations of the Pittman Act in order to permit Nevada silver producers and others to send their silver to the Carson City Government Assay Office. The purpose of the modification asked for is to reduce the delay for settlements which it is claimed work a hardship upon small producers. Senator Key Pittman of Nevada is also reported to be seeking a revision of the Leasing law to the extend of authorizing the Secretary of the Interior to grant extensions of time within which prospecting must begin from six months, the time now required, to two years at his discretion.

Judging by increase in premiums paid to the Nevada Industrial Insurance Commission industrial conditions throughout the state are improving. Virginia City, Tonopah and many smaller districts show some noticeable gains.

Virginia City—The Boericke option on the Middle mines of the Comstock lode has been relinquished. Extensive sampling and some development work was accomplished under the direction of Albert Burch.

UTAH

Lessee Cuts New Ore in Iron Blossom —Park City and Tintic Shipments —The Utah Apex Decision

Eureka — Shipments for the week ended Dec. 24 amounted to 141 cars. Shippers were: Tintic Standard, 42 cars; Chief Consolidated, 38; Colorado, 12; Iron Blossom, 11; Victoria, 11; Eagle & Blue Bell, 8; Swansea, 4; Empire Mines, 4; Dragon, 3; Gemini, 2; Sunbeam, 2; Gold Chain, 1; Centennial Eureka, 1; Mammoth, 1; Yankee, 1.

A strike of interest is reported in the Iron Blossom, where a lessee has opened new silver-lead ore which appears promising, although not yet sufficiently opened to permit of definite statement. A dividend of $25,000 was recently paid.

Park City—Shipments for the week ended Dec. 24 amounted to 2,602 tons. Shippers were: Judge allied companies, 1,452 tons; Silver King Coalition, 662; Ontario, 448.

Salt Lake City—The U. S. District Court, on Dec. 16, 1921, awarded the Utah-Apex Mining Co. the sum of $1,154,928.98 as a result of the apex litigation between this company, which operates at Bingham Canyon, Utah, and the Utah Consolidated Mining Co., its neighbor. It will be remembered that Utah-Apex was awarded the decision. The Utah Consolidated was granted a stay of execution for thirty days to give that corporation time to secure a bond.

The litigation between the Utah-Apex and Utah Consolidated mining companies consists of six suits, brought in the U. S. District Court. By mutual consent of the litigants, as the same fundamental question was involved in each, it was decided to try two suits which should govern all six. Five of the cases were decided by the court in favor of the Utah-Apex; and in the remaining case the Court decided that the Utah-Apex had not proved its contentions. The Utah-Consolidated appealed one suit (the Yampa) which covered four suits; and the U. S. Circuit Court of Appeals confirmed the decisions of the trial court in favor of the Utah-Apex, handing down the decision on Nov. 14, 1921. The other two cases have not yet been appealed.

MONTANA

Butte & Superior's Copper Ore on 2,200 Level Improves — Boston & Montana Mill To Increase Tonnage to 500 Daily

Butte—Butte & Superior's copper showing on the 2,200 level has continued to improve and a substantial body of copper ore, about evenly divided as to first and second class, has been proved after 300 ft. of drifting, with the first-class running about 8 per cent copper and more than 12 oz. of silver. A crosscut of the orebody showed 15 ft. wide with the values as stated.

Elkhorn—Boston & Montana concentrator, which is handling 200 tons daily now, will increase its operations at once to 500 tons.

COLORADO

Service on South Park Branch Must Be Continued

Denver—Application of the Colorado & Southern Railway Co. to discontinue daily service on the South Park branch and substitute a tri-weekly service between Leadville and Denver was denied by the Colorado Public Utilities Commission, Dec. 29. The road serves mining districts in Summit, Park and Lake counties. The railroad company based its application upon the contention that the South Park branch was being operated at a loss. The Commission held that since the Colorado & Southern system as a whole was making money, the fact that one of its branches was operating at a loss did not warrant the curtailment of service asked for.

Wolcott—What may devlop into a mining boom of considerable magnitude seems well under way, and is the result of recent strikes made in this vicinity during the fall and winter. A large number of new locations are being made and much development work is in progress. Several old properties which have been idle many years are being reopened. The values are principally in gold and silver.

Silver Plume—On the evening of Dec. 26, the Burleigh mill, owned by the Silver Plume Mines Co., was completely destroyed by fire, the origin of which is supposed to have been defective wiring. The mill was temporarily shut down for repairs and was to have resumed operation Dec. 27. The plant was located on the Dives-Pelican properties and was successfully handling about 100 tons daily from the Pelican dumps, employing flotation and table concentration.

MICHIGAN

The Copper Country

C. & H. Metal Stocks Expected To Be Depleted by May 1

By M. W. Youngs

Houghton—It would appear at this time that the Calumet & Hecla and subsidiary mines will reopen either May 1 or June 1, although this is mere speculation inasmuch as no definite time for resumption has yet been set. The dates mentioned are based on the amount of metal still on hand, and May 1 should see these stocks all but depleted.

The copper companies of the Lake district can mine, smelt and deliver metal in the East in two weeks' time, whereas it requires ninety days for the mines of the Western and Southwestern fields to produce, treat and lay down their copper in New York or other Eastern points.

Of the Calumet & Hecla group, the amygdaloid mines are for the most part in good condition. There has been little or no crushing in the majority of shafts and no great amount of ground has fallen, making resumption possible with little or no shaft repairs or timbering. At Ahmeek No. 2 shaft it has been necessary to take out the concrete skipway and replace it with timber. Kearsarge No. 1 shaft has been repaired practically to the bottom.

In the conglomerate shafts, where the ground has a greater tendency to crush, it will be necessary to do considerable work. Repairs will be extensive so it is likely this work will be started fully two months before production is resumed. Not a very large force of men will be required, however, to put the shafts in shape.

Arcadian Consolidated is making good progress in sinking its New Baltic shaft from the 9th to the 10th level, from which point a drift will be started to the south to parallel the drift from the 9th level. The shaft is again in the vein and the rock from it is richly shot with copper. The quality of the rock bears out the theory that the shaft is going through a copper shoot, and the continuing values with depth are encouraging. This copper shoot has been encountered on either side of the shaft.

The Cass Copper Co., owning 2,140 acres of land in Ontonagon County, has called for an assessment of 10c. per share on the 54,660 shares of outstanding stock of the company, for the purpose of meeting taxes. The company's land was explored in 1916 and 1918, conditions forcing a suspension of operations. The assessment is payable Jan. 16, 1922.

MINNESOTA

Mesabi Range

Corsica Mine To Be Reopened—Stripping Work Stopped at Boeing Pit

Gilbert—The Pickands & Mather Co. has issued orders for the reopening of the Corsica mine, which will employ approximately 150 men. The reopening is not essential from the standpoint of desiring the ore, but to assist the unemployment situation.

Hibbing—Stripping at the Boeing open pit, a property of the Mesabi Cliffs Iron Mining Co., has been suspended for the winter by the Winston Dear Co. who have the contract. During 1921, 2,400,000 cu.yd. was removed, making a total of 3,700,000 removed. The operating company plans to ship ore from this pit next season.

It has been unofficially announced that the Leetonia and South Agnew mines properties of the Interstate Iron Co., will resume operations soon. Both are underground properties. This will mean the employment of approximately 250 men.

JOPLIN-MIAMI DISTRICT

Skelton Concentrator at Tar River Burned—Pitzer Mine Sold

By P. R. Coldren

Joplin—Fire completely destroyed the concentrator of the No. 2 mine of the Skelton Lead & Zinc Co., Tar River, Okla., on the night of Dec. 26. The mill had been inactive for almost a year and the origin of the fire is unknown, but it was reported by the night watchman to have started in the derrick at the mill's shaft. The mill was of 25,000 tons capacity and was erected about four years ago. It has been a big producer, and by estimate about $2,000,000 worth of ore has been taken from it. The mine was one of six owned by the Skelton company and was the second placed in operation. The loss is estimated at from $50,000 to $60,000 with from $30,000 to $40,000 insurance. The Skelton mines are owned by Oklahoma and Kansas people. Frank Childress of Galena, Kan., is superintendent.

Fred A. Barton and associates, of Chicago, have purchased the Pitzer mine, located on Spring River, about 14 miles west of Joplin, for $10,000 cash. The object in making the purchase, however, was unique in this district. It is the plan of the new owners to mine the land for the crushed rock it contains, and to take the zinc and lead ore obtained as a byproduct. The mine has produced about $45,000 worth of ore in the past, the pay dirt being found as shallow at 18 ft. Sand, gravel and classified rock have come in good demand in this district as a result of much road building.

ALABAMA

Progress Towards Normal Continues—Tennessee Coal, Iron & R.R. Co. To Have 600-Ton Stack—Quenelda Graphite Corporation's Property Sold

By George Huntington Clark

Birmingham—The closing days of the year were noteworthy as still marking advances toward normal. The usual industrial holiday was observed out of regard for the wishes of employees rather than because of any desire of the iron makers to slow up on production.

Of the four blast furnaces belonging to the Tennessee Coal, Iron & R.R. Co., recently in operation on basic at Ensley, one is now running on foundry iron. Another of its idle stacks, which has been for some time undergoing repairs, is being dried out, and will be ready to go in blast as soon as required.

Plans outlined for the rebuilding of No. 1 Ensley stack of this company, will make it, in about six months' time, the record producer of the district, an output of 600 tons per day being expected. The number of tuyeres is to be reduced and the most up-to-date type of blowing engines and other furnace equipment installed. An output of 600 tons will establish a new district record, and will lead eventually to the scrapping and rebuilding of the smaller and inefficient stacks.

The Hattie furnace of the Sloss-Sheffield Steel & Iron Co. at Sheffield will resume operations at once, stocks having been sufficiently worked down to justify increased iron making, for which there is said to be increasing local demand.

As to the merger of independent steel companies recently announced, it is understood that the appraisals of the properties involved have either been or about to be completed, and that the committees working on the general merger plans, will be ready to report early in January.

Involved in one of the two announced mergers are the properties of the Republic Iron & Steel Co. in Alabama, which include three modern blast furnaces, together with ample reserves of raw material.

Furnace interests have been given to understand that as soon as annual inventories are completed, the placing of pig iron contracts for the coming year may be definitely expected.

The beginning of the work of laying concrete on the Mitchell dam recently means that early in 1923 the district will have available nearly another 120,000 hp. of hydro-electric energy, making a total of 200,000 hp. from the Coosa plants of the Alabama Power Co. The expenditure of $8,000,000 on the project will also relieve the condition of unemployment.

An important announcemnt of the week would seem to be the acquirement by Chicago interests, through their attorney Joseph Weisenbach, of all the assets of the Quenelda Graphite Corporation, consisting of some 1,500 acres of ore land, five large graphite plants, and one finishing plant.

It is understood that purchasers will reorganize the company and resume operations, which, if true, it is earnestly hoped may mean the first steps toward the revival of the graphite industry in Alabama, dormant since the signing of the Armistice.

PENNSYLVANIA

E. & G. Brooke Iron Co. Resumes at Birdsboro Plant

Reading—The E. & G. Brooke Iron Co. put its furnace at Birdsboro in blast on Dec. 27, giving work to 130 men. The company has been idle since spring. Its iron mine at French Creek also resumed.

NEW YORK

New Engineer Licensing Law Passed Last May Now Functioning—Percy Barbour Vice-President of State Board

The new engineer licensing law of New York State, which became effective on May 5, 1921, has begun to function. At a session recently held at Albany by the Board of Engineer Examiners, appointed under the law, the first list applicants, numbering 241, was considered and 171 were passed.

Under the law everyone practicing electrical, mining, mechanical, chemical or civil engineering in New York State must now be licensed.

The State Board of Engineer Examiners is composed as follows: President, Albert H. Hooker, chemical engineer, of Niagara Falls; vice-president, Percy E. Barbour, mining engineer, of New York City; secretary, Henry G. Reist, electrical engineering of Schenectady; and Virgil M. Palmer, mechanical engineering, of Rochester; and Col. Walter G. Eliot, civil engineering, of New York.

The Situation at the Mines in December

SENTIMENT continued to improve in December in most districts, though actual operations showed little change from November. The active districts of importance held their own and in some cases increased shipments. Basic conditions affecting mining, such as those of prices, freight and smelting rates, and wage scales, were for the most part unchanged. The outstanding events and those upon which the improvement in sentiment was chiefly founded were the proposal by Anaconda to acquire control of American Brass, which was quickly followed by the announcement that Anaconda and some of the other Butte companies early in January would resume work leading eventually to production; the news that the Colorado Fuel & Iron Co. was to expand its operations beginning Jan. 1; the resumption of work at reduced wages at some Lake Superior iron mines; and the announcement that the Trail smelter would make prompt settlements for custom shipments. Undoubtedly much unemployment existed in some districts. The labor situation in general was favorable to the operator.

Copper companies in Arizona and New Mexico remained inactive except Superior & Boston, which resumed, and Miami and New Cornelia, which produced as usual, the former turning out about 5,500,000 lb. of copper in concentrates and the latter about 1,600,000 lb. of cathode copper, as in November. The International smelter continued to handle Miami concentrates and also treated a small tonnage for Superior & Boston and Inspiration. Ray, Chino, also Utah and Nevada Consolidated remained idle.

On the Coast, gold mining in California proceeded uneventfully. Conditions were fairly normal at Grass Valley. The only copper mining was in Plumas County where the Engels company ran as usual. In Oregon, Washington and British Columbia the situation was quiet, various small operations being under way. In general in the Northwest the outlook for the future was more promising. The Tacoma and Trail smelters ran at about half capacity. A freight reduction of $2 per ton on bullion shipped to Eastern points, effective Jan. 5, was announced.

In northern Idaho the situation was little changed. The output of the Federal, Hecla, and Bunker Hill & Sullivan companies was practically normal and about the same as in November. About 2,000 were employed at the three producing mines and the Bunker Hill smelter and 500 more on the smaller mining and development operations. There were practically no unemployed laborers. The Callahan, Tamarack & Custer and the Hercules were inactive, indications, however, pointing to early resumption by Tamarack and the Hercules.

The situation in Nevada was fairly satisfactory. Heavy storms retarded prospecting and small development operations in remote districts. Tonopah's output was approximately $600,000. Tonopah-Divide's production was unchanged. Developments at Royston and Horn Silver were encouraging. The development and construction work at Virginia City and American Flat progressed.

In Utah, Park City shipped 9,263 tons of ore and concentrates in the first four weeks against 8,330 in November, this being about 1,000 tons above normal. Bingham's output was 15,000 to 16,000 tons of milling lead ore and fluxing iron sulphide ore. Tintic's four weeks' production was 30,352 tons compared with 33,021 in November. Midvale ran three lead furnaces (two in November) and one on matte, Murray three lead furnaces, and Garfield two reverberatories and one blast furnace largely on siliceous silver ores.

Greater confidence in the future was apparent in Colorado. Compared with a year ago the labor situation was greatly improved and the cost of supplies appreciably reduced. The Colorado Fuel & Iron Co. announced that it would increase its operations at the Pueblo steel mills Jan. 1, giving employment there to 2,000 more men. Cresson Consolidated, at Cripple Creek, resumed the declaration of dividends. Numerous operations were under way in various districts. The smelting situation was unimproved.

Conditions continued to better in the Black Hills of South Dakota. The Homestake ran at capacity as in November. The one other large operator, the Trojan, recovered $34,000 in gold from 6,600 tons of ore, as compared to $28,000 from 5,800 tons in November. Activity increased among the smaller operators. The labor situation was unchanged.

Refined copper production fell off somewhat in December in the Michigan Lake district, the output being estimated at 7,500,000 lb. or 33 per cent of normal. Throughout the greater part of the month there were eleven furnaces in blast, against fifteen in November. Calumet & Hecla had seven, Copper Range (Michigan) three, and Quincy one.

Production of zinc ore in the Joplin-Miami district increased slightly, ore prices advancing somewhat. Tonnage produced averaged 7,500 per week, according to estimate, and purchases for the month totaled approximately 32,000 tons. Several mines resumed. Few men were idle. High freight rates continued to hamper work.

Operations in the southeast Missouri lead district continued at about two-thirds of capacity as in November, the general tendency being to increase output slowly. High costs of labor, coal and other supplies served to retard expansion of any kind that the prevailing price of lead might tend to bring about. Wages remained about 30 per cent above the pre-war normal.

In Tennessee, the Ducktown Sulphur, Copper & Iron Co.'s smelter and mill ran at normal capacity. Its production is estimated at about 550,000 lb. of copper. The acid plant remained down. The Tennessee Copper & Chemical Corporation was reported to be running one furnace only and to be making acid at less than half capacity. In the Mascot district, the American Zinc Lead & Smelting Co. operated its mines at about 30 per cent of normal, its output all going to make zinc oxide. In general in the state the situation was unchanged from November.

Operations in the Wisconsin zinc-lead district were practically the same as in November. Production was unchanged, being estimated at 2,500 tons crude blende concentrates, 1,000 tons roasted blende concentrates and 250 tons of lead ore, with no curtailment, the stock of blende concentrates in bins being equivalent to 25,000 tons of roasted ore. Five producers were active during the month, also one roaster, one acid plant, and one oxide plant, and one mill was under construction. One mine, the Big Dick, reopened, the men accepting $2.50 wages.

Signs of improvement in the iron ore business appeared on the Lake Superior ranges. Four mines on the Mesabi Range and three on the Menominee resumed, all with their men on full time and paying the 1913 wage scale. This was probably in part due to a desire to relieve the unemployment situation. At properties working part time no cuts were made. It was said that two of the charcoal iron furnaces in the Lake district would be blown in in January. Iron ore prices for 1922 remained unannounced.

Iron-making conditions in Alabama improved steadily over November. Sloss Sheffield's Hattie furnace was blown in ahead of schedule near the end of the month. Several other idle stacks prepared for resumption. Thirteen were in blast compared with eleven last month and five on July 1. Tennessee Coal, Iron & R.R. Co. operated at two-thirds capacity, an increase of 5 per cent over November. Unemployment was less marked. The Quenelda Graphite Corporation was sold to Chicago interests.

In northern Ontario, dividends declared in December, payable in January, totaled $1,120,000. Cessation of work in the bush caused considerable unemployment but in general the labor situation was good. Production continued normal at Cobalt, increased at Kirkland and receded slightly from above normal to normal at Porcupine. At the last-named camp, there was power enough for McIntyre, Hollinger and Dome but not for Davidson, which shut down. The Silver Cliff, at Cobalt, reopened and the new Ontario Kirkland mill, at Kirkland, was started. In the Sudbury district, Mond Nickel continued its limited production; otherwise things were dead, International Nickel selling $500,000 worth of supplies.

THE MARKET REPORT

Daily Prices of Metals

Dec.	Copper, N. Y., net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
29	13.625	32.375	32.875	4.70	4.375@4.40	4.80@4.85
30	13.625	32.625	33.125	4.70	4.375@4.40	4.80@4.85
31	13.50@13.625	32.625	33.125	4.70	4.40	4.80@4.85
Jan. 2	......	......	.....	....	.....	......
3	13.50	32.25	32.75	4.70	4.40	4.80@4.85
4	13.50	32.00	32.375	4.70	4.40	4.80@4.85

*These prices correspond to the following quotations for copper delivered: Dec. 29 and 30, 13.875c.; Dec 31, 13.75@13.875c.; Jan 3 and 4 13.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Dec.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
29	66⅛	67⅛	74	170¾	172¾	24⅛	24⅛	27¼	27¼
30	66⅛	67⅛	74	170½	172½	24⅜	24⅛	27⅛	27¼
31	...	...	...	....	...	...	..	...	...
Jan. 2	...	...	...	....	....	...	...	...	...
3	65⅞	66¾	73½	168⅝	170¼	24⅜	24¼	27⅜	27⅝
4	65⅝	66⅝	73½	167⅝	169⅝	24¼	24¼	27⅜	27½

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Dec.	Sterling Exchange "Checks"	Silver			Jan.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
29	419	99⅝	65	35⅛	2	....	.	..	. .
30	420	99⅝	64¾	34⅜	3	420	99⅝	64⅛	34½
31	420¾	99⅝	64⅝	34⅝	4	420	99⅝	65	34⅞

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Average Metal Prices for December

Copper:

New York Electrolytic	13.555
London Standard	66.706
London Electrolytic	74.525

Lead:

New York	4.700
St. Louis	4.369
London	25.322

Silver:

New York, foreign	65.760
New York, domestic	99.625
London	35.645
Sterling Exchange	414.880

Zinc:

St. Louis	4.837
London	26.900

Tin:

99 per cent	32.106
Straits	32.486
London	169.738

Antimony	4.500
Quicksilver	49.212
Platinum	78.192

Metal Markets

New York, Jan. 4, 1922

The holiday dullness in the metal markets has not yet lifted, and business has been exceedingly quiet.

Copper

The larger producers continue to quote 14c., delivered, and up to yesterday were able to sell an occasional carload at that price. Smaller producers and second-hands in general were asking 13.875c. until Saturday, when, in an effort to make sales, prices in several instances were cut to 13.75c. Even offers at this price failed to close a 1,000-ton inquiry from the American Steel & Wire Co., and the business was no doubt placed at a slight concession. Scarcely any copper has been sold at any price, and most of the inquiries were apparently for inventory purposes.

The business of consumers continues good, particularly that of the wire manufacturers, and the lull in demand is caused only by the large sales of the last three months, which have provided for immediate requirements. Sales during this time have almost certainly exceeded deliveries. Consumers who have no large supplies of copper would apparently do well to provide for the future at the present time, for as soon as general buying is resumed, prices are likely to come up to the level of the large producers, who have shown no tendency to weaken. The resumption by Anaconda has without doubt had a slightly depressing effect on the market, despite the fact that production from that source will likely be small for some months. None of the other producers has yet shown any intimation of resuming operations. Meanwhile, stocks are declining rapidly. Even the December sales were much larger than was expected.

Sales for export continue satisfactory, at 14.125c. c.i.f. European ports.

Lead

The American Smelting & Refining Co. continues its official contract price at 4.70c. Business has been quiet at this level. Some producers are asking slightly more, but are getting it only when a special brand of lead is in demand. Corroding grades command from 10 to 15 points' premium. The St. Louis market is slightly stronger. Lead was obtainable up to Saturday for 4.375c., but on that day prices were generally advanced to 4.40c., and, in fact, some business was done as high as 4.45c. Yesterday and today producers were asking 4.40@4.425c., although large lots might possibly still have been obtainable at 4.375c. from one interest.

Zinc

Prices are generally unchanged, and the market has been extremely quiet in the East, with somewhat more activity around Chicago. January deliveries have brought 4.80@4.825c., with the bulk of the metal going at the lower figure. Most of the zinc sold for February delivery has brought 4.85c. The European situation is distinctly encouraging to American producers. German production is less, and that country is unlikely to export any more of the metal for some time. A small export tax, about 4 per cent, has been leveled. Scandinavian stocks of German zinc are about exhausted, and Belgian production has been disappointing. There is a good possibility of American zinc going abroad in the not distant future.

Tin

Tin was in somewhat greater demand on Thursday and Friday, and prices were advanced to over 35c., but the expected rise in London failed to take place. This was possibly owing to the large shipments from the Straits, which were reported for December, although this condition may be reflected in smaller shipments later. Tin for forward delivery has sold for the same prices as for spot.

Arrivals of tin, in long tons: Total for December, 4,090; Jan. 2d, London, 75; Bremen, 25; China, 5; 3d, Straits, 875.

Gold

Gold in London: Dec. 29th, 98s.; 30th, 98s.; Jan. 3d, 97s. 9d.; 4th, 97s. 9d.

Foreign Exchange

The foreign exchange market is virtually unchanged from the quotations ruling last week. On Tuesday, Jan. 2, francs were quoted at 8.0375c.; lire, 4.25c.; and marks, 0.53625c. New York funds in Montreal again sharply declined and were quoted at only 4 11/16 per cent premium.

Silver

The market continued dull, with China and Indian exchanges quoted lower until the 4th, when an advance in the China rates caused buying by China in the London market, with a consequent advance in price there and in New York.

Mexican Dollars—Dec. 29th, 49¾; 30th, 49¼; 31st, 49¼; Jan. 3d, 48½; 4th, 48¾.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

Aluminum 20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 4.50c.; market dull. W.C.C. brand, 5¾@5⅞c. per lb. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—7½c. per lb. Market stronger and supplies scanty.

Bismuth—$1.50@$1.55 per lb.

Cadmium—Range $1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Cobalt — Metal, $3@$3.25 per lb., black oxide, $2@$2.10 per lb. in bbls.

Iridium—Nominal, $150@$170 per oz.

[1]**Molybdenum Metal** — In rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

Nickel—Standard market, ingot, 41c.; shot, 41c.; electrolytic, 44c. Small tonnages, spot, 35c. Market dead.

Monel Metal—Shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

Osmium—$70 per troy oz. Nominal. $70, Los Angeles, Cal.

Palladium—Nominal, $55@$60 per oz.

Platinum—$80@$84 per oz.

Quicksilver — $51 per 75-lb. flask. San Francisco wires $50. Market active.

[1]**Rhodium**—$150 per troy oz.

[1]**Selenium** — Black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $20 per lb.

[1]**Tungsten Metal**—Wire, $35@$60 per kilogram, according to purity and gage.

Metallic Ores

Chrome Ore—Ore analyzing 40@45 per cent Cr_2O_3, crude, $20@$25 per net ton; ground, $30; analyzing 45@50 per cent Cr_2O_3, $24@$26; ground, $28; f.o.b. Atlantic ports. Quotations are nominal.

Iron Ore—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $6.45; Mesabi bessemer, 55 per cent iron, $6.20; Old Range non-bessemer, 51½ per cent iron, $5.70; Mesabi non-bessemer, 51½ per cent iron, $5.55.

Magnetite Ore—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, $4.85; old bed concentrates, 63 per cent, $5.75; Harmony, cobbed, 63 per cent, $5.75; new bed low phosphorus, 65 per cent, $8.50.

Manganese Ore—23@24c. per unit, seaport; chemical ore, $45@$60 per gross ton, lump; $75 per net ton, powdered. Nominal.

Molybdenum Ore—85 per cent MoS_2, 45@50c. per lb. of contained sulphide, New York. Quotation purely nominal.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots.

[1]**Titanium Ores**—Ilmenite, 52 per cent TiO_2, 1¾@2c. per lb. for ore. Rutile, 95 per cent TiO_2, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore—Scheelite or wolframite, 60 per cent WO_3 and over, per unit of WO_3, $2.50, f.o.b. Atlantic ports. Chinese, as low as $2@$2.25.

Uranium Ore (Carnotite)—Ore containing 1½ per cent U_3O_8 and 5 per cent V_2O_5 sells for $1.50 per lb. of U_3O_8 and 75c. per lb. of V_2O_5; ore containing 2 per cent U_3O_8 and 5 per cent V_2O_5 sells for $2.25 and 75c. per lb., respectively; higher U_3O_8 and V_2O_5 content commands proportionately higher prices.

Vanadium Ore—$1 per lb. of V_2O_5 (guaranteed minimum of 18 per cent V_2O_5), New York. Nominal.

Zircon—Zirconium silicate, f.o.b. Pablo, Fla., 4½@13c. per lb.

[1]**Zirkite**—According to conditions, $70 @$90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

Zinc and Lead Ore Markets

Joplin, Mo., Dec. 31—Zinc blende per ton, high, $31.80; basis 60 per cent zinc, premium, $29; Prime Western, $28; fines and slimes, $26@$24; average settling price, all grades of zinc, $28.33.

Lead, high, $61.10; basis 90 per cent lead, $58; average settling price, all grades of lead, $58.40 per ton. Rumors of $60 basis lacked verification.

Shipments for the week: Blende, 11,455; lead, 1,877 tons. Value, all ores, for the week, $434,190.

Shipments for the year: Blende, 312,217; calamine, 102; lead, 65,243 tons. Value, all ores, for the year, $11,031,440.

The period of readjustment in 1921 meant a loss to the district, compared with 1920 standards, of $25,000,000. Production decreased by 250,000 tons blende, 10,000 tons calamine and 24,000 tons lead concentrates. Compared with pre-war standards the 1921 valuation is almost $2,000,000 below 1914 and over $4,000,000 under 1913, though the tonnage of blende and lead concentrate in 1921 greatly exceeded either of those years.

Platteville, Wis., Dec. 31—Blende, basis 60 per cent zinc, $30. Lead ore, basis 80 per cent lead, $58 per ton. Shipments for the week: Blende, 186 tons. Shipments for the year: Blende, 11,082; lead ore, 1,793 tons. Shipped during the week to separating plants, 695 tons blende.

Non-Metallic Minerals

Asbestos — Crude No. 1, $1,000@ $1,500; No. 2, $600@$850; spinning fibers, $225@$400; magnesia and compressed sheet fibers, $150@$250; shingle stock, $80@$150; paper stock, $45@ $65; cement stock, $15@$25; floats, $7@$10, all per short ton, f.o.b. Thetford, Broughton and Black Lake mines, Quebec, Canada.

Barytes—Crude, $6@$7 per ton, f.o.b. mines. Ground white, $23, f.o.b. mills. Off-color grades, $15@$17, f.o.b. Southern mills. Foreign barytes, f.o.b. New York, $28 per ton.

Bauxite — French bauxite, $8@$10 per metric ton, c.i.f. Atlantic ports. American bauxite, crushed and dried, $8@$10 per gross ton, f.o.b. shipping points; pulverized and dried, $12@$15 per gross ton, depending upon grade; calcined so as to remove most of the combined water, $20 per gross ton, f.o.b. shipping point.

Borax—Granulated, crystals, or powdered in bags, carloads, 5¼c. per lb.; in bbls. 5⅝c.

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[1] Furnished by Foote Mineral Co., Philadelphia, Pa.

Chalk—English, extra light, 5c. Domestic light, 4½c.; heavy, 4c. per lb. all f.o.b. New York.

China Clay (Kaolin)—Crude, $6.50@$8.50; washed, $9@$10; powdered, $12@$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $13@$20, f.o.b. Virginia points. Imported lump, $12@$20, f.o.b. American ports; powdered, $25@$40, f.o.b., quoted at New York.

Emery—Turkish emery, 6c. per lb. Inferior grades, 3½c., f.o.b., from New England points.

Feldspar—No. 1 pottery grade, $6.50@$6.75 per long ton; No. 2 pottery, $5.75; No. 1 soap grade, $7.25@$7.50, f.o.b. cars. Most properties producing No. 2 pottery shut down or producing below capacity owing to bad roads.

Fluorspar — Gravel, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $20@$22.50 per ton, f.o.b. Illinois and Kentucky mines; gravel, $15; lump, $12.50, f.o.b. Lordsburg, N. M. Ground, acid grade, 97 per cent CaF_2, $30, New Mexico.

Fuller's Earth—16 to 30 mesh, $20 per ton; 30 to 60 mesh, $20; 60 to 100 mesh, $17; 100 mesh and over, $15, f.o.b. Pennsylvania points. Market quiet.

Graphite—Ceylon lump, first quality, 5½@6½c. per lb.; chip, 4@5c.; dust, 2½@3¾c.; No. 1 flake, 5@7c.; amorphous crude, $15@$42.50 per ton. All f.o.b. New York.

Gypsum—Plaster of paris in carload lots sells for $4.25 per 250-lb. bbl., alongside dock, New York.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¾ in. size, $1.40@$1.75 per net ton; 1½ in., $1.35@$1.70. Prices for other sizes practically the same. Agricultural limestone, $2.50@$4.50 per net ton, f.o.b. eastern shipping points, depending upon analysis.

Magnesite, Calcined — Crude, $12@$15 per ton. High-grade caustic calcined, lump form, $30@$40 per ton. Plastic calcined, $45@$50 in barrels, carload lots, f.o.b. California points. Atlantic seaboard, $60.

Dead-Burned — $33 per net ton, Chewelah, Wash.; $58@$64, Chester, Pa. Austrian grade, $53.80 per ton, f.o.b., Chester, Pa. (Magnesite brick—See Refractories.)

Mica — India block mica, slightly stained, per lb.: No. 6, 35c.; No. 5, $1.20; No. 4, $2.50@$3; No. 3, $3.50@$4; No. 2, $4.50@$6; No. 1, $5.50@$6.50. Clear block: No. 6, 50c.; No. 5, $1.75; No. 4, $3.25; No. 3, $5; No. 2, $6.50; No. 1, $8; A1, $6.50@$8.50; extra large, $25; ground, wallpaper grade, $90@$160 per ton (depending upon quantity); ground roofing mica, $25@$70, all f.o.b. New York.

[1]Monazite — Minimum of 6 per cent thorium oxide, $30 per unit, duty paid.

Phosphate Rock—Per long ton, Florida ports: 77 per cent tricalcium phosphate, $11; 75 per cent, $9.50; 75@74 per cent, $9; 70 per cent, $6.25; 68 per cent, $5.75; 68@66 per cent, $5.50

Pumice Stone — Imported, lump, 3@40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

Pyrites—Spanish fines, per unit, 12c., c.i.f. Atlantic seaport; furnace size, 13c.; Spanish lump, 13@14c.; domestic fines, f.o.b. mines, Georgia, 11@12c.

Silica — Glass sand, $2.25 per ton; sand-blast material, $2.25, both f.o.b. Indiana points. Amorphous or decomposed variety, soft silica, 250 to 500 mesh, $16@$30 per ton. Ganister, crude, $2.50 per ton, f.o.b. Illinois points. Molding sand, building sand, glass sand, $2.25@$3, f.o.b. Pennsylvania points. Market reported dull.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s. New York.

Talc—20 to 200 mesh, $7@$12 per ton, f.o.b. Vermont; $8.25@$13, f.o.b. points in Georgia; 200 mesh, $16@$20, f.o.b. Los Angeles.

Mineral Products

Copper Sulphate — Large crystals, 5.65c.; small crystals, 5.55c. per lb. f.o.b. New York.

Potassium Sulphate — Powder, domestic, 90c.@$1 per unit, basis 90 per cent, f.o.b. New York.

Sodium Nitrate—$2.30 per cwt. ex vessel, Atlantic ports.

Sodium Sulphate—For 95 per cent material, $12.50 per ton, f.o.b. in bulk, Western mines, spot and six months' contract; $20@$22 per ton, New York.

Ferro-Alloys

Ferrotitanium—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrocerium—Per lb., $12@$15.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 12c. per lb. of chromium contained; 4 to 6 per cent carbon, 13c., f.o.b. works.

Ferromanganese—Domestic 76 to 80 per cent, $58@$60, f.o.b. furnace; resale, $90, delivered; English and German, $54@$58, c.i.f. Atlantic seaport. Spiegeleisen, 18@20 per cent, $25@$27 per gross ton, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, $2.25 per lb. of contained metal, f.o.b. works. Imported material, $1.70@$2.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, $38@$40; 50 per cent, $57@$59; 75 per cent, $120@$125.

Ferrotungsten—Domestic, 70 to 80 per cent W, 40@45c. per lb. of contained tungsten, f.o.b. works. Foreign, 50c., duty paid, f.o.b. Atlantic ports.

Ferro-uranium—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

Ferrovanadium—$4.25@$4.50 per lb. of V contained, according to analyses and quantity.

Metal Products

Copper Sheets—Current New York list price, 21.25c. per lb.; wire, 15@15.25c.

Lead Sheets—Full lead sheets, 7¾c.; cut lead sheets, 8c. in quantity, mill lots.

Nickel Silver—29.50c. per lb. for 18 per cent nickel. Grade "A" sheets.

Yellow Metal — Dimension sheets, 17.75c.; sheathing, 16.25c.; rods, ½ to 3 in., 14.75c.

Zinc Sheets—$8.50 per 100 lb., less 8 per cent on carload lots, f.o.b. works.

Refractories

Bauxite Brick—56 per cent alumina, $50 per ton; 76 per cent, $90@$95 f.o.b. works.

Chrome Brick—$43@$45 per net ton.

Chrome Cement — 40@45 per cent Cr_2O_3, $30@$32 per net ton, and $31 in sacks, carload lots, f.o.b. eastern shipping points.

Firebrick—First quality, 9-in. shapes, $28 per 1,000, Pennsylvania, Ohio and Kentucky.

Magnesite Brick—9-in. straights, $52@$55 per net ton, f.o.b. works.

Silica Brick—9-in., per 1,000, $28@$40 in carload lots, f.o.b. shipping points.

The Iron Trade

Pittsburgh, Jan. 2, 1922.

The steel market has been inactive the past week. Fundamental conditions have undergone no material variation in two or three months, and the market is not likely soon to change. In the past year the average decline in finished steel prices was approximately $22 per net ton. Under promise of a heavier operation, involving slightly lower costs, producers might shade present prices a trifle.

A few mills are closed temporarily. Production of ingots is at the rate of about 23,000,000 tons a year, equal to 44 per cent of capacity, which has increased by one-half since 1914 and has doubled since 1910.

Pig Iron—The market has continued extremely quiet. Bessemer remains quotable at $20, Valley, and foundry is $19.50. Basic iron, which has been quotable nominally at $19, is now quoted by merchant furnaces at $18.25, the merchant producers accepting as governing, a sale made two or three weeks ago by a steel works at this figure.

Coke

Connellsville—Furnace, $3.25@$3.50; foundry, $4.25@$4.50.

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[1]Foote Mineral Co., Philadelphia, Pa.

COMPANY REPORTS

El Oro Declared Dividend and Bonus

A report of operations of the El Oro Mining & Railway Co., Ltd., for the year ended June 30, 1921, states that the net profit earned during this period was £74,383 3s. 6d. Out of this sum the directors declared dividend No. 31, of 5 per cent, or 1s. per share, tax free, for the year 1920 and 1921, which absorbed £57,375 0s. 0d., paid on Nov. 19, 1921.

During the year the directors decided to distribute a similar sum in a bonus dividend, No. 30, payable in shares of La Compania de Inversiones del Oro, S. A., equivalent in capital value to 1s. per share held by the shareholders of the El Oro Mining & Railway Co. This distribution has not yet been effected.

General and economic conditions in Mexico in the past year have shown improvement. In consequence, and in conjunction with further economies at the mine, due to extremely watchful management, working costs have been reduced by, roundly, $1[1] per ton. This has rendered it possible to maintain the average rate of profit per ton of ore, and at the same time to bring under treatment ore of correspondingly lower grade, which, under the conditions prevailing in the year preceding, would not have yielded a profit. The general result was that 383,043 tons of ore, having a gross value of $7.63 per ton, as treated in the reduction works, (compared with $8.77 for the previous year) produced bullion which realized $2,545,446, or $6.64 (compared with $7.61 for the pevious year) per ton, resulting in a net profit of $357,010, or £95,202 13s. 5d.

Profit and loss account follows:

Debit:	£	s.	d.
Mining expenditures	583,305	11	6
Railway department expenditure	44,563	1	0
London expenses	2,546	3	2
Directors' fees	2,310	2	9
Depreciation of plant, machinery and investments	45,000	0	0
Provision for income tax and corporation profits tax	56,800	0	0
Balance carried to balance sheet	74,383	3	6
Total	£808,908	1	11
Credit:	£	s.	d.
Bullion recovered	678,508	4	11
Railway department receipts	98,836	14	1
Interest and dividends	31,124	3	3
Sundry receipts	438	19	8
Total	£808,908	1	11

Balance at hand June 30, 1920, was £172,273 7s. 3d., less two dividends of £57,375 each plus profit for the year of £74,383 3s. 6d., which gives a balance on June 30, 1921, of £131,906 10s. 9d.

Costs per ton were: Mining, $2.38; development, $0.79; milling, $0.24; cyaniding $1.06; general expense, $0.32; taxes, $0.81; total, $5.66.

Ore reserves total 282,124 tons, estimated to contain $7.96 gold and 2.11 oz. silver per ton.

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[1] American gold dollar. Exchange rate taken at $3.75 to £1.

Tonopah Belmont Development Co.

A condensed statement of operations of Tonopah Belmont Development Co. for the quarter ended Sept. 30, 1921, follows:

[illegible]	$489,822 75
Mining, milling and [illegible] expenses	357,459 50
Net earnings for the quarter [illegible]	$132,363 25
Miscellaneous income	1,482 43
Total net income for three months ended Sept. 30, 1921	$133,845 68
Available [illegible], Nov. 30, 1921, were:	
Due from [illegible]	$291,649 57
Due from [illegible]	56,168 98
Cash in [illegible]	216,179 21
	$563,997.76

The net earnings for the quarter ended Sept. 30, 1921, of the Belmont Surf Inlet Mines, Ltd., of which this company owns 80 per cent, were $11,144.47.

Chile Copper Co. Shows Loss for Third Quarter

A report showing the results of the operations of Chile Exploration Co. for the third quarter of the year 1921 states copper output was 12,023,177 lb., compared with 12,001,873 lb., for the preceding quarter.

The cost of copper produced during the quarter was 11.405c. per lb., including selling and delivery expense, but excluding depreciation and Federal taxes and with no credit for miscellaneous income, compared with 11.971c. per lb. for the previous quarter.

The financial statement of the Chile Copper Co., and Chile Exploration Co. combined, (earnings being based on copper actually delivered) compares as follows:

	Third Quarter 1921	Second Quarter 1921
Pounds copper delivered	17,300,055	13,878,412
Net profit on copper delivered	$429,652.07	$291,667.31
Miscellaneous income	44,594.24	8,827.58
Interest on call loans and bank balances	86,055.87	122,883.19
Total income	$560,302.18	$423,378.08
Depreciation	$789,402.19	$697,249.54
Amortized discount on fifteen-year 6 per cent convertible bonds	35,000.00	35,000.00
Accrued bond interest of Chile Copper Co	787,500.00	787,500.00
Expenses of Chile Copper Co	8,280.00	13,661.92
Total charges	$1,620,182.19	$1,533,411.46
Balance undivided profits for quarter, both companies	(a)$1,059,880.01	(a)$1,110,033.38

(a) Loss.

It will be noted that of the above loss of $1,059,880.01, the sum of $789,402.19 is for depreciation, which is a book entry and is computed on a time basis, regardless of production or sale.

The companies had on Dec. 1, $8,586,000, representing cash on hand and marketable securities, after setting aside the amount required to complete payment of purchase price of the two tank ships mentioned in the last annual report.

Mining Dividends for December, 1921

The following dividends were paid by mining and metallurgical companies during December, 1921:

Companies of the United States	Situation	Per Share	Totals
American Smelting & Refining, pfd	U. S.	$.75 Q	$875,000
Calumet & Arizona, c.	Ariz.	0.50 Q	321,260
Federal Mining & Smelting, pfd., s.l.	Idaho	1.00 Q	120,000
Hecla Mining, s.l	Idaho	0.17 Q	170,000
Homestake Mining, g.	S.D.	0.25 M	62,790
Iron Blossom Consolidated, s.c l.	Utah	0.025 I	25,000
National Lead, com.	U. S.	1.50 Q	309,831
National Lead, pfd.	U. S.	1.75 Q	426,433
St. Joseph Lead	Mo.	0.25 Q	352,367
St. Mary's Mineral Land, c.	Mich.	1 00 I	160,000
Texas Gulf Sulphur	Texas	1.00 X	635,000
United Verde Copper	Ariz.	1.50 Q	450,000
Utah Copper	Utah	0.50 Q	812,245
Companies in Canada			
Hollinger Consolidated Gold	Ont.	0.10	492,000

Q, quarterly; M, monthly; I, irregularly; X, includes extra; c, copper; s silver; l, lead; g, gold.

The showing is slightly improved over that of three months ago. Hecla increased its dividend from 10 to 17c. Iron Blossom Consolidated appears for the first time since January, 1920, with the then customary dividend of 2½c. St. Mary's Mineral Land paid its only dividend of the year, $1, half of the 1920 distribution. Texas Gulf Sulphur paid an initial dividend of 50c. with 50c. more as an extra. This company was only recently listed on the New York Stock Exchange, quotations rising from 32⅝ on Dec. 1 to 42⅝ on Dec. 28. Two of the Hollinger payments, which are made every four weeks, came in December, on the second and thirty-first. The 2½c. dividend of the Rochester Silver Corporation is missing from the list, but will be paid in January.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York 1920	New York 1921	London 1920	London 1921	Sterling Exchange 1920	Sterling Exchange 1921
January	132.827	65.950	79 846	39 985	367 082	372 650
February	131 295	59.233	85 005	34 745	337 466	385 932
March	125 551	56.023	74 194	32 479	370 870	389 806
April	119.779	59.337	68.848	34 250	392 438	391 784
May	102.585	59.810	60.010	34 165	383 360	396 580
June	90.957	58.510	51 096	34 971	393 663	377 236
July	91.971	60 260	53.736	37 481	385 538	362 565
August	96 168	61 597	59.875	38 096	360 404	364 505
September	93 675	66 160	59.476	40 082	350 370	371 725
October	83.480	70 970	54 197	41 442	346 460	386 315
November	77.734	68.234	50 952	38 750	342 333	396 315
December	64.774	65.760	41.845	35.645	348.101	414 880
Year	100.900	62 654	61 590	36 841	364 840	384 191

New York quotations cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York Electrolytic 1920	New York Electrolytic 1921	London Standard 1920	London Standard 1921	London Electrolytic 1920	London Electrolytic 1921
January	18.918	12.597	118.095	70 964	123 238	79 119
February	18.569	12.556	120.188	70.925	126.950	75.925
March	18.331	11 976	109.533	67.565	118 348	71.190
April	18.660	12.438	103.025	69.381	111.500	71.786
May	18.484	12.742	96.750	73.196	109.200	74.298
June	18.065	12.697	87.864	71.852	101.909	75.682
July	18.576	12.170	90.148	71.155	106.455	75 286
August	18.346	11 634	93.935	68 614	111 143	72 705
September	18.144	11 948	96.381	67 977	111 905	72 295
October	15.934	12.673	93.327	67.327	104.905	73.476
November	14.257	13.035	84.807	66.614	94.614	74.386
December	13.188	13 555	75.702	66 706	85 905	74 525
Year	17.456	12 502	97.480	69 356	108 839	74 223

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York 1920	New York 1921	St. Louis 1920	St. Louis 1921	London 1920	London 1921
January	8.561	4.821	8.300	4.747	47.095	23.387
February	8.814	4.373	8.601	4.228	50.256	20.650
March	9.145	4 084	8.894	4.000	46.054	18 911
April	8.902	4.356	8.618	4 272	39 225	20 589
May	8.576	4.952	8.352	4 784	38 488	23 399
June	8.323	4.485	8.169	4.293	34.330	22.563
July	8.338	4.410	8.283	4.260	34.960	23.399
August	8.687	4 382	8.725	4 217	36.304	23 489
September	8.177	4.600	8.160	4.392	35.452	23.148
October	7.070	4.690	7.018	4.439	35 238	23 679
November	6.159	4.683	6.127	4.356	32.489	24.483
December	4.727	4.700	4.717	4 369	24.089	25 322
Year	7.957	4.545	7.830	4 363	37 832	22.752

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York 99% 1920	New York 99% 1921	New York Straits 1920	New York Straits 1921	London 1920	London 1921
January	61.596	31.470	......	36.000	376.512	198.464
February	58.466	28.534	59.932	32.142	395.750	166.250
March	61.037	27.296	61.926	28.806	369.489	156 024
April	61.120	28.990	62.115	30 404	345 450	163 905
May	53.230	31.431	55.100	32 500	294 813	177 411
June	46.125	28.514	48.327	29.423	250.614	167.506
July	45.798	26.755	49.154	27.655	261.886	164.530
August	43.856	25 662	47.620	26 301	274 048	155 318
September	41.940	26 280	44.465	26 680	270 120	156 750
October	39.310	27.278	40.555	27.655	258.190	156.380
November	35.667	28.592	36.854	28.935	241.080	158.898
December	31.135	32 106	34.058	32 486	212 440	169 738
Year	48 273	28 576	49 101	29 916	295 866	165 265

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis 1920	St. Louis 1921	London 1920	London 1921
January	9.133	5 413	58.643	25.262
February	8.708	4.928	61.338	24.850
March	8.531	4.737	53.467	25.077
April	8.184	4.747	47.388	25.530
May	7.588	4.848	45.088	26.923
June	7.465	4.421	41.193	26.750
July	7 720	4 239	41.886	26 262
August	7 835	4 186	41 220	25 068
September	7.661	4 235	39.690	25 256
October	7.150	4.605	39.756	26.315
November	6.247	4 665	35.028	25.949
December	5.824	4.837	27.762	26 900
Year	7.671	4.655	44 372	25.845

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony ( ) New York 1920	Antimony ( ) New York 1921	Quicksilver ( ) New York 1920	Quicksilver ( ) New York 1921	Platinum ( ) New York 1920	Platinum ( ) New York 1921
January	10 577	5 258	90 192	48 440	154 23	73 400
February	11 588	5 250	84 432	49 545	151 59	70 227
March	11 056	5 282	92 611	46 796	138 56	72 465
April	10.500	5 137	102 192	45 423	127 04	73 404
May	9 655	5 250	89 560	47 000	97 50	73 740
June	8 289	5 087	90 154	46 846	85 19	74 942
July	7.500	4.735	90.333	44.950	83.94	70.440
August	7 177	4 597	83 806	45 028	111 44	73 222
September	7 113	4 564	75 000	42 660	115 20	75 960
October	6 723	5 085	67 200	39 840	101 70	81 800
November	6 109	4 734	58 417	39 804	84 75	82 609
December	5 534	4 500	49 577	49 212	79 62	78 192
Year	8 485	4 957	81 123	45 462	110 90	75 033

(a) Antimony quotations in cents per lb for ordinary brands. ( ) Quicksilver in dollars per flask. ( ) Platinum in dollars per ounce

Pig Iron, Pittsburgh

	Bessemer 1920	Bessemer 1921	Basic 1920	Basic 1921	No. 2 Foundry 1920	No. 2 Foundry 1921
January	$40 47	33 96	$39 88	31 96	$39 86	33 88
February	42.95	28.96	42.61	26.96	43.40	30.25
March	43.40	28 16	42 90	26 46	43 40	27 85
April	43.72	26.96	44.22	24.46	43.90	26.77
May	44.00	26.21	44.88	23.84	45.56	25.56
June	44.89	24.96	45.41	22.66	46.40	24.38
July	47.21	22.84	47.42	20.76	46.56	22.36
August	48.90	21.96	49.88	20.29	49.35	21.53
September	50.46	21 96	50 46	21 21	51.96	22 82
October	49.21	21 96	44.38	20 96	48.58	22.96
November	41.26	21 96	39 20	20 96	42.61	22 74
December	36.96	21 96	34.90	20 65	37.73	21 96
Year	44.45	25 15	43 85	23 43	44 93	25 26

In dollars per long ton

Monthly Crude Copper Production

	1921 August	1921 September	1921 October	1921 November
Alaska shipments	4,407,434	3,709,844	6,160,847	4,841,506
Arizona Copper	(a)	(a)	(a)	(a)
Calumet & Arizona	(a)	(a)	(a)	(a)
Con. Ariz. Smelting	(a)	(a)	(a)	(a)
Inspiration	(a)	(a)	(a)	(a)
Magma	(a)	(a)	(a)	(a)
Miami	4,281,000	4,268,000	5,084,000	4,514,000
New Cornelia	1,511,964	1,527,493	1,536,725	1,605,936
Old Dominion	(a)	(a)	(a)	(a)
Phelps Dodge	(a)	(a)	(a)	(a)
Shattuck Arizona	(a)	(a)	(a)	(a)
Ray	(a)	(a)	(a)	(a)
United Verde	(a)	(a)	(a)	(a)
United Verde Extension	(a)	(a)	(a)	(a)
Calumet & Hecla	(a)	(a)	(a)	(a)
Other Lake Superior	4,250,000	4,250,000	4,250,000	5,500,000
Anaconda	(a)	(a)	(a)	(a)
East Butte	1,278,000	949,980	1,000,000	750,000
Nevada Cons.	(a)	(a)	(a)	(a)
Chino	(a)	(a)	(a)	(a)
Utah Copper	(a)	(a)	(a)	(a)
Others, estimated	7,520,000	9,150,000	5,200,000	[illegible]
Total United States	23,248,398	23,855,317	23,231,572	28,341,442
Imports: Ore and concentrates, matte, etc	10,888,426	6,268,635	8,445,551	7,297,583
Imports of blister, unrefined	12,574,740	8,614,851	23,360,893	10,561,454
Imports of refined, etc	662,885	10,553,792	761,125	[illegible]
Grand total	47,374,449	49,292,595	55,799,141	49,339,623
Granby Cons	2,485,704	2,720,761	2,593,250	2,365,017
Boleo	770,096	771,305	1,041,863	976,815
Cananea	(a)	(a)	(a)	(a)
Phelps Dodge Mexican	(a)	(a)	(a)	(a)
Cerro de Pasco	4,630,000	4,594,000	5,330,000	5,618,000
Chile	4,000,000	4,000,000	4,000,000	4,000,000
Katanga	6,509,160	6,136,515	6,189,435	5,984,370
Backus & Johnston	720,000	350,000	198,000	[illegible]
Hampden Cloncurry	(a)	(a)	(a)	
Mount Lyell	940,000	1,204,000	1,220,000	...
Mount Morgan	(a)	(a)	(a)	
Cons. M. & S. of Canada	209,090	261,855	156,940	[illegible]
Falcon Mines	540,880	511,280	550,710	518,600
Furukawa	2,580,473	2,744,371	2,541,508	
Sumitomo	1,673,601	1,674,865	1,444,316	[illegible]

(a) No copper produced during this month.

Comparative Annual Copper Production

	1919	1920	1921
January	135,733,511	121,903,744	90,596,597
February	111,649,512	117,450,000	86,682,941
March	102,040,460	120,309,316	91,046,345
April	98,808,998	116,078,871	46,946,523
May	92,652,975	114,964,207	25,310,511
June	95,856,570	116,107,856	24,623,693
July	100,369,247	109,729,610	22,033,739
August	107,994,040	112,460,254	23,248,398
September	108,703,075	104,9195,62	23,855,316
October	115,143,143	105,231,571	23,231,572
November	117,289,735	106,700,178	28,341,442
December	102,997,633	95,709,009	......

MINING STOCKS

Week Ended December 31, 1921

Stock	Exch.	High	Low	Last	Last Div.	
COPPER						
Ahmeek	Boston	62	60	62	Sept. '20, Q	$0.50
Alaska-Br. Col. new	N. Y. Curb	2⅛	2⅛	2⅛		
Allouez	Boston	24	23	24	Mar. '19	1.00
Anaconda	New York	50⅛	49¾	49⅞	Nov. '20, Q	1.00
Arcadian Consol.	Boston	3	2	3		
Ariz. Com'l.	Boston	9	8½	9	Oct. '18, Q	.50
Big Ledge	N. Y. Curb	*28	*25	*25	...	
Bingham Mines	Boston	†13½	†12½	13	Sept. '19, Q	.25
Calumet & Arizona	Boston	59	58	59	Dec. '21, Q	.50
Calumet & Hecla	Boston	280	270	270	June '20, Q	5.00
Canada Copper	N. Y. Curb	*38	*30	*38		
Centennial	Boston	10	9½	9½	Dec. '18, SA	1.00
Cerro de Pasco	New York	35½	34¼	34	Mar. '21, Q	.50
Chile Copper	New York	16¼	15½	15¾		
Chino	New York	28⅜	27	28	Sept. '20, Q	.37½
Columbus Rexall	Salt Lake	†*12	†*11½	†*11½		
Con. Arizona	N. Y. Curb	*4	*3	*3	Dec. '18, Q	.05
Con. Copper Mines	N. Y. Curb	1⅛	1⅛	1 3/16		
Copper Range	Boston	39¾	38½	38½	Sept. '20, Q	.50
Crystal Copper	Boston Curb	*65	*55	*64		
Davis-Daly	Boston	7	6½	6½	Mar. '20, Q	.25
East Butte	Boston	11¼	10¼	11	Dec. '19, A	.50
First National	Boston Curb	*80	*75	*75	Feb. '19, SA	.15
Franklin	Boston	1⅛	1⅛	1⅛		
Gadsden Copper	Boston Curb	*50	*50	*50		
Granby Consol.	New York	29	28½	28½	May '19, Q	1.25
Greene Cananea	New York	28½	27½	27¾	Nov. '20, Q	.50
Hancock	Boston	2½	2	2		
Howe Sound	N. Y. Curb	2⅜	2⅜	2⅜	Jan. '21, Q	.05
Inspiration Consol.	New York	41¼	40	40¼	Oct. '20, Q	1.00
Iron Cap	Boston Curb	7½	7½	7½	Sept. '20, K	.25
Isle Royale	Boston	24½	23	23½	Sept. '19, SA	.50
Kennecott	New York	27¾	26½	26⅞	Dec. '20, Q	.50
Keweenaw	Boston	1¼	1	1½		
Lake Copper	Boston	2¼	2	2¼		
La Salle	Boston	2	1½	1¾		
Magma Chief	N. Y. Curb	..	..	*8		
Magma Copper	N. Y. Curb	28	25⅞	28	Jan. '19, Q	.50
Majestic	Boston Curb	*4	*2	*4		
Mason Valley	Boston	1½	1⅜	1½		
Mass Consolidated	Boston	3	2½	2½	Nov. '17, Q	1.00
Miami Copper	New York	27¼	26¼	27⅛	Nov. '21, Q	.50
Michigan	Boston	2	1½	2		
Mohawk	Boston	57½	54	54	Nov. '20, Q	1.00
Mother Lode Coa.	N. Y. Curb	7⅞	5½	7⅞		
Nevada Consol.	New York	15¼	14½	14⅝	Sept. '20, Q	.25
New Cornelia	Boston	18½	17½	17½	Aug. '20, K	.25
North Butte	Boston	13½	12½	12	Oct. '18, Q	.25
North Lake	Boston	†*40	†20	*24		
Ohio Copper	N. Y. Curb	*11	*8	*8		
Old Dominion	Boston	25	23	23	Dec. '18, Q	1.00
Osceola	Boston	33¼	32	32	June '20, Q	.50
Phelps Dodge	Open Mar.	†185	†175	....	Oct. '21, Q	1.00
Quincy	Boston	45	43	43	Mar. '20, Q	1.00
Ray Consolidated	New York	15⅝	14⅝	15⅜	Dec. '20, Q	.25
Ray Hercules	N. Y. Curb	*15	*12	*12		
St. Mary's Min. Ld.	Boston	45	43	43	Dec. '21, K	1.00
Seneca Copper	Boston			24½		
Shannon	Boston	1¼	1	1	Nov. '17, Q	.25
Shattuck Arizona	New York	8	8	8½	Jan. '20, Q	.25
South Lake	Boston	†1	†*55	*60		
Superior & Boston	Boston	1¼	1¼	1½		
Tenn. C. & C. cfs.	New York	10½	10	10	May '18, I	1.00
Tuolumne	Boston	*67	*60	*65	May '13	.10
United Verde Ex.	Boston Curb	30	28¾	29½	Nov. 21, Q	.25
Utah Consol.	Boston	2	1¾	1¾	Sept. '18,	.25
Utah Copper	New York	65¼	62¾	63¾	Dec. '21, Q	.50
Utah Metal & T.	Boston	1¼	1¼	1	Dec. '17,	.30
Victoria	Boston	†1½	†1½	1½		
Winona	Boston	*35	*35	*35		
Wolverine	Boston	11½	11	11		
NICKEL-COPPER						
International Nickel	New York	12¼	11⅜	12	Mar. '19,	.50
Internat. Nickel, pf.	New York	67½	60	65	Nov. '21, Q	1.50
LEAD						
National Lead	New York	87	83¼	87	Dec. '21, Q	1.50
National Lead, pfd.	New York	108	107½	108	Dec. '21, Q	1.75
St. Joseph Lead	New York	13½	12¾	12⅞	Dec. '21, Q	.25
QUICKSILVER						
New Idria	Boston	1¼	*50	1		
ZINC						
Am. Z. L. & S.	New York	14½	12¼	13½	May '20	1.00
Am. Z. L. & S. pfd.	New York	38	36	36	Nov. '20, Q	1.50
Butte C. & Z.	New York	6	5¼	5½	June '18,	.50
Butte & Superior	New York	22½	20¼	22	Sept. '20	1.25
Callahan Z.-L.	New York	6½	5⅜	5⅞	Dec. '20, Q	.50
New Jersey Zn.	N. Y. Curb	125	124½	125	Nov. '21, Q	2.00
Yellow Pine	Los Angeles	*48	*45	*47	Sept. '20, Q	.03
GOLD						
Alaska Gold	New York	⅜	¼	⅜		
Alaska Juneau	New York	¾	⅝	¾		
Carson Hill	New York	11½	11	11½		
Cresson Consol. G.	N. Y. Curb	2⅞	2 11/16	2¾	June '20, Q	$0.10
Dome Extension	Toronto	*69	*69	*69		
Dome Mines	New York	19	18⅞	19	Oct. '21, Q	.25
Florence Goldfield	N.Y. Curb	*30	*26	*26		
Golden Cycle	Colo. Springs	*70	*66½	*62½	June '21, Q	.02
Goldfield Consol.	N. Y. Curb	*4	*3	*4	Dec. '19,	.05
Hollinger Consol.	Toronto	7.75	7.70	7.72	Dec. '21, 4 wks.	.05
Homestake Mining	New York	55	53¾	55	Dec. '21, M	.25
Kirkland Lake	Toronto	*30	*27	*30		
Lake Shore	Toronto	1.34	1.25	1.34	Nov. '21, K	.02
McIntyre-Porcupine	Toronto	2.12	2.00	2.12	Sept. '21, K	.05
Porcupine Crown	Toronto	*13½	*10½	*11½	July '17,	.03
Porcupine V. N. T.	Toronto	*18	*17½	*17¾		
Portland	Colo. Springs	*40	*40	*40	Oct. '20, Q	.01
Schumacher	Toronto	*31	*30	*31		
Silver Pick	N. Y. Curb	....	....	*50		
Teck Hughes	Toronto	*15½	*14¾	*15½		
Tom Reed	Los Angeles	*40	*36	*38	Dec. '19,	.02
United Eastern	N. Y. Curb	2 7/16	2 5/16	2 7/16	Oct. '21, Q	.15
Vindicator Consol.	Colo. Springs	*21	*19½	*19½	Jan. '20, Q	.01
White Caps Mining	N. Y. Curb	*5	*3	*5		
Yukon Gold	N. Y. Curb	1 3/16	1	1 1/16	June '18,	.02½
SILVER						
Batopilas Mining	New York	½	½	½	Dec. '07, I	.12½
Beaver Consol.	Toronto	*20	*16¾	*18	May '20, K	.03
Coniagas	Toronto	1.50	1.30	1.50	May '21, Q	.12½
Crown Reserve	Toronto	*10	*8	*8	Jan. '17,	.05
Kerr Lake	N. Y. Curb	3½	3⅜	3⅜	Oct. '21, Q	.12½
La Rose	Toronto	*34½	*32½	*34	Apr. '18,	.02
McKinley-Dar.-Sav.	Toronto	*14½	*14	*14	Oct. '20, Q	.03
Mining Corp. Can.	Toronto	1.15	1.00	1.15	Sept. '20, Q	.12½
Nipissing	N. Y. Curb	7	6½	6⅞	Oct. '21, Q	.03
Ontario Silver	New York	4½	4	4	Jan. '19, Q	.50
Ophir Silver	N. Y. Curb	....	....	*12	Jan. '12,	.10
Temiskaming	Toronto	*26	*25	*25	Jan. '20, K	.04
Trethewey	Toronto	*8	*5½	*5¾	Jan. '19,	.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*91	*85	*87		
Cash Boy	N. Y. Curb	*5	*5	*5		
Dolores Esperanza	N. Y. Curb	1	*75	1		
El Salvador	N. Y. Curb	*6	*3	*4		
Jim Butler	N. Y. Curb	*6	*6	*6	Aug. '18, SA	.07
Jumbo Extension	N. Y. Curb	*3	*3	*3	June '16,	.05
Louisiana Con.	N. Y. Curb	....	....	½		
MacNamara M. & M.	N. Y. Curb	*10	*4	*8	May '10,	.02½
Tonopah-Belmont	N. Y. Curb	1½	1⅜	1⅜	Apr. '21, Q	.05
Tonopah-Divide	N. Y. Curb	*67	*60	*65		
Tonopah-Extension	N. Y. Curb	1⅜	1 5/16	1 5/16	Oct. '21, Q	.05
Tonopah Mining	N. Y. Curb	1½	1⅜	1⅜	Oct. '21, SA	.05
West End Consol.	N. Y. Curb	*80	*75	*75	Dec. '19, SA	.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*6	*5	*6	Jan. '21, M	.01
Cardiff M. & M.	Salt Lake	†*92	†*85	*92	Dec. '20,	.15
Chief Consol.	Boston Curb	3⅜	3	3	Aug. '21, Q	.05
Consol. M. & S.	Montreal	18½	18½	18½	Oct. '20, Q	.62½
Daly Mining	Salt Lake	†3.00	†1.00	....	July '20, Q	.10
Daly-West	Boston	†3⅜	†1¾	2	Dec. '20, Q	.25
Eagle & Blue Bell	Boston Curb	2½	2½	2½	Apr. '21, K	.05
Electric Point	Spokane	*4	*4	*4	May '20, SA	.03
Federal M. & S.	New York	....	....	10	Jan. '09,	1.50
Federal M. & S., pfd	New York	39½	38⅝	39	Dec. '21, Q	1.00
Florence Silver	Spokane	*19½	*19½	*19½	Apr. '19,	.01½
Grand Central	Salt Lake	†*45	†*41	*41	Jan. '21, K	.01
Hecla Mining	N. Y. Curb	4¾	4¾	4¾	Dec. '21, Q	.17
Iron Blossom Con.	N. Y. Curb	*53	*28	*30	Dec. '21, Q	.02½
Judge M. & S.	Salt Lake	†3.00	†2.00	2.50	Sept. '20, Q	.12½
Marsh Mines	N. Y. Curb	*4	*4	*4	June '21, I	.02
Prince Consol.	Salt Lake	*7½	*7½	*7½	Nov. '17,	.02½
Rambler-Cariboo	Spokane	*4	*4	*4	Feb. '19,	.01
Rex Consol.	N. Y. Curb	*8	*7	*7		
South Hecla	Salt Lake		†*12½	....	Sept. '19, K	.15
Standard Silver-Ld.	N. Y. Curb	*10	*10	*10	Oct. '17,	.05
Stewart Mining	N. Y. Curb	*2	*1	*1	Dec. '15	.05
Tamarack-Custer	Spokane	2.27	2.20	2.22	Jan. '21 K	.04
Tintic Standard	Salt Lake	1.87½	1.80	1.80	July '21, Q	.05
Utah Apex	Boston	3	2¾	3	Nov. '20, K	.25
Wilbert Mining	N. Y. Curb	*1	*1	*1	Nov. '17,	.01
VANADIUM						
Vanadium Corp.	New York	32⅞	31	31⅞	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	50	50	50	Oct. '21, Q	1.50
Asbestos Corp., pfd.	Montreal	....	....	77	Oct. '21, Q	1.75
SULPHUR						
Freeport, Texas	New York	14½	13½	13⅞	Nov. '19, Q	1.00
Texas Gulf	New York	42	39	41	Dec. '21, Q	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	46⅞	44	45¼	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf	New York	87½	86½	86¾	Dec. '21, Q	1.75
Am. Sm. pf. A	New York	..	..	87½	Oct. '21, Q	1.50
U. S. Sm. R. & M.	New York	38⅞	36	36	Jan. '21, Q	.50
U. S. Sm. R. & M. pf.	New York	45	44	45	Oct. '21, Q	.87½

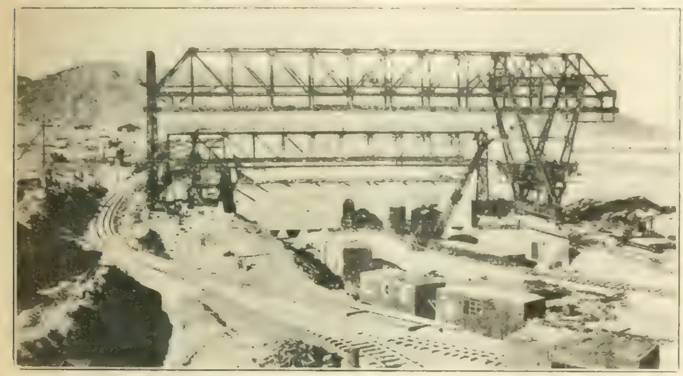
* [illegible] Q, Quarterly. SA, Semi-annually. M, Monthly. [illegible] I, Initial. X, Includes extra.

[illegible] courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce; [illegible] Exchange; The Financial Press, N. Y.

NEW MACHINERY AND INVENTIONS

An Ore Unloading Bridge in Chile

An accompanying illustration shows the ore unloading bridge used by the Chile Exploration Co. at their Chuquicamata plant for unloading leached tailings from three 10,000-ton capacity leaching vats into railroad cars. The bridge is electrically operated and is equipped with a trolley-operated grab bucket of 12 gross tons capacity.



ORE UNLOADING BRIDGE THAT HANDLES 10,000 TONS IN SIXTEEN HOURS

The leaching vats are 150 ft. in length, 110 ft. wide and 20 ft. deep. The runways for the bridge extend along the sides so that the bridge commands the total area of all the vats. The grab bucket deposits the material in hoppers on the main tower of the bridge, from which it flows by gravity into the side-dump railroad cars and is hauled to the tailings dump. It is possible to unload the vats at the rate of 10,000 tons in sixteen hours.

The bridge traverses at a rate of 75 ft. per minute and the motor is equipped with a powerful magnetic solenoid brake capable of locking all of the wheels connected with the driving mechanism to the rail when the bridge is not in motion. The equipment is of Wellman-Seaver-Morgan Co. manufacture.

Novel Use of Flood Light Projector

Recently the Eagle-Picher Lead Co. made extensive improvements at their oxide works at Galena, Kan., and among other things had built a concrete stack 257 ft. in height to carry off fumes from their "bag room." The stack, when put into use, was found to serve its purpose admirably, but an unforeseen difficulty developed, which for a time threatened to materially cut down the efficiency of the plant.

In the process of separating the oxide from the gases, it frequently happens that one or more bags become unfastened from their shackles, thereby permitting the valuable byproduct to escape to and out of the stack. In order to detect such disarrangement of bags, frequent observations of the mouth of the stack are made and if a whitish haze is seen to emerge therefrom, it is evident that something is not right in the bag room. An attendant, protected by gas mask, enters the chamber, makes whatever adjustment may be necessary and then returns.

During daylight hours, it is a simple matter to detect the escape of oxide, but at night suitable illumination must be provided to show that all is well or otherwise in the bag room. In building the stack no provision had been made for such lighting, and owing to the height of the structure it was deemed impracticable to equip and maintain a scheme of illumination. After vainly trying out various schemes, which proved unsuccessful or unsatisfactory, the management appealed to the Empire District Electric Co. at Joplin, from whose lines the plant is supplied with power and light, and asked their engineers to recommend a plan to illuminate the mouth of the stack.

The logical method of providing the desired illumination was found to be a beam of light directed to the top of the stack from some vantage point in its vicinity. For various reasons, the management would not consent to having the source of light placed on the building in which the bag room is located and it was necessary to mount a projector on a low storage building about 150 ft. from the base of the stack. This necessitated a "throw" of about 325 ft., requiring a highly efficient reflector of concentrated beam. After studying the characteristics of several projectors, it was decided to specify a National X-Ray No. 60, equipped with reflector No. 840, for use with 500 watt flood lamp.

This unit was ordered and installed as directed and was found to give entirely adequate intensity at the tip of the stack and the lead company management expressed themselves as very well pleased with the result.

Fines Are Rapidly Removed in New Coal Pulverizing Machine

A new machine, known as the "Pulverburner," which is used for the preparation of powdered coal, has recently been placed on the market. The essential features of the machine, which is fed by an automatic feeder of the belt type, are the pulverizing mechanism and the air separating chamber.

The pulverizing is accomplished by means of six rapidly revolving hinged beaters, which smash the coal against breaking blocks and then against grinding plates in the bottom of the machine. The pulverulent material is discharged by centrifugal force directly into a large separating chamber. An exhaust fan, in the discharge duct leading from the separating chamber, induces air at slow velocity through the chamber, removing the fine coal and allowing the oversize to return to the machine for further pulverization. It is apparent that the velocity of the air through the separating chamber determines the fineness of the product. From the separating chamber, the fine dust is drawn through the fan and blown directly into the furnace. Secondary air is added at the nozzle. By using "splitters," the stream of coal and air can be distributed to several nozzles, thus enabling one machine to serve several furnaces.

By combining impact pulverization with air separation, many advantageous features are obtained. The "fines" are removed from the machine as rapidly as produced, so that the beaters are always operating on coarse material. This is an important item of power saving, even though impact pulverizing is known for its low power requirements.

Coal that has not been dried can be successfully handled in this type of mill, and, because of the air separator, there are no screens to clog.

For efficient powdered-coal burning, close regulation is necessary, and this has been provided for in the "Pulverburner." The rate at which the coal is fed is controlled by the automatic feeder by means of a cam arrangement that varies the speed of the belt. (The coal should be fed in such a size that a uniform "ribbon" is formed on the belt. Coal of 1 in. and under is satisfactory.) A magnetic pulley can be used with the feeder to prevent tramp iron from entering the machine. The quantity of air is controlled either by the speed of the fan, if a variable speed motor be used, or by a damper in the discharge passage. Air is introduced around the shaft. Velocity of the air through the separating chamber is regulated by two vanes in the chamber which are controlled through a worm and wheel.

The entire controlling mechanism can be operated by an automatic regulator. The apparatus is designed to be driven by either one, two or three motors. If one motor is used, both fan and feeder are driven from the pulverizer shaft. It is sometimes desirable to drive the fan from a separate motor; likewise the feeder.

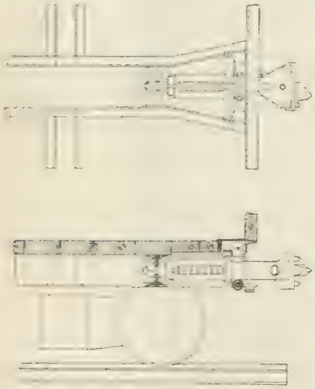
The advantages claimed for the machine are its compactness, close regulation of fineness and air, simplicity, economy and adaptability to small as well as large installations. It is being built in capacities up to three tons per hour.

The K. B. Pulverizer Co., 92 Lafayette St., New York, is the manufacturer.

Automatic Couplers for Mine Cars

The automatic coupling of cars in mine haulage is a subject which is beginning to receive the attention its importance has long merited. The same considerations which dictated the adoption of automatic couplers on trains in surface operation apply with equal if not greater force to trains running under ground. Safety to operators, increased flexibility of train movements and reduction of time required in distributing and collecting cars are all items of vital importance to the modern mine management.

The conditions obtaining in mines are admittedly severe for the coupler designer, particularly in old workings where small cars and extremely short radius track curves are frequently encountered. There are few cases however that will not yield to a careful study of conditions and appropriate design.



AUTOMATIC COUPLER FOR MINE CAR

The Ohio Brass Co., Mansfield, Ohio, which has for many years been a foremost manufacturer of automatic couplers for all classes of electric railway service, has designed special mine car couplers for several large operators and is well equipped through its long experience in coupler production to give expert engineering service in connection with these later types of mine couplers.

The illustration shows an automatic coupler mounted upon a large modern double truck mine car. The coupler is equipped with heavy draft spring and has a spring carrier, or yielding support, which maintains the coupler head at proper elevation and in the necessary central position. Information concerning this and other types of coupler equipment will be supplied upon request.

INDUSTRIAL NOTES

The Boston office of the Cutler-Hammer Mfg. Co., Milwaukee, has been moved from the Columbian Life Bldg. to Rooms 403 and 404 Harvey Building, Chancey St. C. W. Yerger is manager of this office.

I. C. van Itallie Co., 90 West Broadway, New York, have been appointed the exclusive selling agents for Messrs. J. K. Smit & Zonen of Amsterdam, Holland, high grade industrial diamonds (carbons and borts).

Combustion Engineering Corporation, Broad St., New York, have opened a new branch office at 806 First National Bank Building, Pittsburgh, Pa. This office will be in charge of W. C. Stripe, formerly manager of the Philadelphia office.

The Osgood Co., Marion, Ohio, announces the opening of a branch sales office at 1211 Conway Building, Chicago, Ill., which will be in charge of Arthur B. Sonneborn, as manager.

The New York office of the Blaw-Knox Co. has moved from the City Investing Building to the Carbide & Carbon Building, 30 East 42d St.

Whiting Corporation, Harvey, Ill., has purchased a controlling interest in the Grindle Fuel Equipment Co., manufacturers of complete powdered coal plants for use in connection with malleable furnaces, annealing ovens, steam boilers, billet heating and various other types of furnaces. The Grindle Fuel Equipment Co. has moved its offices to Harvey, Ill., and will continue its business under the same name.

Announcement is made of the retirement, effective in January, of A. P. Van Gelder, general superintendent of high explosives plants, Hercules Powder Co., from the active ranks of the organization. Following Mr. Van Gelder's decision to retire, several changes have been made in the operating organization of the Hercules company, all of which will take effect the first of the year. L. N. Bent will assume the duties and title of assistant general manager in charge of miscellaneous manufacture and C. A. Bigelow, formerly general manager of the Aetna Explosives Co., Inc., will be assistant general manager in charge of high explosives manufacture. F. P. H. Sholly, who came with the Hercules company through the purchase of the Aetna company, has been transferred from the operating to the purchasing department and will be an assisting purchasing agent.

TRADE CATALOGS

Mine Locomotives—Atlas Car & Mfg. Co., Cleveland, Ohio, recently issued Bulletin No. 1212, descriptive of combination storage battery and trolley locomotives.

Tractor Crane — Industrial Works, Bay City, Mich., is distributing free upon request Catalog No. 113, illustrating and describing the Type BC "Industrial" crawling tractor crane of 20,000 lb. capacity.

Pump Data—The Aldrich Pump Co., Allentown, Pa., have issued an 18-page pamphlet which contains engineering tables relative to pumps. It is seldom that such data are arranged so conveniently in a publication of this sort, and the tables and other information will be found invaluable to the mine operator and engineer.

Oil Engines—Information regarding oil engines of the surface ignition type is reviewed in detail in a book, "Oil Engines," recently issued by the Vacuum Oil Co., New York. Construction, operation, fuel, methods of lubrication, lubricating oils, and deposits are included in the topics covered. The book is well illustrated with colored diagrams which show operation in an excellent manner.

Screens—Bulletin No. 10 of The Simplex Screen Co., Felt Building, Salt Lake City, Utah, describes and illustrates the Simplex screen which consists of a plurality of bars mounted in a frame. To each bar is secured a series of screening teeth, the free ends of the teeth of each bar resting on the next bar below. The screen surface resembles a series of combs with each alternate tooth of each comb offset.

Gasolene-Electric Shovel—The Marion Steam Shovel Co., Marion, Ohio, have recently placed a newly designed gasoline-electric shovel on the market. The machine is applicable in stone quarries, lime and cement plants, clay pits and open mines where boiler feed water as a rule contains a high percentage of mineral or vegetable matter; also in the oil producing sections of the Southwest and in the many localities where steam is impractical. This new shovel is described in a 4-page folder issued by the Marion Steam Shovel Co.

Wire Rope — "Outspinning the Spider" is the title of an attractive book recently published by Robert L. Stillson Co., New York. The author, John Kimberly Mumford, who has written a number of books on industrial subjects, tells for the first time the history of wire-rope making in this country, from the beginning of the industry in 1840 by the John A. Roebling Sons Co., Trenton, N. J. "Outspinning the Spider" relates the romance of the Brooklyn Bridge, of the wire rope barrage laid down in the English Channel during the late war, and other interesting engineering achievements.

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Volume 113 New York, January 14, 1922 *Number* 2

The Time To Buy

THERE IS A TIME TO BUY and a time to sell. Now is the time for American companies to invest in mining properties in foreign countries. Owing to the depreciated currency of Europe, and the consequent varying but great premium on the dollar, your dollar capital is comparatively worth more than ever before, or than it is ever likely to be again. Therefore, mining properties in foreign countries can be bought on extraordinarily favorable terms, on account of the lack of competition. The general depression in the mining industries of the world is another factor favorable to the long-sighted buyer. It is average human nature to sell—mines or stocks—when prices are low and business is poor; and to buy when prices are high and business is good. In the long run—for the long pull, as the investment specialists say—there is nothing of more solid value than a good mine of any necessary metal. It is sure to recover its value, and in the case of many metals at least, it will gradually acquire a higher value, as the mining of metals renders more valuable what has not yet been mined. The time to invest is now.

A certain amount of American capital has actually gone recently into European mines. Mexican mines have been acquired during the past few years by active companies. But it is safe to say that the evident opportunities will in general be passed by. The mining companies are not prosperous—are not operating, or are operating at a loss. The renewal of the demand for metallic products has been slow in coming; and the tendency will naturally be all against further extensions under the circumstances. It will be in later years, when business is booming and there is surplus cash in the treasuries, that new properties will be sought in foreign countries; only at that time the price must be paid down accordingly.

Consulting Practice and Mining Education

THERE IS A STEADY ACCESSION to the consulting field coming from operating positions and various ramifications of the mining industries. Apparently it is the mecca toward which engineers trend in more or less uncertain fashion. We wonder how much is really known about it as a business. Certainly there must be a considerable number in it, but we have no adequate measure of the success of its participants nor of the methods taken to insure success and provide enough continuity in the line of clients to keep the coin jars on the home hearths jingling. How much of a feast or a famine is it? At the moment we do not know of any seasoned consultant who has candidly spread his experiences before our technical societies. We have seen an occasional paper on engineering ethics, but not for a long time past. We do not know whether some of our mining schools have given any serious attention to the business of the consultant or not? How many of them analyze the structure of this business. Do they instruct their students how to get and to hold clients? Is there an adequate effort made to give a student an insight into the subtle art of selling his services? Do they take up such subjects as fees, ethics and the pitfalls that beset the neophyte? Do they warn him of dead ends and the importance of safeguarding his professional and private reputation? It's a safe bet that they don't, or, if they do, it is only a casual reference. Between the interval of graduation and the consulting field a relatively long time may supervene, and therefore some will reason that there is no pressing need for such instruction. Others will represent that experience will supply all that is needed. Perhaps it will, but then again it may not. Certainly it would be helpful to have a well balanced analysis of this future business in the hands of the graduates as a rack upon which to hang his individual experience.

The American Valuation Plan

IN THE MIDST of the confusion welter of assertion and denial from those whose interests are affected by the proposed American Valuation Plan, many are turning to the professional economists for counsel. This group takes a remarkably united and unequivocal stand in opposition to the measure. The grounds upon which they take their stand are roughly these:

In the first place, they believe that the proposed plan really means a higher tariff. They recognize that the precise rates to be imposed on the American values are the determining factor here, but they are convinced that those urging the plan intend to see to it that the rates shall be sufficiently high to cover any uncertainty incident to the establishment of the new valuation basis. They suspect that at bottom the proposal resolves itself into a demand for a hidden and undetermined amount of increased protection.

The arguments, aside from this, do not impress the economists. The three which contain some modicum of force are that the plan will meet the problem of the fluctuating exchanges, that it will prevent "dumping" and that it will put up a more effective bar against the country with exceptionally low production costs. The economists point out, however, that prices rise in countries whose exchanges fall and that any disparity in the two movements is largely offset by the internal disorganization of the productive forces in the country whose exchanges are violently deranged. "Dumping," they believe, can best be prevented by administrative measures applied when the facts of a particular situation demand them. The argument that the present method of valuation puts a lower duty, for example, on cheaply produced Japanese goods than on more expensively produced European goods of the same character is admitted, but it is pointed out in rebuttal that specific rates would meet this situation as well as the American valuation plan.

On the other hand, the economists are considerably influenced by the contention that the adoption of the proposed plan would introduce so much uncertainty into the process of importing goods as to greatly embarrass the process. A retailer, buying foreign merchandise, cannot estimate his costs with any degree of precision under the proposed plan. Uncertainty of this character is a very potent anaesthetic to business enterprise. The economist suspects that the adherents realize this and view it with complacence because it means fewer imports and less foreign competition.

The administrative difficulties of securing fair cost figures from American manufacturers interested in excluding their rival's goods, of determining American costs in the case of goods which America does not make, and of securing uniform valuations at various points of entry, are perfectly self-evident. Furthermore, it is contrary to all past practice and procedure in this country. It constitutes, in the words of Professor Taussig, the foremost student of the tariff in this country, "a veritable leap into the dark."

But, after all, the opposition of the economist rests back upon his conviction that the proposal is equivalent to a demand for increased rates at a time when the true economic interests of the country would not be served by the establishment of a high tariff wall. The changed conditions resulting from the war have convinced many who previously were in favor of high protection that we cannot hope for a real business recovery until we reach an economic adjustment which the high tariff will tend to prevent or postpone. The question of American Valuations should not be settled without a full consideration of all of these elements.

Mining Schools in a Mining Environment

WE HAVE BEEN ASKED whether it is necessary, for the success of a mining school—and by that we mean, of course, the success of its graduates—that the mining school be contiguous to or a part of a mining environment. The Committee on Technical Education of the Mining and Metallurgical Society of America has this to say on the subject:

> "If other things are equal, the mining school situated in a mining environment will obviously have an advantage over that not so situated. To overcome this advantage the schools remote from mines must possess some compensating advantages. It is urged by many, of course, that the mining schools connected with the great universities more than offset their handicap of location by their general strength of resources, whether in material or in staff, by the broadening influence they exert, and by the power of their traditions and prestige. The one advantage is tangible and inherent, the other is complex and acquired; balancing of the two is difficult, and this committee prefers not to enter on any such uncertain or dangerous ground."

We agree with the committee's conclusion in the principle that it is extremely difficult to weigh the relative advantages and disadvantages of the two alternatives. There is something to be said on both sides, as the committee infers. Freiberg, once famous as a great mining school, was in the heart of a mining district. The Michigan College of Mines, in the copper country, has a splendid record in its graduates. Nevertheless, Columbia, the Massachusetts Institute of Technology, and others also have excellent records. Western mining schools have been an important factor in supplying graduates to the mining industries. Thus the degree of the essentiality of the mining environment cannot be determined from the record of the schools.

Contact with a going mining district gives a student a sense of proportion and wears off a certain greenness that is inevitably present if a student has had little or no contact with mining. Trips to mining districts and the common requirements that mining students must spend a stated time in employment or in studying actual mining operations compensate to some extent for the lack of a mining environment. Modern facilities for travel, the railroad and the automobile, contribute in bringing mining districts nearer to distant centers. Too long a time in one mining district probably gives a student an exaggerated idea of the importance of the practice in that district, and this must be avoided by excursions to other districts where conditions are different. Thus the school in a mining environment must face a similar problem differing only in degree from that of the school at a large population center.

Most important are the ideals of the school and the personnel of its faculty. If these are excellent, the mining environment is an added advantage. If they are indifferent, the school that possesses excellent ideals and personnel has, in our opinion, a greater value to the student, even though it has no mining environment.

It is more important that the mining students' fundamental work be thorough, and this requires good teachers and standards. Sometimes these pertain in the smaller schools, but just as frequently they do not. They are more often found in the large and well-established schools. Another angle to this question is the fact that the mining-camp environment does not always attract the highest type of instructor, for the reason that there is little intellectual stimulus in a mining district and the social conditions may not be always attractive. Again, the educational opportunities for the instructor's family (and he sometimes has a family) may not be satisfactory. There is a well-marked tendency, we believe, for the best instructors to gravitate to the larger schools in a diversified environment, for here the intellectual opportunities and social advantages are greater.

For some years there has been considerable discussion of the need for greater cultural development for the engineer. To specialize this into definite courses to be prescribed to a prospective engineer and "intruded" or superimposed upon his technical education is extremely difficult. Nevertheless, a diversified environment and contact with other students and instructors in other lines of work is conducive to a certain stimulus in this direction. Tradition and prestige in the larger schools are additional factors.

We consider the plan of having the first two years of instruction given at a well-established university and the remaining two years at a mining school in a mining community as worthy of discussion. This arrangement would avoid some duplication and would provide suitable environments for the respective faculties.

Humanizing Geology

THAT GEOLOGISTS CAN BE PRACTICAL and efficient in managing a convention has been happily demonstrated by the geological department at Amherst College, in co-operation with the various geological societies which met at that college by invitation during the Christmas holidays. Professor Loomis, of Amherst, and his assistants left no stone unturned toward making visitors comfortable and anticipating their characteristic touristic troubles. It was a demonstration of the humanizing process which has gone on in geology. This process has been evidenced, also, in recent years by the linking up of geologic science to the uses of humanity. Thus have arisen mining geology or geological engineering, hydro-geology, petroleum geology or engineering, civil engineering geology, military geology, political and commercial geology, and other definite branches. The Society of Economic Geologists, in which the various branches of applied geology naturally head, showed great strength in this meeting, and noteworthy papers and discussions ranged all the way from ore genesis to ore reserves and production. The promising future of the society was further assured by the election for president, from a triangular ticket, of Mr. Waldemar Lindgren, experienced field geologist, leader in geologic thought, and author of the most advanced textbook on ore deposits; and, also from a triangular ticket, of Mr. Ralph Arnold as vice-president, thus assuring the important group of petroleum geologists an adequate representation.

For the Geological Society of America, which, with its affiliated societies, also met at Amherst, the occasion was outstanding for the honors paid to the venerable geologist, Emerson. He and his predecessor, Hitchcock, have together held the chair of geology at Amherst for an even hundred years. The address of the retiring president of the Geological Society of America, Prof. James F. Kemp, was on the subject of ore deposits, and was a most noteworthy review.

WHAT OTHERS THINK

The Future of Mining

In *Engineering and Mining Journal* of Dec. 10, 1921, appeared a first-column editorial, the caption of which is "The Future of Mining." The obvious purpose of the editorial was to set forth the importance of American participation in foreign mining developments. In the prefatory paragraphs appear the following statements:

> "Meantime, great organizations of capital, served by exploration, geological, and engineering talent, have been systematically sifting the country for new mines of low or high grade wherein to invest the funds they have reaped from the mines they have exhausted or are exhausting. Thousands of mines and prospects are examined, and perhaps one in a thousand or one in five thousand, if the investigators are patient enough, can be made to yield some profit.
>
> "It is the gleaners—so soon—going over the field. And there have been many of them, for there are many strong companies whose exploration departments have followed one another from preferred mine to possible prospect. Some of our great companies have quit—abandoned their exploration departments and contented themselves with what they have, giving up the idea of replacement, and perhaps embarking their surplus capital on other lines of business."

These statements have been construed by some of your readers as a virtual "obituary" on American mining. Perhaps this implication is not fair to the writer of the editorial, but as the issue has been thus raised, it seems to me that it would be in order for the *Journal* and its editors to undertake a survey of American mining, so as to advise the readers of the publication and the large public interested in American mining, either financially or vocationally, as to the near future of the industry and the possibility of its effectual extinction during our time. It is admitted that the American mining industry is at the present time greatly curtailed in every way, but as this same thing might be said of other basic industries, the admission does not infer permanent and complete decline. It must be admitted that the American mining industry has reached that uncertain status known as "middle age," but this does not necessarily imply that a tombstone is immediately needed.

It may be accepted that American mining is sick, and it would certainly be interesting, and it might help the industry to more healthy activity and to longevity, if the *Journal* could add to its own editorial discussion, as to the future of American mining, the opinion of some of the veterans in the business, many of whom now have some time in which to record their ideas.

By way of starting a discussion, I submit the following extracts from a leading editorial in the *Journal* of May 25, 1912, entitled "Some Reasons Why Mining Languishes." This editorial, discussing the report of the exploration department of the U. S. Smelting, Refining & Mining Co., wherein it is set forth that the company had, during 1910, considered 684 separate mining propositions, of which 268 were examined, with the result of acquiring finally only *three* mines, says:

> "It is not to be inferred from these figures that out of the mining property in the market 99 per cent is valueless; rather do the figures point to the inability of buyers and sellers to come to terms."

In discussion the editorial continues:

> "Experience teaches that the common idea among mine owners is to demand all that a mine has actually developed, plus all probability, computed as to net value on the basis of what the large company can accomplish by virtue of its superior organization, knowledge, and command of capital. The standing upon such a demand is, of course, obstructive, because there is no use for a buyer to acquire a mine if he has to take all the chances and can only get his money back if all hopes are realized. The view of the purchaser is to pay for the ore developed plus a reasonable allowance for probability, figuring net value on the basis of what the owner can accomplish in his own working.
>
> "A reason why more mines are not taken over and exploited energetically by modern methods is the failure to reconcile the widely varying views of buyer and seller. Obviously the position of the average seller, as indicated in the foregoing paragraph, is quite unreasonable, and undoubtedly stands in the way of progress in mining. Here enters the question to which we have repeatedly referred, viz., Would it not be wise for the states wherein mining is becoming decadent to adjust their system of taxation so as to promote it? The conditions under which much mining property is held at present are not greatly different from those of much suburban real estate that is held out of use, by virtue of an unduly lenient system of taxation, awaiting a realization of unearned increment."

This earlier-day diagnosis of the mining situation is interesting, and the proposed remedy is ingenious and one not altogether acceptable to the "covetous" owners of mines, I am sure. At the present time, however, due to the general financial disturbances of the past seven years, it is a well-known fact that mine owners are generally disposed to offer their properties for sale, or financing, at much lower prices than have prevailed previously, and also usually on very attractive terms. The remedy for present conditions must therefore be worked out on some other formula than that set forth in the Journal's editorial of 1912.

I do not think that American mining, as a whole, has yet approached the period of general decline, and certainly not the state of total obliteration. It has inherent vitality to come back under the stimulus of general resumption of normalcy in the world's business, and there are new conditions affecting the cost of producing the metals and the market for them which will prolong American mining as one of the great basic industries for many years. **KIRBY THOMAS.**

New York.

The Eubœan Magnesite Field

In *Engineering and Mining Journal* of Dec. 3, C. S. Maltby takes me to task for having stated in my article on "The Eubœan Magnesite Field" that "Greece . . . produces the world's purest magnesite." In using those terms I had no intention of either unduly eulogizing the Grecian product or depreciating that from California, but rather was guided by such reports and figures as were available with regard to California magnesite, the experience of those in America who have handled both that and the Grecian article, and also by Greek records covering the export of magnesite for the last forty-five years. F. B. Romey, in the *Mining & Scientific Press* for April 19, 1919, contributes an article on "Hewet Magnesite" (from Riverside County, Cal.), in which he gave an analysis of calcined magnesite from that mine containing 14.46 per cent of silica, meaning 7 per cent approximately in the crude mineral, a much higher percentage than that in Eubœan magnesite.

While in Greece recently I supervised the shipment of 4,000 tons of crude mineral from Eubœa. This had to be transferred from the stockpile in one-ton cars, and a "grab" sample was taken from each car. The shipment consisted of two lots, of 2,500 and 1,500 tons. The bulk sample from each lot was reduced, and both were submitted for analyses to P. A.. Zalacostos, the director of the chemical laboratory, Ministry of National Economy, Athens, Greece.

The results of the analyses were the following:

	Lot of 2,500 Tons, Per Cent	Lot of 1,500 Tons Per Cent
Silica	0.86	1.54
Oxides of iron and alumina	0.55	0.33
Lime	0.55	1.21
Magnesia	46.94	46.38
Loss on calcination	51.10	49.84
Moisture	Nil	Nil
Total	100.00	100.00
	Per Cent	Per Cent
Equivalent to magnesium carbonate	98.57	97.39

These figures indicate a high degree of purity in a crude mineral, and samples taken from picked pieces would have given even better results. With regard to Mr. Maltby's implied unsatisfactory experience of the quality of Grecian magnesite, I think that this must have been due to lack of proper precaution. When Grecian magnesite is purchased in a businesslike way, and from reputable firms, a magnesium carbonate content of 94 per cent is guaranteed, and the payment of a considerable portion of the purchase price is made contingent on agreement of the analysis made from a bulk sample properly taken at a United States seaport, with the guaranteed percentage.

Mr. Maltby refers to the necessity of "cobbing" or dressing the Grecian magnesite, and infers that this is not necessary with the California article. In the *Mining & Scientific Press* for Aug. 30, 1919, W. C. Phalen had an article entitled "The Magnesite Industry in the United States." *Inter alia* he wrote of the California deposits: ". . . Some of the magnesite masses are as much as 30 ft. in thickness, and from this thickness they range to mere stingers and gash veins too thin to work." The maximum width of the California deposits thus appears to be 30 ft. The maximum in Eubœa (as I stated in my article) is 130 ft.

Most of the Grecian magnesite requires no preparation for sale, but a portion of otherwise too impure mineral can be rendered workable by a simple cleaning from adhering serpentine. If the demand for magnesite ever justifies it, a simple process of mechanical dressing would render a large part of the deposits now discarded as waste fit for sale.

In the interests of accuracy and scientific truth, will Mr. Maltby please give figures comparable to the foregoing to confirm his at present unsupported positiveness with regard to the superiority of California magnesite? Until he does so I shall continue to believe that "Greece provides from the Island of Eubœa the world's purest magnesite." **HARRY C. BOYDELL.**

University of Wisconsin.

The Proposed New Mining Law

It is evident, to most of us in the West, that H.R. 7736 has not the ghost of a chance to pass. Whether on not its demerits justify this, is immaterial; an overwhelming majority of the men engaged in the mining industry, in the states affected, are opposed to it.

As (I hope) practical people, the question now arises, —what shall we do about it?—shall we let the matter drop, for the next generation to consider?

Nearly all agree that the principal advantage to be hoped for, under the proposed law, is that it might facilitate the discovery and development of new districts; especially where there is reason to suspect the existence of ore deposits which do not outcrop. It seems generally admitted that there is little to be gained from its adoption in old districts, where most of the important orebodies have already been discovered, and located under the present law. On the other hand, the opposition comes, naturally, from such districts. Why not therefore solve the difficulty in a common-sense way, by making the new law apply only to new districts; or perhaps only to districts, to be indicated by the Geological Survey, where there is ground to surmise the existence of buried deposits? This solution was advocated by the writer in 1907, and met with the approval of high legal authorities.

In any event, certain features of the proposed law such as the limitation of time during which locations can be held without patenting, permissive payment in lieu of assessment work, and the requirement that locations shall conform to section lines, will have to be abandoned. These features were contrary to the judgment of most Western engineers, and are extremely unpopular with prospectors. The extralateral right in existing districts will have to be left as it is, unless the collective judgment of a community, as at Leadville or Bisbee, should agree tacitly to ignore it.

Denver, Colo. **GEORGE E. COLLINS.**

[Note: The revised mining law as proposed in H.R. 7736 does not affect claims already located. No such law can be made retroactive; therefore claims located before the passage of any new law will always retain extralateral rights, as under the old law. **EDITOR.**]

The New Stack at the Midvale Smelter

Weight of Over 8,000 Tons Necessitated Careful Planning for Foundations —Construction of Highest Quality and Completed in Six Months From First Excavation — Gases Will Be Liberated at a Height of 451 Feet

BY D. W. JESSUP

Written for Engineering and Mining Journal

THE 451-FT. STACK just completed at the Midvale, Utah, plant of the United States Smelting, Refining & Mining Co. was placed in operation on Nov. 26, 1921. Though it was practically finished during the latter part of October, time was needed to remove the scaffolding, make necessary repairs in the baghouse, and finish the flue connections.

Under the direction of L. D. Anderson, chief engineer, the construction of the stack was contracted for by the Wiederholdt Construction Co., of St. Louis, with J. D. Martin in charge. The foundation was sublet to Villadson Bros., of Salt Lake City. Not only was the best of material and labor employed, but a record was made in the speed with which the structure was built. Never has a stack of this size been erected in so short a time. This was because of an efficient organization and propitious weather conditions.

The exact height of the stack is 451 ft. 4 in. The outside diameter at the base is 46 ft. 1 in. and the inside diameter is 39 ft. 5 in. At the top, the outside diameter is 29 ft. and the inside, 24 ft.

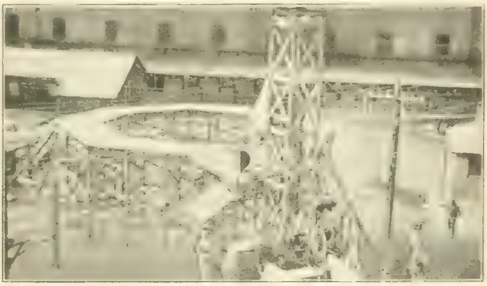
Excavation for the foundation was started on April 29 and was finished in about three weeks, several days being required to test the ground for subsidence. Laying of the foundation was begun on May 26 and finished June 15. Two weeks were allowed for the cement to set. The first work on the stack proper was on June 30, and by Oct. 20 the chimney was finished. Two weeks were necessary to tear down the inside scaffolding, piece by piece, and leave the structure ready to handle the smelter gases.

LAYING THE REINFORCING RODS FOR THE CONCRETE FOUNDATION

In the meantime, many alterations and changing of the flue connections were made. The baghouse roof was repaired and the large flue connecting the stack to the baghouse was built. Since starting up, absolutely no operating troubles have arisen.

The preliminary survey consisted of boring seventeen holes with a well digger to determine a foundation site. The holes varied from 30 to 5 ft. in depth, with a casing 3 in. in diameter. The lower 6 ft. of the casing was a split pipe held together by a ring at the top and bottom. When the pipe reached a depth of 6 ft. it was withdrawn and opened and the core removed and placed in a box. This was done for each 6 ft. of the hole. In this way a complete core was obtained. The soil was found to be fairly uniform, with a sandy top underlain by alternating layers of clay and sand.

An 8-ft. layer of water-bearing sand, almost like quicksand, was found at a depth from 24 to 32 ft. It contained 25 per cent of moisture. Underneath this sand was a predominating bed of impervious blue clay, which was followed by a micaceous clay that bore evidences of being eroded from the Little Cottonwood granites. A gravel bed underlaid the clays, and as it proved too troublesome to keep the hole open, drilling was discontinued at about 63 ft. Cores of each hole were kept in boxes, to obtain complete data of the underground structure.



THE CIRCULAR TRACK FROM WHICH THE CONCRETE FOUNDATION WAS POURED

The Salt Lake Valley is the bed of the prehistoric lake Bonneville, which disappeared about 30,000 years ago, leaving the present body of water, the Great Salt Lake. Streams from the near-by Wasatch Mountains fed this lake, and these bore-holes made an interesting geological study.

FOUNDATION WAS TESTED BEFORE BUILDING BEGAN

It was decided to erect the stack a short distance south of the baghouse, having in view other flue connections that might be made in the future. Owing to the densely packed nature of the soil, the excavation for the foundation was made only 10 ft. in depth. The soil was removed with scrapers and teams, and the finishing touches were done by hand labor. A testing machine built of 6 x 6-in. timbers, and carrying a load 50 per cent greater than the weight of the stack, was then placed in the center of the excavation. At the end of seven days the ground had settled only ¼ in.

Preparatory to laying the concrete foundation, a circular wooden platform or track was constructed inside the excavation; this was about 20 feet high and was carried on 4 x 4-in. supports. Chutes for dumping the concrete were built on both the inner and outer edges.

THE FINISHED FOUNDATION. NOTE UPRIGHT REINFORCING RODS

Sand and gravel were trammed from near-by trestle bins by specially constructed wheelbarrows or buggies and dumped into a concrete mixer; portland cement and sufficient water were added and the whole was mixed for one minute. The mixture was then hoisted in an elevator bucket and dumped into a pocket, from which it was drawn out and trammed by buggies around the circular platform, being distributed where needed. Before pouring the concrete, reinforcing rods of 1-in. square deformed shape were laid on the bottom of the excavation, spaced 1 ft. apart and crisscrossing at an angle of 45 deg. These rods were also placed in an upright position, being held by wire.

The foundation was laid in an octagon shape, 87 ft. in diameter and 10 ft. thick. The lower 5 ft. is a solid block and the upper 5 ft. is stepped in at each foot so that the top is 51 ft. across. Later, the top was covered with soil. Upright reinforcing rods were left standing to anchor the base of the stack.

METHOD OF BUILDING SCAFFOLDING

After the cement had set, the inner scaffolding for the stack was started. This consisted of a double compartment tower, 14 ft. square and built of eight 6 x 6-in. posts in twenty-nine full 16-ft. sections. It was held together by 2 x 12-in. ledgers and 2 x 8-in. sway braces, securely bolted. The tower was kept three or four sections ahead of the wall.

A movable table or platform constructed of steel members was built around the tower. It was supported underneath by angle braces. The table was held in place and also raised through the medium of eight two-ton chain blocks. When the wall had reached a certain height, the table was hoisted a few feet and the bricklaying again started. The blocks were moved to a new position when necessary. Careful inspection kept the wall in line, and no irregularities were allowed.

To hoist the material, two 5 x 8-ft. cages were operated inside the tower. They traveled at the rate of 400 ft. a minute. The hoist was of the double-drum mine type, with an a.c. slip-ring motor of 75 hp., the voltage being 440. The cable was of $\frac{5}{8}$-in. steel.

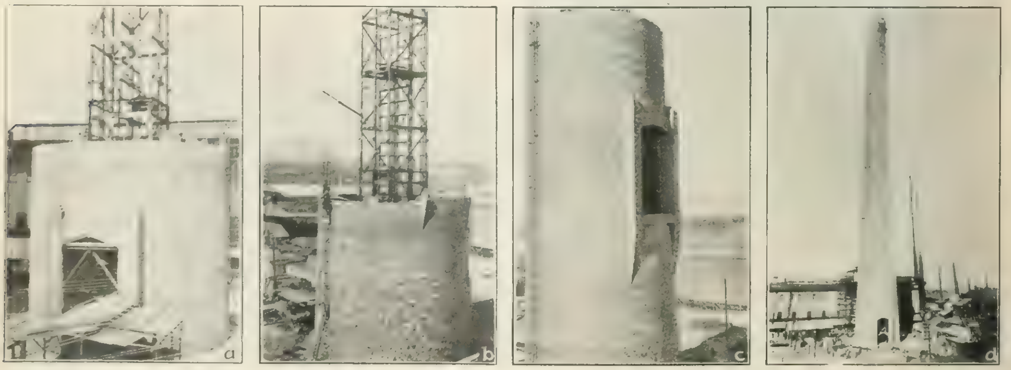
The stack consists of an inner and outer shell. The inner shell is a lining built of $4\frac{3}{8}$-in. soft-glazed hard-fired brick; primarily this is for insulation. The lining extends from top to bottom and is held in place by expansion joints. A 3-in. air space was left between the walls. The first 125 ft. of the outer shell is of hollow radial brick filled with reinforced concrete. It is 33 in. thick at the base, and at the 125-ft. mark it decreases to $17\frac{1}{2}$ in. From this point to the capping the wall is made of Wiederholdt patented brick or tile, filled with reinforced concrete. The thickness is $12\frac{1}{2}$ in. up to 190 ft., and 10 in. for the next 90 ft. This decreases to 8 in. at the top.

At intervals of 25 ft., the main wall is corbeled out to carry the lining. At these points, special tile is used to make a slip or expansion joint; this permits the lining to expand and telescope with the section above it. The joint extends all the way around. The chimney head is corbeled out and is covered with a 30-in. cast-iron cap made in sections and bolted to the top with anchor bolts. The latter are protected by cast-iron covered nuts.

To avoid danger from lightning, eight lightning rods of the Carl Bajoler type were installed. These are tipped with a very thin foil of platinum to protect the points against corrosion. Two $\frac{5}{8}$-in. copper ground-cables, one on each side, are connected to the rods and will carry any discharge 14 ft. below the surface.

The stack is provided with a safety ladder extending to the top. Three platforms were installed at intervals of 150 ft. The ladder is inclosed by horizontal and vertical straps, so that it is almost impossible for one to fall out except straight downward. It was hoisted in sections by the aid of a gin pole and tackle and bolted into place.

For the purpose of taking gas readings and samples, a pipe was extended across the stack at the 300-ft. level. The pipe is made of iron, but is covered both



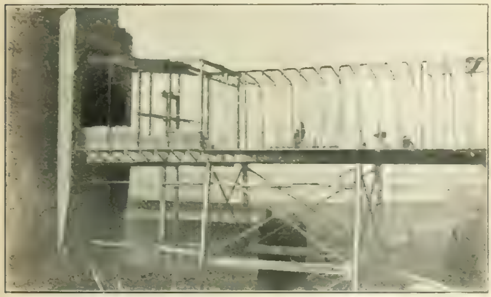
THE STACK AT VARIOUS STAGES OF CONSTRUCTION

(a) 35 ft. (b) 45 feet (c) Flue opening at baghouse. (d) The completed stack.

inside and out with sheet lead. There is a series of [illegible]-in. holes through the bottom of the pipe to permit the gases to enter. This pipe will extend to the ground and a rotary blower will suck out the gases so that the chemist will not have to climb a ladder to take his sample.

THE ARRANGEMENT OF ENTERING FLUES

At the bottom of the stack was built a flue opening or portal 12 ft. 3 in. by 22 ft. 3 in. There is a possibility of this opening being used in the future, but for the present it was bricked in. The portal leading to the baghouse was made 15 ft. 6 in. by 22 ft. 2 in. The flue connecting the stack to the baghouse is 16 by 14 ft. and 86 ft. long. It is supported by a steel tower 55 ft. 7 in. high and 28 ft. wide. The first 30 ft. of the flue is built of tile with firebrick lining, the remainder of double-wall transite filled with ground cork between the walls for insulation, and supported by a steel frame work. The roof is insulated with felt instead of cork. The transite is an acid-proof board consisting of a mixture of ground asbestos and cement, made by the Johns-Mansville Co.



FRAMEWORK OF FLUE CONNECTING BAGHOUSE TO STACK

At present a firebox with a coal stoker feed is being installed at the base of the chimney, so that during certain seasons of the year heat may be applied to the smelter gases, causing them to rise to a greater height and be diffused more completely in the atmosphere.

All of the construction work was done on one shift daily, the crew numbering thirty-one men. This included carpenters, bricklayers, helpers, laborers, and an engineer. The largest number employed at any one time was thirty-five men. During the entire period of building, only five hours were lost, this being due to a severe rainstorm in August. Other than this, the weather remained ideal.

A "Safety First" campaign was conducted, with excellent results. Only three accidents occurred. They were not of a serious nature, and no time was lost by the men. After the stack was finished, and while tearing out the scaffolding, one employee was so unfortunate as to have his leg broken. This marred an otherwise perfect record.

The sand and gravel for concrete work was obtained from near-by pits. After a careful inspection, a chemical analysis and sizing tests were made to determine if they were suitable. The brick and tile were made locally. In mixing the concrete for the stack building, one part of cement was added to three parts of sand, with sufficient water to make a dry mix.

The weight of the whole structure is enormous. In the stack there are 15 carloads of cement and in the foundation 12 carloads, a total of 1,962,000 lb. The stack contains 33 cars of sand, and the foundation 21 cars, or 5,698,000 lb. The foundation contains 10 carloads of gravel, weighing 4,590,000 lb. (the stack contains no gravel). The brick and tile used in the stack weigh 4,353,000 lb. and make up 65 carloads. Two carloads of Utah Copper tailing were used in the mortar for the brick lining with the idea of making the mortar more acid proof and also of a thinner consistency. The bar iron for reinforcing the concrete weighs 50 tons, and a large amount of water is contained in the concrete, mechanically and chemically combined. The weight of the total material is 16,903,000 lb., or 8,452 tons. This amounted to 188 carloads. With all of this great weight, the structure has settled only 1¾ in. and part of this is due to the shrinkage of the concrete. The settling has been entirely uniform.

The erection of the stack marks a new era in smelting at the Midvale plant, and it appears that all draft problems have now been definitely solved.

The Copper Mines of Eastern Finland

Negotiations have recently been carried on between the owners of the Outokumpu copper mines, in eastern Finland, and some German copper-mine owners for the lease of the Outokumpu mines or the sale of the raw ore from them, according to *Commerce Reports.* It is stated that enough ore is being produced at present in one month to suffice for smelting for one year, but that it is intended to double the productive capacity of the smelting works, in which case the production of two months can be utilized here and that of ten months can be disposed of otherwise.

There is considerable opposition on the part of experts in this country to disposing of these mines or their products, as they are considered to be a valuable asset for Finland.

The Outokumpu ore field is located in the district of Kuusjarvi, 50 kilometers from Joensuu and 90 kilometers from Kuopio. It consists of a long, flat layer of quartzite, which, according to borings already made, appears to be 2,500 meters long and 200 or 300 meters wide, with a depth of 9 to 10 meters, as stated above. The ore contains on an average 4 to 4.5 per cent of copper, 27 per cent of sulphur, 28 per cent of iron, and approximately 1 per cent of zinc, as well as small quantities of silver and gold. The mineralogical composition of the ore is on an average 12 per cent of copper pyrites, 32 per cent of sulphur pyrites, 15 per cent of magnetic pyrites, 1 per cent of zinc blend and 40 per cent of quartz.

Notwithstanding the importance of the deposits of copper and sulphur at Outokumpu, these mines have never been worked with much success. The ore was first discovered in 1910, and trial work began three years later. The following table shows the annual production of ore and of copper since 1914 and the value of the copper:

OUTOKUMPU PRODUCTION OF ORE AND COPPER

Year	Ore *Tons*	Copper *Tons*	Value of Copper *Marks (a)*	Year	Ore *Tons*	Copper *Tons*	Value of Copper *Marks*
1914	7,500	148.2	375,000	1917	15,000	145.6	[illegible]
1915	9,800	157.1	580,000	1918	17,200	69.5	1,300,000
1916	22,000	175.8	1,025,000	1919	11,000	15.6	[illegible]

(a) The normal value of the Finnish mark is $0.193 [illegible] depreciated.

The Sierra Madre of Northwestern Mexico

A Description of the Country—Topography, Inhabitants, and History—Range Formations Essentially Volcanic and Remarkably Mineralized—Many Famous Camps—Present Conditions and Outlook

BY H. H. TAFT

Written for Engineering and Mining Journal

OF MOUNTAIN RANGES called Sierra Madre, "Mother of Mountains," there are many. The highest area in Mexico is about the City of Mexico. Humboldt describes three ranges spreading northerly. The middle one breaks up into small detached mountains in the central plain or basin. The others become the western and eastern Sierra Madre respectively. That to the west is the larger and more commonly bears the name. On the western side is the greatest and richest mineralized region of the North American continent.

Both of the ranges are nearly parallel to the coast, being closer to the sea on the south. North there is a constantly widening coastal plain, and in Sonora are several smaller chains. In both areas streams of water rise in or near the central plain and break through in deep canyons on their way to the sea. In Chihuahua the river at Guerrero flows north; at Yepomera it flows west and breaks into the mountain range, receives a stream from the south, breaks through another range in a canyon as the River Arros, flows north and receives the Chico, flows south and west again to receive the Mulatos, then north and west in a deep canyon all the way and receives the Bavispe, and flows west and south again as the Rio Yaqui. A deep canyon and one rich in mineral is the Urique, which is from 3,000 to 6,000 ft. deep and in picturesqueness rivals the canyon of the Colorado in the United States. An east and west profile is that of an ordinary mountain range turned over. The general country and the nearly flat lands are on top. The valleys are deep and narrow, often several thousand feet below the general level. South, about the latitude of Guadalajara, the range bends east and continues to the isthmus. In this section it is not so rugged and precipitous and there are many large tracts of grazing and agricultural land. Although it contains some good mines, it is not as well mineralized as the north.

DISTANCES MEASURED IN HOURS AND DAYS

Distances are of little account in the Sierra. One does not often hear of miles, leagues, and kilometers, but, instead, of hours and days. Ordinarily, one travels by horse, or, better, on mule-back from twenty-five to thirty miles per day. In some regions three days are required to gain fifteen miles; occasionally that distance can be made in two or three hours. There are few roads, and all freight is carried on the backs of animals. There is but one railroad across the Sierra, that from Tuxpan to Colima. Three other roads are projected and partly constructed. To the miner the most important will be the Chihuahua-Sinaloa line, known as the "Orient." The mountain range is from 100 to 200 miles wide. Railroad construction is difficult enough on top, but there are only a few places where there is room to get down on the west side with a grade that is not too steep for traffic.

The country is fairly well inhabited, and one rarely travels more than a few hours without seeing ranches and small towns. The natives will plow, cultivate and raise a crop on a 35-deg. slope. One finds all kinds of fruit, from apples to bananas, though they are not good for much, being practically wild. Occasionally one meets a more enlightened rancher who has been north and purchased some good nursery stock. The people belong to various tribes of Indians, with a little admixture of Spanish. In the south there are many who speak only the local dialect, but north nearly all understand Spanish and some English, for a surprisingly large number were, at some time or other during the last ten years, refugees in the United States. The land holders and storekeepers are *gente de raison*. Most of the towns are communes. The people are kindly enough, but are afraid of strangers.

One accustomed to the Sierra can tell the elevation within a few hundred feet by the vegetation. The higher reaches are in the pines; in fact, there is an almost continuous pine forest from the Arizona line to the Isthmus of Tehuantepec. The highest parts are between 9,000 and 10,000 ft. above sea level. At 9,500 ft. and lower on the north side one finds hemlock and cedar. The average elevation is about 7,000 ft., and at this altitude the oaks begin to show scattered through the pines. At 6,000 ft. the pines give out and through the oak one finds juniper and cedar, which become the principal trees a little lower. In the oaks and the lower pines is the picturesque red-barked madroña. There is none of the cacti and thorny growth in these uplands that one usually looks for in Mexico. The barrancas are semi-tropical. Oranges, limes, lemons, pomegranates and other fruits are found. Near Urique is a coffee grove.

FORMATIONS OF RANGE PRINCIPALLY VOLCANIC

The entire range is essentially volcanic. There is little of the black lava so often seen in the Rocky Mountains and the Cascades in the United States. This is on top, the latest formation, for it is recent. The last flow was in 1756, when Jorullo, in Michoacan, overflowed and destroyed a rich farming district. The great mass of the Sierra is made up of light-colored flat-bedded volcanic tuffs, in all from 1,000 to 2,000 ft. thick, so bedded that one in passing often thinks of them as recent sediments. Under these beds are a great variety of intrusive rocks, porphyry, diorite, andesite and others. Granite does not appear until near the coast. These rocks are nearly always mineralized.

Rarely does one drop off of the high mesa into the barrancas without going into a *mineral*. Occasionally in the valleys there is a development of the sedimentaries. In southeastern Sonora, coal occurs, the sandstones and slates so metamorphosed as to be unrecognizable from the saddle. The coal is crushed, and altered to a high ash and low volatile content. There are a few instances where the eruptives reach the higher elevations and the miner does not have to get his ore out of a deep barranca. In the Barranca del Cobre, on the Urique River, there are but three months in the year when the sunshine reaches the river. The nearly vertical vein of copper, gold-silver ore is well exposed on both sides of the river and is a fine example of a strong vein in the older rocks, at the lower elevations, and of a diminishing vein as it passes into the upper, newer formations.

The veins of the Sierra are as varied as the topography. They range from quartz stringers to massive veins over 100 ft. thick, as at Guadaloupe y Calvo; breccia zones of all thicknesses; pipes or funnels; country rock mineralizations as at Mulatos, where gold has been mined for a distance of four miles; lime-porphyry contacts, as at the Liuvia del Oro, where the ore is quartz, and the historic Bahuarachic, a basic copper ore.

The great values that the Spaniards obtained came from the oxidized zones and the secondary enrichments. The primary sulphides and the water that come with depth were always insufferable obstacles for them. There are a great many veins that have never been examined, of which no samples have been taken, no shots put in, or test pits sunk. Systematic exploration has not been attempted. It is a most attractive field for the prospector who will get out himself and work, and not wait for some peon to bring in samples. It is probable that some of the *antiguas* would be profitable under present metallurgical practice. The great difficulty is in installing machinery, heavy parts required for large operation having to be dragged at great expense over the mountain trails. Perhaps the airplane will do this later.

PRIMITIVE METHODS OF TREATMENT EMPLOYED

The Spaniards divided the ores into *fuegos* (fire) and *azogues* (amalgam). The former were smelted in *vasos*, small reverberatory furnaces peculiar to Mexico, built of sun-dried brick and fired with wood. The ore, oxidized or roasted, with sufficient lead is liquated on the hearth, then slagged and drawn off. A current of air is blown over the molten lead, leaving the silver, which must be further refined in a cupel. The sulphides and the poorer oxides are treated in a small shaft furnace a foot or two feet square and from two to four feet high. These are often built in a wall. The furnace is tapped in front and blown from behind, a block of rhyolite with drill hole through it serving for tuyère. The bellows, one or two, is operated by men. Sometimes a man will lie on his back and move a small vertical bellows with each foot. It reminds one of possibilities in slave days.

Later the *caldo* and the *patio* were used, and one still sees small hypo leaching plants operating. The Americans used pan amalgamation extensively, first free, then with a salt roast. This was followed by cyanide plants. Concentration augmented as now by flotation would be successful at many of these mines, but there is always the problem what to do with the concentrates. Rarely are they rich enough to warrant the expense of shipment. The further treating of sulphides of iron, lead, zinc, and copper combined offers another problem. The favorite method of treatment by the *antiguas* was by the arrastre, and this is the first evidence that one is near an old mine. The arrastres were of all sizes, ranging from the small hand affair to those driven by horse or water power. They were simply large pieces of hard rock dragged around on a circular rock floor, the gold and silver oxides and chlorides being amalgamated with quicksilver. The sale of mercury was a prerogative of the Spanish crown.

The Spanish first saw the Mexican coast in 1517. In the fall of 1521 they were in complete possession of what is now the City of Mexico. The following winter silver was found in the neighborhood of the present *mineral* of Tasco. Guanajuato came in 1526, [illegible] in 1524, Zacatecas in 1546, and Indé and Santa Barbara in 1547. The present site of Chihuahua was probably reached in 1539.

The conquerors crossed the mountains south, and in 1532 two brigantines sailing from Acapulco reached the Gulf of California. Durango (Guadiana) was founded in 1563, after considerable fighting, and the Sierra was crossed at Topia. In 1628-30 Batopilas, Urique, Guazapares, Chinipas and other camps were found. This region has probably produced a thousand million ounces of silver, including the gold at its silver value. Guadaloupe y Calvo was discovered in 1835 and produced nineteen million in ten years, and by 1848 had produced thirty million. Ocampo (Jesus Maria) was found in 1811 and was operated at its best when affairs in the south were at the worst. In eleven years the Santa Juliana produced thirty-nine million ounces. The Santa Eduvigis produced in a few years eleven million. This mine is in a breccia zone. The vein at the surface was 15 ft. thick and in from 100 to 200 ft. in depth it opened into the *Plaza de Gallos*, 60 ft. wide and 400 ft. long. Below the vein trimmed down to 15 ft. in width and a length of 350 ft.

There are several important mining regions in the south: Topia, San Andres de la Sierra, San Dimas, Hostoti-Paquillo, and others. Humboldt called the Chihuahua-Sonora region the world's richest in silver and gold.

With all the troubles that occurred between the Spaniards themselves, between Jesuits and Franciscans, and in the local Indian uprisings, the great one in the latter part of the seventeenth century, the many Apache raids, extending as far south as Zacatecas, on one side, and Hermosillo on the other, and the forty-odd revolutions in the last century, it is no wonder that there are many fascinating romances of lost mines: El Naranjal, Gloria Pan, Tyopa, and others.

MINING OPERATIONS LARGELY PARALYZED SINCE REVOLUTIONS BEGAN

The recent revolutions stopped all foreign mining in the Sierra. The natives continued to work in a small way, not only their own mines but others, as they had to sustain life. In some cases the owners themselves destroyed the exits to save the ore that was ready to be brought out. Some of the plants are a complete wreck; others are in a fair state of preservation. There is one active mining region in Jalisco. Dolores, in the extreme north, has started with a full crew. Batopilas is employing about a hundred men. Otherwise there is an almost complete paralysis in the Sierra Madre. The people are extremely poor now—in the fall of 1921—and except for the few more fortunate they are living on green corn and wild herbs. The ordinary corn tortilla and beans are not to be had. Fortunately, there has been plenty of rain and a good crop is ripening.

Along the railroads there is a change in the ore business. Formerly the natives operated many small mines. They are wonderfully adept at sorting ore and shipped a considerable tonnage of high-grade siliceous ore. The Americans milled the low-grade and shipped their high-grade to the smelters. The principal ore on the market was quartz. The smelting companies protected themselves by buying flux mines, generally large bodies of low-grade iron-lead carbonate found along or near limestone-eruptive contacts. These mines have developed wonderfully. Milling has so improved that little siliceous ore is now shipped.

The natives are working but little. The consequence is a material advance in the charge for smelting basic ore. Lead-silver ores, unless of high grade, are unprofitable. The natural outcome is the development of the richer milling ores of the Sierra.

Prospecting has ceased in the United States. The mines that are easier to work were found long ago. The mining laws make it possible for speculators and men who have nothing, to hold for long periods of time claims that might otherwise be developed. Little money is ventured in the search for mines. Most of the various exploration companies are seeking developed mines.

Mexico is richer in mineral than this country, and the Sierra Madre is the richest portion of the country. Its inaccessibility has, so to speak, held it in reserve. With common labor at 75c. per day, as it is now, a given sum of money will do three or four times as much exploring or development as it will in the north.

Filter-Cake Tailing Makes Good Building Brick

By DONALD F. IRVIN

Written for Engineering and Mining Journal

During the last administration, a national statute was enacted in Chile, providing for certain obligatory regulations governing the character of houses for workmen in mining camps. This "Workmen's Housing Act" is directed largely against the generally unsanitary shacks now found in most camps, and encourages the use of substantial construction, such as adobe brick.

HOUSE UNDER CONSTRUCTION USING BRICKS MADE FROM FILTER CAKE

In the nitrate districts, corrugated iron, or *calamina*, construction has been the usual type heretofore, but is generally disliked as being expensive and poorly adapted to the climate, as it is too hot in the daytime and too cold at night.

It happened that some nitrate operators near Sierra Gorda, in the Antofagasta district, found it necessary to provide workmen's dwellings in accordance with the law mentioned, and at the same time (1920) they were tramming to the dump discharged filter cake containing about 12 per cent moisture from their drum-filter installation.

Resolving to kill the proverbial two birds with one stone, they set to making adobe bricks from their filter dump. The results were so satisfactory that they stopped tramming the filter cake to waste, and put an *adobero* to work, making bricks as fast as the cake fell from the scraper of the filter, after most of the original dump had been converted into adobes. The filter cake, which is mostly clay, with some sand, contains small residual amounts of nitrate and salt, and is molded in the time-honored manner of the *adobero*. Besides quickly drying very hard and smooth, the resultant bricks are easily set by masons, and a building made of them is much cheaper than the alternative of a *costra* (clod) wall, plastered with mud, or the usual adobes, which require considerable labor in preparing and mixing the dry material.

As an outer finishing coat, a thin layer ($\frac{1}{2}$ to $\frac{5}{8}$ in.) of cement grouting material and sand is plastered over the adobe wall, thus providing excellent protection against water or casual rainfall.

Many thousands of adobe bricks were made, and a number of dwellings as well as various storehouses and other structures were built from them at this plant. It is conceivable that the same use might be made of filter-cake tailing elsewhere, at least where the discharged cake is uniform and moderately moist.

This information is offered in hope that it may suggest such an economy at this time, when further economies are the aim of every one responsible for the course of mining operations.

Radium Production in Czecho-Slovakia

There is a large radium content in the uranium ore found at Jachymov, in Bohemia, near the frontiers of Saxony, according to Trade Commissioner Fernald L. Breed in *Commerce Reports*. Although the radium production in the United States is greater as to quantity, the ores of Jachymov are richer in quality. The known supply of radium in the Jachymov district will last for twenty years, at the present rate of production. As there are three large mines which are not yet prospected as to depth, and in which the veins of ore widen as they are followed deeper, it is certain that the mining of radium will continue for much more than twenty years at Jachymov.

The Jachymov mines passed in 1912 into the possession of the Austro-Hungarian government. They have now become the property of the Czecho-Slovak Republic. The annual quantity of radium produced amounts to about two grams. The net profits to the government in 1913 were about 1,000,000 crowns. The net profit anticipated for the current year is about 3,500,000 crowns, which, of course, has less foreign exchange value than the pre-war profits. The price of one gram of radium in the home market in 1913 was 588,000 crowns. Today the price of one gram is about 10,000,000 crowns. As the earnings from the radium mines of the republic are looked upon as a possible source of much profit to the government, projects are under way for electrifying the shafts and mill houses, as well as enlarging and modernizing the entire plant. At present the equipment at Jachymov is somewhat primitive. About 100 workmen are employed in the different parts of the establishment.

There are several byproducts of considerable importance. Uranium dyes are produced, eleven workmen being employed in the dye factory. A radio-active watering place is also being built near the mines.

Oatman Today

Conditions Gradually Improving in Arizona's Principal Gold Camp
Costs Lowered Somewhat But Wages Still High—Skilled Labor Supply Ample Diamond Drilling Gaining Favor Operating Data

BY W. F. BOERICKE

Written for Engineering and Mining Journal

THE CAMP OF OATMAN, Ariz., is situated about twenty-seven miles southwest of Kingman, on the Santa Fé railroad. It is reached over a good automobile road from the last-named town, being part of the National Old Trails Road, and dozens of tourists drive through daily. The magnificent mountain scenery over the Black and River ranges makes it well worth while to attempt the steep grades even with a flivver, though an alternate route is offered by way of the Topock and Needles.

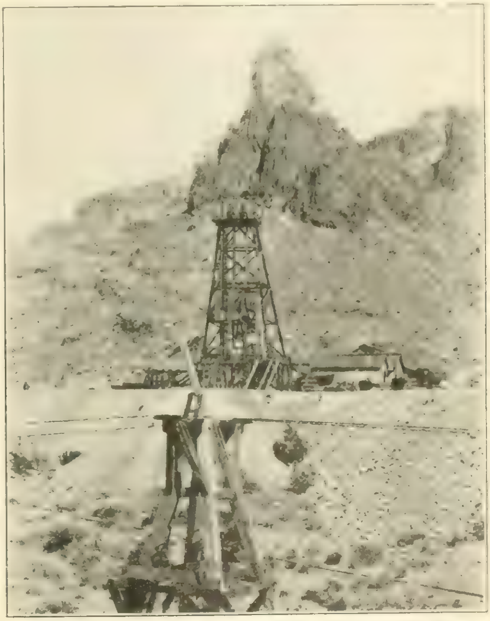
Oatman itself is an anomaly in mining camps. To an engineer accustomed to the rude frontier mining towns of the West, it comes as a shock to find a village of tolerably substantial buildings, a water system, electric lights, and every evidence of law and order. This is undoubtedly due to Oatman's being the pioneer dry camp of the West, with a strict taboo on saloons, gambling houses, and the usual accompaniments. Although the fire in June gave a hard blow to the place, coming as it did when gold mining was still struggling against high costs and meager profits, evidence of it has been largely removed through the energy of its citizens, although the camp has not been entirely rebuilt.

Communication with the outside world is effected entirely by automobile. The fare to Kingman is $5 each way. Stages leave daily in the morning, making the trip in about two hours. The camp is supported principally by the Tom Reed and United Eastern mines. These have been steady producers, and employ about 200 men between them. Besides these, the United American and Oatman United are working, and a number of other companies are prospecting in a small way, some of them diamond drilling.

GEOLOGY OF THE DISTRICT

The geology of the district has been described by F. C. Schrader in Bulletin 397 of the U. S. Geological Survey, now unfortunately out of print, as well as in a number of excellent articles in the technical press. Briefly, the gold occurs in fissure veins resulting from a series of fault movements in the "green, chloritic andesite" of Schrader, which are generally overlaid with a capping of Tertiary volcanics. These veins trend to the northwest, and dip steeply to the northeast. The filling is mainly quartz adularia, with a small amount of calcite. The veins vary considerably in width; at the United Eastern the vein was reported to be at one time 55 ft. wide, but this width is not maintained for any distance. The walls are not especially well defined; the hanging wall is usually the stronger, and has the best values in the oreshoots. Underlying the green chloritic andesite is the older andesite, and below it the pre-Cambrian granite, which is prominent in the northern part of the district, notably at Katharine.

Although it seems established, from developments at the Tom Reed, that the veins themselves extend into the older andesites, the values in the oreshoots upon entering this formation have generally been disappointing, and the conclusion seems justified that the profitable ore deposits will be found in the later formation. However, considerable prospecting is being done in the earlier formation, and the conclusion may be found to be in error.



BIG JIM HEADFRAME IN CENTER. RHYOLITE DIKE AND "ELEPHANT'S TOOTH" BEHIND ANDESITES, IN BACKGROUND; AERIAL TRAMWAY STATION IN FOREGROUND

The oreshoots are often of considerable extent, reaching as much as 1,000 ft. in length and depth, and sometimes extending clear across the width of the vein. They frequently occur in lenses paralleling each other between the walls.

TOM REED VEIN OPENED FOR OVER THREE MILES

The main vein of the district, the Tom Reed, on which the two principal properties are located, is of extraordinary persistence and length, and has been opened up for a distance of over three miles. This has given rise to the impression that Oatman is a one-vein camp. However, recent developments on the Hammond vein by the Oatman United, which roughly parallels the Tom Reed on the north, give considerable encouragement to the belief that other orebodies may be found on veins of the same age and character as the Tom Reed.

Faulting is common, and displacements are often very large. The history of the apex suit between the United Eastern and the Tom Reed, involving the influence of the Mallery fault, is too recent to demand much discussion.

ELEPHANT'S TOOTH A LANDMARK

Paralleling the vein systems, and situated about a half mile to the northwest, is a very prominent rhyolite intrusion, culminating in a gigantic spire known locally as the Elephant's Tooth. It is believed that this intrusion had important genetic effect on the gold, and that the gold came in with it and was given off by it to the underground circulation.

The gold is found in the quartz adularia gangue, in an extremely fine condition, generally invisible even under the glass. It is not susceptible to plate amalgamation, but, being entirely free from sulphides, it is an ideal cyaniding material, and extractions have been exceedingly high. At only one mine, the Alcyone, about two miles south of the Tom Reed, and on a different vein system, have sulphides been found to any extent. Average values range from $10 to $22 per ton, with some high-grade portions considerably higher. Below $10 there is a large tonnage available, notably at the Gold Road mine, but with present costs this can hardly be classed as ore. The gold content does not generally vary inversely with the width of the oreshoot, as might be expected, but the wider veins often contain the best ore. Such ore is found in a quartz of a peculiar faint, ribbon-like, banded structure, often stained with manganese.

Approved methods of prospecting are to sink through the capping of the Tertiary volcanics and into the later andesites, and crosscut for the vein. It has been truthfully said that the trouble has been not so much to find the vein, as to find the oreshoot within it. Shafts usually have two compartments, and are 4 ft. 6 in. by 9 ft. in the clear, which gives ample room for a bucket or cage in one side, and a ladderway, pump and ventilating pipes in the other. Some smaller shafts have been sunk, in which the ladderway is cut down to 2 ft., but this makes the space very cramped. Its advantage is a saving in timber cost. All the larger shafts have three compartments. When ore is found, the two compartments are enlarged by raising from the bottom to a full-sized working shaft. This involves considerable effort and loss of time, but is usually justified.

COST OF SINKING AND DRIFTING—OTHER DATA

All shafts are timbered and lagged solid from top to bottom; 6 x 6-in. timbers are used in the small shafts, and 8 x 8-in. timbers spaced 6 ft. apart in the larger, with 2 x 12 in. lagging. The cost of sinking is usually given as $40 to $50 per ft., and is customarily done on contract. As the shafts are practically dry, the water problem is not troublesome, particularly down to the 500 level, and bailing is employed instead of pumps for the small inflow. The usual custom is to contract for the labor, powder, and timber-setting, the company furnishing equipment, power, and timbers. In such contracts the cost is about $20 per ft. The speed of sinking will, therefore, have an important bearing in cutting down the overhead, and so getting a low cost per foot. Most of the shafts are vertical, but some inclines have been sunk at steep angles. Buckets are used in sinking, with crossheads in guides. The operating mines use skips for hoisting ore.

Drifting costs vary from $8 to $15 per ft. With a surplus of labor and good top equipment, the lower figure is more usual. Drifts are generally 5 or 6 ft. wide, and arched to 6 ft. high. Timbering is not usually necessary in development drifts, and the ground, though ragged, stands fairly well. When opened up along the vein, however, conditions are very different and the cost of timbering to keep the drifts open when stoping has begun is high. Equipment is light for prospecting. Buckets are trammed by hand over 8-lb. rails to the shaft. End-dump cars are used at the operating mines, and the ore is dumped on a grizzly at the shaft, where it drops into an ore pocket.

Overhand stoping methods are used in mining, with chutes to the lower levels. Filling is obtained by running raises into the hanging wall for waste, and this involves considerable expense. The ground breaks well, and there is not much trouble with blocked chutes. Stoping drills, known among the miners as "wiggletails," are used with solid steel. Both bull bits and four-point bits are popular. The dust problem has been attacked by using water sprays and having the men wear respirators.

Working conditions are made somewhat difficult by high temperatures and humidity underground. On the lower levels this becomes particularly oppressive, unless relieved by raises or connections to afford natural ventilation. On the bottom level (1,060) of one of the large mines the temperature is about 90 deg., and the water temperature reported at 103 deg. Ventilation, where possible, is obtained by natural air currents through raises, supplemented at dead headings by blowers and ventilating pipes. Booster fans are introduced at frequent intervals. The men work stripped to the waist on tramming and mucking. Change houses and showers on the surface are, of course, a necessity in even the smallest mines. Where connections have been made underground with other mines, conditions are much better.

WATER EASILY HANDLED IN MOST MINES

Pumping, except at the deepest levels, is not much of a problem. With prospects, if bailing is not resorted to, a small duplex pump is connected to the air line. This is uneconomical, but about the only resort where power is not available. The average amount of water pumped is 5,000 to 7,000 gal. per twenty-four hours. Ample water for domestic purposes is piped from nearby springs.

Gas engines are generally used for power, though the larger mines have electric power from an oil-burning plant at Kingman, that of the Desert Power Co. Rates are regarded as high, but this power is more economical for large-scale operations than are oil engines, aside from the question of greater convenience and freedom from break-downs. Present power rates are $0.0355 per kw.-hr., subject to discount for quantity consumption.

OIL ENGINES NECESSARY FOR SMALL PLANTS

At one of the smaller operating mines, where there was a long and steep haul to the plant, over 20 per cent grades, the following data were given regarding the operation of a 50-hp. compressor (240 cu.ft.) and a 25-hp. hoist, pulling 700 ft. The cost of fuel oil (tops) is given at 18c. per gal. delivered at mine: Oil consumption, hoist, 2½ gal. per hour; oil consumption, compressor, 7 gal. per hour; lubricants, 1½ gal. per eight-hour shift at 90c. per gal. Total cost of fuel and lubricants per shift, $15.75.

Although the advantages of the electric drive are recognized, the initial cost of equipment and transformers is high, and for isolated plants the oil engines are a necessity.

SUPPLY OF EXPERIENCED LABOR AMPLE AT PRESENT

Labor conditions are good. Owing to the shutdown of the copper mines, no scarcity of experienced men is to be recorded. At present there are more men than jobs, but a considerable proportion are "floaters," and there is no serious unemployment. The present wage scale is $4.50 for stope men, $5 for shaft men and blacksmiths, and $5.50 for drill men and hoist men. A cut of $1 was put into effect some months ago, which was accepted by the men without much trouble. For contract work in the shafts a bonus of $1 per shift is allowed by the contractor. Living costs are not notably higher than in places much more accessible to the railroad. Meals cost 50c. and are of good quality.

Although the present wage scale is high in comparison with that paid in the eastern mining districts, there appears to be no immediate intention of the operators to cut again. In the past it has been difficult to get good men at Oatman in competition with the copper mines, and the operators are unwilling to take advantage of the opportunities presented by the present situation. There is no union.

TOM REED MILL AND CYANIDE PLANT, OATMAN, ARIZ.

The cost of timber has been a serious item of expense in shaft sinking. Although it can be bought f.o.b. San Pedro at a reasonable figure, freight rates are high, and the cartage into Oatman is about $12 per thousand. In small quantities it is quoted at $80 per thousand delivered, but carload rates are much less. Considerable saving could be made by the small operators and those developing new properties by buying both timber and powder in carload lots, but this co-operation is not often possible, because of inability to place orders at the same time.

Diamond drilling is now being tried at several properties to prospect underground, instead of the conventional drifting and crosscutting. The cost is about $3.50 per ft., the operator furnishing air for power. The andesite can be drilled rather easily, and the plan has been indorsed by the larger companies.

Costs of mining and milling are reported as $6 to $7 per ton. They have come down somewhat from the peak figure, and will come lower, but very slowly. Labor is necessarily the chief item, and, as stated, no immediate wage cut is considered. More may be gained by better co-operation and by increasing the efficiency and output per man underground. With a steadier crew this is entirely possible. Costs of supplies, timber, and even power are dependent as much on a lowering of freight rates as on any other single factor. It has already been suggested that co-operative buying of timber and powder by the small companies would result in a substantial saving. There is not much chance for a lowering of power rates, except through an increased use of power by the district generally. These rates are under the control of the state commission, and profits are limited to a reasonable and equitable return on the investment.

LARGER TONNAGE AWAITING LOWER COSTS

It is essential, however, for the full development of the resources of the camp and the district generally, that costs should be reduced, as there is a considerable tonnage of ore exposed and available that cannot be worked under present conditions. The famous old Gold Road mine, for example, two miles from camp, is said to have a very large tonnage in sight and is only awaiting better operating conditions before resuming operation.

Oatman, in common with other gold camps during the last few years, has had to combat constantly advancing costs and insufficient and inefficient labor without a compensating advance in the price of its product. With the turn in the times, however, gold mining seems likely to come into its own again, and the camp should take on new vigor. There is considerable optimism in the district over the future, and a well-grounded belief that with its remarkable record of production, large extent of yet unprospected ground, and with the newly awakened interest in gold mining, Oatman will see much activity at an early date.

Copper for Welding Steel

The persistently high cost of labor and material has forced manufacturers to give the keenest attention to every promising source of economy in production. For this, among other reasons, there has been a revival of interest in a unique welding system developed in Great Britain a few years ago, and since put into commercial operation, says *The South African Mining and Engineering Journal.* This system depends upon the fact that if a piece of copper on an iron plate is heated in an atmosphere of hydrogen to the smelting point of copper, the copper will spread over the iron in a thin penetrating film like butter on hot toast. So, if the copper is melted between two pieces of iron it welds them together in an amazingly intimate fashion, the copper film actually working itself in between the crystals of the iron. By this process machine parts which can most conveniently be made in two pieces can be efficiently joined together without the complication of screws. In effect it enables the cheapness of separate manufacture to be combined with the strength and convenience of the solid combination. Steam turbine blades and the cage or body of a high-speed centrifugal governor for small steam turbines are among the articles which have been successfully made by this simple and ingenious process.

Flotation Tests on Zinc Table Slime

Experimental Work Indicates That Much Fine Material Now Going to Waste in Tri-State District Can Be Easily Floated With Naphthylamine-Toluidine Mixture and Copper Sulphate — High Recoveries Secured

BY M. H. THORNBERRY

Written for *Engineering and Mining Journal*

THE EXPERIMENTAL WORK here described was planned and carried out to provide the mine operators of the Missouri-Kansas-Oklahoma zinc district with facts concerning the amenability of their table slime to flotation. An attempt will be made to show that high-grade concentrate can be made economically; also that the concentrate so made will be a distinct addition to that made by usual gravity concentration. The oil and reagent needed should not put a prohibitive cost burden upon the operators. It is, of course, realized that flotation concentrates of any zinc tenor bear a penalty because of the fineness of the product.

The term "table slime" used in this article should not be confused with table sludge. Table slime is the discharge from the tables. This product is sent to the tailing dump in many of the mills, but in the modern plants it is sent to thickeners, after which it is given further treatment. Table sludge is the table feed, and is considered as any product that can be treated commercially and metallurgically on a concentrating table. Reports from two of the modern mills in the district state that approximately 9 per cent of the total mill feed is sent to the thickeners. This figure under normal operating conditions would mean a daily production of 13.5 tons of table slime for a 150-ton mill.

The slime for these tests was obtained from the Dorr thickener of the Golden Rod Mining & Smelting Corporation, Tar River, Okla., was barreled wet, and when received contained approximately 25 per cent moisture. A representative sample of the material gave the following analysis in per cent:

CHEMICAL ANALYSIS OF TABLE SLIME

Zn	13.77
Fe	0.92
CaO	6.83
MgO	5.41
Pb	0.76
Insoluble	55.51
Total determined	83.20

A screen analysis of the slime was next made. It was found necessary to screen the wet material because when dried the screen openings clogged, owing to the fineness of the slime. Tyler Standard screens were used, and the results were as follows:

SCREEN ANALYSIS OF TABLE SLIME

Screen Sizes	Diameter Opening, Inches	Sample Weights	Per Cent	Per Cent Cumulative Weights	Per Cent Zinc
65	0.0082				..
100	0.0058	9.28	2.25	2.25	2.18
150	0.0041	73.70	17.83	20.08	3.63
200	0.0029	124.50	30.13	50.21	12.17
200	0.0029	205.70	49.79	100.00	15.35

A series of preliminary tests was next made to ascertain the oil or combination of oils and reagents best suited to float the blende in this slime. In making these tests the desired weight of ore was approximated, placed in a laboratory Janney flotation machine, different oils and reagents added, and the effect noted.

After trying many oils, which included pine products, creosotes, coal tars, and special mixtures in combination, with and without different reagents, it was found that the "A.T. Mixture" (a mixture of alpha naphthylamine and ortho toluidine) from the Newport Chemical Co., of Passaic, N. J., when used with copper sulphate, produced such favorable results that it was decided to confine the research work to this combination.

The later tests were all made in a laboratory flotation machine of the Minerals Separation type. The impeller of this machine consisted of a ⅝-in. shaft, to which were fastened two sets of four-blade agitators of 2-in. radius. The lower set was fastened to the end of the shaft and the blades were set at an angle of 45 deg. to the horizontal. The other set was fastened 3 in. above the lower set, and the blades were left horizontal. The speed of the impeller was 1,500 r.p.m.

METHOD OF CONDUCTING THE EXPERIMENTS

The experiments were carried out as follows: A portion of the slime was thoroughly mixed and the moisture determined. A weighed charge of wet pulp containing approximately 700 grams of dry ore was poured into the machine, with sufficient tap water to give the charge a dilution of five parts of water to one part of dry ore, by weight. The machine was started and allowed to run until the charge was well mixed, after which a quantity of oil equivalent to 0.75 lb. per ton of dry ore was added and the agitation continued. Copper sulphate was then added, and the froth skimmed off. That portion of the froth removed during approximately the first half of the test, and while the bubbles appeared to be carrying practically nothing but blende, was designated as the concentrate. That portion removed after the concentrate, and until apparently no blende was carried up with the bubbles, was designated as the middling. The total time for each test varied between fifteen and twenty minutes.

The first series of tests was made for the purpose of ascertaining the minimum amount of copper sulphate necessary to float the blende in this slime. It was found that this reagent produced the best results when added all at one time and after the oil had been added. The results show that 70 c.c. of a 1 per cent solution of copper sulphate produced a very good concentrate and a good recovery. This amount involves approximately a consumption of two pounds of copper sulphate per ton of slime treated.

The concentrate and middling from each test were dried, weighed, and assayed, whereas the tailing from each test was only sampled and assayed. The recovery was calculated in the following manner:

$$\frac{(\text{Weight of Concentrate} \times \text{per cent Zn}) + (\text{Weight of Middling} \times \text{per cent Zn})}{\text{Weight of charge} \times \text{per cent Zn}}$$

In the table which follows are results which are representative of the large number of tests performed in this work. Every result shown in the table has been checked at least once, and some of the results have been checked as many as three times.

RESULTS OF EXPERIMENTAL FLOTATION WORK

	Oil		Reagent		Results					
Test No.	Amount, Drops	Kind	Amount, C.C.	Kind	Concentrate Wt. Grams	Concentrate Per Cent Zn	Middling Wt. Grams	Middling Per Cent Zn	Tailing Per Cent Zn	Recovery, per Cent
1	8	A.T.	30	$CuSO_4$	48	54.70	39	41.44	8.12	44.0
2	Drops	Mixture	40	in	98	54.91	20	45.60	5.09	65.0
3	in	in	50	every	120	57.91	27	43.30	2.34	84.0
4	every	every	60	test	130	58.74	25	40.92	1.37	88.5
5	test	test	60		130	58.33	27	39.16	1.40	88.0
6			70		150	57.08	17	26.31	1.22	92.8
7			70		150	58.84	12	32.45	0.58	95.0
8			70		148	58.64	14	31.50	0.61	95.0
9			80		150	58.42	17	25.41	0.60	95.0
10			90		149	58.70	16	22.81	0.59	95.0

Edward H. Robie, in his paper on "The Use of Naphthylamin and Xylidin in Flotation," *Engineering and Mining Journal*, Vol. 108, No. 18, page 731, makes the following statement: "When operating with X-cake-xylidin, economy requires the use of the largest possible amount of return water. Flotation operators have found that when oils are used in a closed circuit only a little less oil is required than when the mill feed is made up entirely of new water. The insoluble parts of the oil are probably lost entirely, and only a part of the soluble constituents is returned to the frothing cells with frothing properties unimpaired. With X-cake, this has not been found to be the case. Whatever amount is returned in the water from concentrate or tailing seems just as efficient as ever. Apparently little or no deterioration occurs in settling ponds, although the water gradually turns a dark brown. Considerably less of the agents under discussion are therefore required if the make-up water is kept at a low proportion of the total."

To verify the above statement several series of tests were run in the following manner:

One of the weighed charges was run as previously described. This test has been designated as No. 1-A. The water from test No. 1-A was siphoned off and used for the next test. No oil was added, but the same amount of copper sulphate was found to be necessary. This test was called No. 2-A. The water from test No. 2-A was siphoned off and used in like manner for test No. 3-A. The froth which formed in test No. 2-A had the same characteristics as that formed in No. 1-A. The froth in test No. 3-A, although it did not appear to be as stiff as in tests No. 1-A and 2-A, carried practically as much blende. One set of these results is tabulated below.

EXPERIMENTS TO SHOW PERSISTENCE OF A. T. MIXTURE

	Oil		Reagent		Results					
Test No.	Amount, Drops	Kind	Amount, C.C.	Kind	Concentrate Wt. Grams	Concentrate Per Cent Zn	Middling Wt. Grams	Middling Per Cent Zn	Tailing Per Cent Zn	Recovery, per Cent
1-A	8	A.T. Mixture	70	$CuSO_4$	153	57.00	25	12.43	1.01	95
2-A	None		70	$CuSO_4$	148	57.71	26	21.76	0.81	95
3-A	None		70	$CuSO_4$	149	58.22	18	21.86	0.92	95

CONCLUSIONS BASED ON THE TEST WORK

1. Copper sulphate is the main factor in the concentration of the blende in this slime by flotation.

2. The "A. T. Mixture" of the Newport Chemical Co., of Passaic, N. J., in conjunction with copper sulphate, was the oil best suited to float the blende in this slime. The amount of oil used in each test is equivalent to 0.75 lb. per ton of dry ore.

3. The best results were produced by 70 c.c. of a 1 per cent solution of copper sulphate, this amount being equivalent to approximately 2 lb. per ton of dry ore.

4. Small amounts of copper sulphate added at intervals did not raise the blende as well as when added all at one time.

5. The oil must be added first. When the copper sulphate was added to the charge before it was poured into the machine, practically no blende floated.

6. The consumption of oil may be lowered considerably by returning the water from the concentrate and tailing to the flotation cells.

German Potash Loses Markets

The German Potash Syndicate has issued figures in its semi-annual statement placing Germany's production of potash salts during the first six months of 1921 at 4,454,261 metric tons, or 497,373 tons of pure potash, according to William T. Daugherty, Assistant Trade Commissioner, Berlin, in *Commerce Reports*.

The sales from this production during the same period, according to the syndicate, amounted to 1,546,353 tons of potash salts, or 366,633 tons of pure potash. The difference between the figures of production and those of sales is due to the loss of weight undergone in the process of working up. Most of the sales (1,408,911 tons of salts, or 333,281 tons of pure potash) were made in the domestic market. The remainder (137,442 tons of salts, or 33,352 tons of pure potash) was sold in relatively small quantities, as compared with before the war, to The Netherlands, England, Czecho-Slovakia, Austria, Italy, and Spain.

During the year 1920 Germany produced 11,386,439 metric tons of potash salts, of which 4,313,325 tons was sold, and sales of pure potash amounted to 923,643 metric tons.

The loss of foreign markets, which before the war absorbed 46 per cent of Germany's sales, is attributed in a large measure to the competition resulting from the acquisition by France of the important deposits of Alsace Lorraine under the terms of the Treaty of Versailles. During 1920, out of a total production in the Alsace mines of 1,061,197 metric tons of potash salts, 450,000 tons was sold to France, 327,000 tons to the United States, 117,000 tons to Belgium, and 92,000 tons to England. Furthermore, the former pre-war market in Poland, and through Poland to the East, has been cut off by reason of political and economic conditions in that quarter.

Of the total German production of 4,454,261 tons of potash salts during the first six months of 1921, there was a yield of 2,535,451 tons of carnallite (7 to 12 per cent salts), 1,828,959 tons of kainite (12 to 20 per cent salts), and 89,852 tons of sylvanite (over 20 per cent salts).

In the several districts yielding potash the production during the first six months of 1921 was as follows:

GERMAN POTASH PRODUCTION DURING FIRST SIX MONTHS OF 1921

Districts	Potash Salt Metric Tons	Pure Potash Metric Tons
Hanover	1,401,452	159,169
Stassfurt	1,024,836	101,900
Halle-Mansfeld	594,312	58,259
Sued-Harz	806,245	105,802
Werra	627,416	72,243
Totals	4,454,261	497,373

Hoist for Men and Supplies at Arizona Copper Mine*

BY R. E. DONOVAN

Written for Engineering and Mining Journal

THE United Verde Copper Co., at Jerome, Ariz., has recently installed new equipment on the 500-ft. level of its No. 6 shaft, for rapidly hoisting and lowering men. Supplies can also be taken into the mine down this new shaft.

The United Verde mine is 2,400 ft. deep, and has extensive workings. At present, about 1,800 tons of sulphide ore, containing 6 per cent copper, is mined per day. Approximately 400 men are employed underground on each shift. The length of a shift in Arizona is limited by statute to eight hours from "collar to collar." The law also limits the hoisting speed for men to 800 ft. per minute. With the old hoisting equipment, which consisted of two double-decked cages in No. 4 shaft and two double-decked cages and a "chaser" in No. 3 shaft, each deck holding nine men, forty-five minutes was required to lower a full shift of 400 men. With the new equipment the same number can be handled in twenty-five minutes, or practically one-half of the time formerly required. Also, under the old arrangement, when the shift was ready to come up, men often had to wait twenty to thirty minutes before they could be hoisted. This waiting, done on the company's time, is now eliminated, as the new cage arrives at each station at a stated time and will carry all men waiting at that station. The power loss resulting from making many trips with small loads of men and supplies will also be eliminated, owing to the large capacity of the new cage. The new installation has many safety improvements not found in the old equipment.

Formerly all timber, steel, and supplies had to be transferred at the collar of the shaft, and again transferred to trucks on the different levels. With the new equipment, the standard steel and timber trucks are lowered on the double-decked man-cage and run direct from the shaft to the working place, no unloading being necessary except at the stopes.

No. 6 shaft, which was started over two years ago, extends from the 500 level to below the 1,800 level. It is expected to be completed to the 2,400 level within two years. It will be used exclusively for lowering and hoisting men and supplies. The shaft was constructed by raising in sections of 200 ft. from the 700 to the 500, from the 900 to 700, and so on. Three cubic yards of concrete were used to each foot of the shaft, and each 200-ft. section was concreted separately. The shaft has a hoisting compartment 8 x 13 ft., a counterbalance compartment, a pipe compartment, and a manway. The cost of construction, including raising, trimming, and concreting, was approximately $210 per foot. An adit level, called the "500 surface level," connects the collar of No. 6 shaft with the surface buildings and change house. This adit is 1,635 ft. long, timbered, and large enough to permit a pathway on one side of the standard-gage track. The track is provided with a third rail, and both the standard-gage electric trolley and the narrow-gage electric-storage battery locomotives haul supplies through the adit.

The hoist room is 120 ft. from the center of the shaft. It is 44 by 45 ft. and 26 ft. high, is well lighted, has concrete walls, and contains a hoist and motor. The cableway, 140 ft. long, is at an angle of 32 deg. above the horizontal. The sheave wheel is 70 ft. above the collar of the shaft. The cableway is about 10 x 7 ft. in cross section. An iron ladder is put alongside the cable.

Opening off the hoist room on the south side is the motor generator room, which is 20 x 32 by 13 ft. in height, has concrete walls, and contains two motor generator sets which change alternating current at 2,200 volts to direct current at 250 volts. The equipment supplies power for all underground haulage motors, including the charging panels for the storage-battery locomotives on the intermediate levels. It also furnishes power for small fans which are connected to the trolley circuit and used for ventilating purposes.

The hoist, which was put into operation on March 16, 1921, has a single cylindrical drum, 12 ft. in diameter, holding 2,500 ft. of 1¾-in. extra plow-steel rope, in two layers. The drum is coupled direct to a counterbalance reel, which has a hub diameter of 6 ft. 1 in. and a rim diameter of 12 ft. This reel will hold 1,920 ft. of ½ by 5-in. seven-strand flat rope.

The maximum rope speed is 800 ft. per minute, with an acceleration period of six seconds and a retardation period of five seconds. The flat cable passes over two 8-ft. sheaves, one being at the lower end of the inclined cableway and placing the flat rope in the same plane as the round rope. The round rope passes over a 10-ft. sheave, which varies from the ordinary sheave in that the rim is fastened to the hub by disks of ⅜-in. plate. The brakes are of the parallel motion, gravity, post type, set by a deadweight and released by a hydraulic oil-thrust cylinder. The hoist is operated by a 350-hp., three-phase, 60-cycle, 2,200-volt, round-wound induction motor, with liquid rheostat control. The gear ratio is sixteen to one. There is no clutch on the hoist.

The cage weighs 13,000 lb. It is a double-decked cage, 24 ft. high, each deck being 6 ft. 8 in. by 12 ft. 7 in., and accommodating between 120 and 140 men. Two 18-in. gage tracks give each deck a capacity of four cars. The cage is fitted with double gates, which have offset hinges and prevent the gates from swinging outward. It is also equipped with the ordinary safety dogs and, in addition, has two chains from the cage to the cable above the clevis. The weight of the cage and men is balanced by a counterweight of 31,500 lb. The varying weight of the cable in the shaft is offset by the varying diameter of the counterbalance reel. When not handling a full load the counterweight is too heavy for the cage. To offset this disadvantage, a car of scrap drill steel is run on the lower deck and only one deck is used for ordinary service.

The hoist is provided with an over-speed safety device, which breaks the power circuit and applies the brakes in case the cage should attain a speed of more than 800 ft. per minute. The shaft is also provided with limit switches at both the upper and lower extremities. These also cut off the power and apply the brakes in case of over-winding or lowering. All station gates have lock-switch contacts, which prevent the cage-rider from giving the signal before the gates are closed.

A substation has been cut 10 ft. below the collar of the shaft, with a concrete stairway leading to it from the level. This will enable both decks of the cage to be loaded at the same time. A room has been excavated and concreted alongside of the shaft, and contains a crane for changing cages when repairs are needed. An extra cage will be kept in this room.

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Geologists of Note

Frank L. Hess

FRANK L. HESS was born in Streator, Ill., which, at that time—Sept. 4, 1871—was a small coal mining town. On his father's side his ancestors were early German and Dutch settlers and Revolutionary soldiers. On his mother's side he was descended from German, French, and Scandinavian ancestry. His father, a physician, had a taste for various sciences, particularly geology, and from him young Hess acquired a love for rocks and minerals. The dumps of the coal mines offered a good opportunity to the juvenile collector, as the shales from the roof contained many ferns and other plant forms and in the waste coal there was to be found a little pyrite and rarely a pyritized gasteropod shell. The glacial drift afforded some corals, and along the little Vermilion River were a few outcrops of thin fossiliferous limestones. As a small boy Hess tramped the neighborhood over hunting such occurrences, and the desire to become a geologist possessed him from the time he was eight or nine years old. But in this community, with no mineral resources other than coal, clay, and a little poor sandstone, there was nothing to inspire the belief that a living could be made in such a profession, so after going through the common and high schools of the place he farmed for a time in Minnesota and Illinois, and was teller in a bank, later moving to California and ranching between Visalia and Tulare. While at this place he became familiar with metal mines, and, finding that a living might be made through the practice of geology, the old desire again became strong and he left the ranch and went to Stanford University. While there he worked for the U. S. Geological Survey during two summer vacations. To get work one summer he had to take a job as assistant packer; he took care of the nine head of horses before breakfast, did eleven hours of work as a geologist, and again took care of the stock after the day's work was over.

FRANK L. HESS

In 1903 Hess was graduated from Stanford, was married to Miss Eva Roseberry, and went to the Nome region, Alaska, as a field assistant on the Survey, and he has been associated with that organization from that time. He spent three seasons in Alaska studying the gold deposits of the Nome, Council, Fairbanks, and Rampart regions and the tin deposits of the York district, and later he studied many of the mining regions of the United States, and made a specialty of the rare metals. His studies and publications have covered tungsten, radium, and other of the rarer metals, the rare-earth metals, gold, silver, tin, nickel, gypsum, magnesite, graphite, arsenic, oil, and other deposits. This work has been of such a nature as to give him an unusually wide variety of geological experience, and the research has been mostly among the less known, and therefore scientifically more interesting, minerals, but those which are of the smaller money value. Geologists of the U. S. Geological Survey are permitted to engage in private professional work outside of the United States, and Mr. Hess spent the winter of 1919-1920 in Bolivia examining tin and tungsten deposits for one of the large American mining firms and for local Bolivian and Chilean companies. Owing to his interest in the U. S. National Museum, in Washington, Mr. Hess was made Honorary Custodian of Rare Metals and Rare Earths, and has assisted in building up at that institution what is probably the best collection of tungsten and other rare-metal minerals in the world.

Mr. Hess has published about two hundred papers on various geological and economic subjects, and at the last meeting of the Society of Economic Geologists at Wilkes-Barre he presented a paper, "Some Unique Bolivian Tungsten Deposits." He belongs to the American Institute of Mining and Metallurgical Engineers, the Society of Economic Geologists, the Washington Academy of Sciences, the Geological Society of Washington, and is a member of the Petrologists' Club. Among his writings are the following: "The Magnesite Deposits of California," 1908; "The Gypsum Deposits of California," 1910; "A Bibliography of the Geology and Minerology of Tin," in collaboration with Eva Hess, 1912; "Colorado Ferberite and the Wolframite Series," in collaboration with Waldemar Schaller, 1914; and "Tungsten Minerals and Deposits," 1917.

The "Journal's" Editorial Dinner

Gold Medal Awarded to Walter Fitch, Jr., Co. for Breaking World's Shaft-Sinking Record Speakers' Program Includes a Great Diversity of Topics—Aids for Improvements in Metal Mining Proposed—Standard Ore Sale Contracts Urged

GOOD FELLOWSHIP, friendly criticism, sincere approval, and assurances of co-operation were in evidence at the editorial dinner of *Engineering and Mining Journal*, held at the Harvard Club, New York, on Thursday evening, Jan. 5. The guests, numbering forty-three, included members of the editorial staff and contributors. The dinner, in addition to being in the nature of a conference, was also the occasion of the awarding of the gold medal for the breaking of the world's shaft-sinking record to the Walter Fitch, Jr., Co., of Eureka, Utah.

In his opening speech as toastmaster, J. E. Spurr said that he had looked forward to such a gathering of the editorial group with great pleasure. He spoke briefly concerning the early history of the *Journal*, its place in the mining industry, and the part which is played by the editors and contributors in the preparation of the paper. He gave interesting figures to show the manner in which the various developments and activities of the mining industries were covered in the *Journal* during 1921, and called attention to the number of correspondents (about fifty) in various parts of the world, and the importance of the market reports.

NEED FOR STANDARD SALE CONTRACTS

In introducing the first speaker, Dr. A. R. Ledoux, Mr. Spurr referred to him as "our sage and Nestor of engineers." Dr. Ledoux said: "The shippers of ores or metals are largely not represented in New York. They are increasingly abroad. The future of the industry in the East at least is not to handle material originating in this country, which will be fabricated in the West, and New York and the Eastern coast is going to depend for supplies on imports, and these people in foreign countries don't know how to make contracts."

George J. Young, Western editor of the *Journal*, was the next speaker. Mr. Young said that at one time there was current in the West a conviction that *Engineering and Mining Journal* was owned by the A. S. & R. At another time the labor unions were convinced that the *Journal* was decidedly capitalistic and opposed to labor interests, but all of this has changed. He also spoke briefly on the relation of the *Journal* to the West and to Western subscribers.

Mr. Spurr remarked that the reference to the ownership of the *Journal* by the A. S. & R. Co. afforded an opportune time to introduce one of the men of that company, so he called on Joseph Clendenin. Mr. Clendenin, in giving his opinion of the *Journal*, said that he regarded it as "the representative newspaper in the metal industry." Prof. B. L. Miller, of Lehigh University, was introduced by the toastmaster as the "author of the best book on the geology of South America, because it is the only one." Professor Miller stated that the subject of graphite, which had been assigned him, seemed too dark a subject to discuss during the evening. In addition to having been assigned the topic of graphite, Professor Miller was also asked to talk on mining geology, on which he spoke briefly, and made humorous references to the use of newly discovered appliances for finding ore and petroleum.

S. S. Tuthill, secretary of the American Zinc Institute, the next speaker, pointed out the necessity of protecting American zinc. He said: "We have got to develop mining zinc in our own borders, and if we do not there is going to be no American zinc. This year we made 250,000 tons of American zinc in this country, whereas we should have made 560,000 tons, and I believe we should first take care of ourselves before we worry about anybody else."

RICE DISCUSSES TUNNELS

The subject of safety was assigned to George F. Rice, chief engineer of the U. S. Bureau of Mines. Mr. Rice spoke briefly of the work of the Bureau in connection with tunnels for mines and tunnels for vehicles and pointed out that there were certain matters of common interest in the work. Mr. Spurr facetiously remarked that besides being owned and controlled by the American Smelting & Refining Co. and the American Metal Co., the *Engineering and Mining Journal* was also exclusively owned by the St. Joe Lead Co., and accordingly he called upon its representative, I. H. Cornell. Mr. Cornell stated that the marketing of lead in 1921 has been a pretty sad affair. He said that every time he quoted a low price on lead and his competitor got the order he felt disappointed, and every time he quoted a price and got the order himself he was even more disappointed.

Mr. Spurr next called upon H. C. Parmelee, editor of *Chemical and Metallurgical Engineering*. Mr. Parmelee mentioned his brief connection with the *Journal* and related that he had been instrumental in securing Mr. Spurr as editor. The several talks mentioned above were interspersed by the reading of letters that had been received from a number of contributors in various parts of the country, who had been invited to attend the dinner, but were unable to do so.

WESTERVELT PRESENTS GOLD MEDAL

Mr. Spurr then called upon W. Y. Westervelt, who was chairman of the committee of engineers who judged the awarding of the medal, to present the medal to P. M. White, whom Walter Fitch, Jr., had appointed as his personal representative. Mr. Westervelt outlined the work done by the committee in preparing the set of rules governing the contest, and also pointed out many of the details concerning the work done by the Walter Fitch, Jr., Co. Mr. Westervelt also announced that Mr. Young, Western editor of the *Journal*, will present to the forty-three members of the crew at Eureka silver replicas of the same medal, each man receiving his own silver medal.

Mr. White, in receiving the medal, said that he felt like the Frenchman who had a number of medals, and one man asked him how he came to get them. The first medal, he said, was a mistake, and the other powers naturally followed suit. Mr. White stated that he was no longer in mining, although he had been very much interested in the contest. He closed by saying that he wished to thank the committee and *Engineering and Mining Journal* on behalf of Mr. Fitch.

Referring to the award of the silver medal, Mr. Spurr said: "It is, of course, a fact that the *Engineering and Mining Journal* is owned and controlled by the American Federation of Labor, and when we announced our gold medal we immediately received word from them that they resented a medal awarded to capital, and that we would not be allowed to go on if we did not also award a medal to labor; so we promptly came back and said we would give a silver medal to every man who mucked out or drilled. We had in mind a small, select crew, but when the picture came we counted them up and there were forty-three. Here are forty-three medals just as big and just as pretty as the gold medal, excepting that they are made from silver—presumably foreign silver."

D. E. A. Charlton was the next speaker, and despite the fact that five topics had been assigned him, he elected to tell a Cousin Jack story relating to high costs.

"JOURNAL" METAL QUOTATIONS EXTOLLED

Mr. Spurr then introduced Julius Loeb, president of the American Metal Co. Mr. Loeb stated that he thought it was a remarkable testimonial to the standing and high respect in which *Engineering and Mining Journal* and its quotations are held by those transacting business on the basis of these quotations that they have been unquestioningly adopted, at least for zinc, for the last ten years or more.

KELLY DESCRIBES WORK OF REAL "DIVINING ROD"

Sherwin F. Kelly, the next speaker, spoke of his recent work with the invention of Professor Schlumberger, of the Ecole des Mines, and told of the results obtained in experiments in various mining districts ranging from Ducktown, Tenn., to Timmins, Ontario. He stated that this method of electrical prospecting is simply a guide in the orienting of a diamond-drill campaign, or the continuing of the development of a partly developed area or country.

S. H. Dolbear, the next speaker, said that he had always had a great admiration for editors, and could talk about them in general without singling them out. This he attributed to the fact that in his youth he became reckless and became a publisher of a country newspaper, near San Francisco, in a small mining camp. According to his story he continued there about six months, and during that time he made more enemies and lost more money than in any period before or since.

GEOLOGY APPLIED TO DINING

Mr. Spurr then introduced A. H. Hubbell, news editor of the *Journal*, and also editor of the "By the Way" column. Mr. Hubbell spoke of the co-operation which he received in securing news from the various points in the mining field, and also referred to the practice which some of the *Journal* readers have of taking seriously the "By the Way" page. In closing, Mr. Hubbell made reference to Mr. Spurr's book "Geology Applied to Mining" and added that the entertainment of the evening furnished an excellent example of what "Geology can do when it is applied to dining."

J. H. Lang, president of the American Metal Exchange, said that he did not feel obliged to give much of a speech, inasmuch as he had been asked to talk on the subject of tin mining in America, and there was no such thing. Continuing seriously, Mr. Lang added, "We have got a perfectly good metal exchange in New York, and if we were to work and really do our business on our own exchange, we would have the greatest metal exchange in the world and be a great benefit to the metal trade and the commercial and financial interests of the entire country."

In introducing the next speaker, Mr. Spurr stated that he almost said that he was going to ask him to speak on "one of the burning questions of the day." He referred to F. G. Clapp. Mr. Clapp stated that he had been very much pleased with the Petroleum Section of *Engineering and Mining Journal*.

WAR FINANCE CORPORATION REVIVING BUSINESS

H. G. Moulton, former assistant to the chief of the War Finance Corporation, was the next called upon. Mr. Moulton outlined something of the past and present work of the War Finance Corporation, which just now is engaged principally in trying to revive business, which ultimately, he stated, means a revival of business in the mining industries.

F. F. Colcord, upon being called by the toastmaster, decided to speak on "nothing else" instead of "anything else." Mr. Colcord stated that he was in the position of the railroad man who was accosted by the new president of the road. After telling the president that he had been working for the company for twenty-five years, the president asked him what was his job. The man replied that he did not know, and Mr. Colcord related this incident to illustrate the fact that he did not know what he would speak about.

CONTACT AS APPLIED TO EDITORS

Mr. Spurr next introduced Kirby Thomas as a "well-known optimist, who is certainly not a bear on the United States." Mr. Thomas said that if mining was accepted as a game of chance and put into the same class with gambling, preaching and getting married, he supposed that the *Journal* might be classed with the *Police Gazette* or Izaak Walton's paper or perhaps with the *Matrimonial News*.

Paul Wooton, Washington correspondent of *Engineering and Mining Journal*, was introduced by Mr. Spurr as "*persona grata* in Washington." Mr. Wooton dates his connection with the *Journal* from May, 1906, when he was running a weekly paper in southern Mexico, and was installed as correspondent for that section of the *Mining World*, which was afterward taken over by *Engineering and Mining Journal*. Charles Hardy, the next speaker, in speaking of the marketing of foreign ores, stated that apparently nobody realizes how few people buy foreign ores. Mr. Hardy said: "If you take tungsten ore, you have eighteen buyers; of manganese six; of copper ore, probably four at the most; yet though there are so few buyers you cannot bring the four or six of them to adopt a standard contract."

IMPORTANCE OF NEAR EAST MINING

Mr. Spurr, in introducing the next speaker, made reference to his own residency in Constantinople, when he was in service of the Sultan of Turkey as consulting mining engineer. He then introduced Djevad Eyoub, who sketched briefly mining conditions in the Near East, and called particular attention to the petroleum deposits of Mesopotamia, which he predicted would some day be one of the most important fields in the world. He hoped that the United States would prevail upon Great Britain to have some interest in that section. E. L.

Gruner spoke on the subject of mining engineers' reports. These he defined as "some optimistic, some pessimistic, and most of them non-committal."

METALLURGY IN THE "JOURNAL"

E. H. Robie referred to the articles on metallurgy which have appeared in *Engineering and Mining Journal*. He said that for every hundred men that are interested in mining there are possibly half of those who are interested in milling, five or six in smelting, and one or two in refining, so that it was hardly to be expected that the *Journal* should devote quite as much attention to the metallurgical side of things as other activities treated in the paper.

Dr. H. M. Payne said that he had always found the *Journal* one of the greatest aids that he has in his work. He also called attention to the human side of the publication, and said that this attribute had given mining men a general feeling that mining, after all, is a pretty good thing with which to be connected.

S. Sussman, in speaking of the London metal exchange, stated that "it acts as a sort of a clearing house for the metal industries of all the world." London is, after all, the oldest metal market, said Mr. Sussman.

S. H. Ball was asked to speak on the subject of diamonds in the Belgian Congo. He replied that he had a very interesting lecture which did not take more than four hours to deliver, so he begged to be excused on account of the lateness of the hour.

COPPER MINES TO RESUME SOON?

M. H. Crego, of the Phelps Dodge Corporation, said that he expected that inside of three months most of the copper mines are going to start something. He stated that the employment situation would probably be a serious question, because many of the men who have lost their employment in copper camps have left for other districts.

Oliver Bowles, of the U. S. Bureau of Mines, told of the work in non-metallics which is being done by the Bureau. He stated that he was interested in knowing from the summary of subjects covered by the *Journal* of last year that the literature published on non-metallics would make a book of 350 pages. Mr. Bowles hoped that this would increase in volume and that the contributors would keep in mind the tremendous importance of the non-metallics in the economic life of the country.

E. H. Behr spoke with relation to the establishment of a metal exchange in New York. He said that it would be the logical outcome of present conditions, inasmuch as this country is the biggest consumer and the biggest producer of non-ferrous metals.

W. Spencer Hutchinson recalled his first connection with *Engineering and Mining Journal*, about twenty-five years ago, when Professor Richards had recommended him to Mr. Rothwell, who had invited him to come to New York and join the *Journal's* staff, but he decided to stick to mining.

THE VALUE OF "JOURNAL" MARKET QUOTATIONS

H. M. Brush stated that *Engineering and Mining Journal* was taking a real responsibility on its shoulders in giving out to the world quotations which form the basis of millions of dollars' worth of contracts. There is no hesitancy on the part of any of the companies to offer either to buy or to sell on *Journal* quotations, and he felt sure that the editors would continue to give this matter the most careful, conscientious and exact attention which they have done in the past.

F. E. Wormser related briefly some of the experiences encountered in the preparation of the market quotations. He expressed appreciation for the co-operation which had been received from the producers and consumers in New York and elsewhere.

E. C. Holden, in replying to the toast "The Old-Time Mining Engineer," said that the old-time mining engineer very much resembled the miner of today. "He had a Lizzie, for instance. Of course it had long ears, but it has a brain very much like the one we have today. The old-time mining engineer was an irreproachable thing. You would not dare approach him, because he was a good shot both with his revolver and his tobacco juice."

V. C. Leftwich was assigned the subject "How Can the *Journal* Be Improved?" but he stated that inasmuch as his subject was limited to a three-minute discussion he did not know whether it was too long or too short a time.

DR. KUNZ DISCUSSES DIAMONDS

Dr. G. F. Kunz pointed out the simplicity of the metric system as against our modern system of weights and measures, comparing the latter to the Tower of Babel. Briefly summing up the diamond situation, Dr. Kunz remarked that it is not that diamonds are not selling, but the fact that the diamond producers are much worried because many diamonds are getting on the market and that interferes with the production. He said that it would be just as if every old pot and kettle made of copper or brass in the United States were melted up and came into the market, and he regards the situation as a serious one.

H. J. Wolf, in speaking on "Our Duty to the Mining Industries." said that he had come to the conclusion that oftentimes the best articles were in the fewest words and were almost always those that were systematically arranged and showed that the man had thought over his subject systematically. He closed by telling the Mark Twain story concerning the preacher who talked so long that one of his parishioners, who was charitably inclined at the beginning of the sermon, and had decided to place a large donation in the collection plate, ended up by removing 10c. when the plate was finally passed.

STANDARD ORE CONTRACTS ADVOCATED

Dr. A. R. Ledoux spoke briefly on the suggestion made earlier in the evening by Mr. Hardy, relative to the procuring of standard contracts for the sale of ores and metals in the American market. He stated that there was a great discrepancy between contracts, and if a more general form of contract could be adopted for copper, silver, gold, and the other metals the accomplishment would surely be worth while. Dr. Ledoux also proposed a vote of thanks to the host of the evening and his associates on *Engineering and Mining Journal*, for the instructive evening and the dinner.

Mr. Spurr in closing said: "I wish to express my thanks to you. All my joy and anticipations with which I looked forward to this meeting have been fully justified. I wish to thank you for your co-operation in the past. I want to work with you in the future. I thank you for your praise; I thank you for your adverse criticism, and I want to make 1922 a better year than we did 1921."

Mr. Fitch's Story of the Breaking of the Record

Efficiency Plus Marked Every Phase of Operations in Completing the Work—Handling of Materials and Arrangement of Shifts Essential Features of Achievement

THE FOLLOWING ACCOUNT of the methods used and other data relating to the sinking of the Water Lily shaft at Eureka, Utah, has been courteously supplied to us by Walter Fitch, Jr.:

In 1916 we made 261 ft. in thirty-one days in the Homansville shaft. At that time we announced a World's Record, and as no one contested it we assumed our claim was correct. This accomplishment, however, aroused new interest, and in a few years our record was exceeded several times. On May 15, 1920, *Engineering and Mining Journal* made this contest official and offered a gold medal for the World's Shaft-Sinking Record, appointing a committee to award the prize and specify rules and regulations.

Upon being awarded the contract for the Water Lily shaft in July, 1921, we were quite convinced that the conditions there were favorable for record speed. We therefore set about to make our plans accordingly. The management of the Chief Consolidated Mining Co. gave us all necessary support and encouragement, and so equipped the property as to make the utmost speed possible.

We estimated an advance of 350 ft. or more in a thirty-one-day period would be possible by shortening the cycle of operations, including drilling, mucking, and timbering, which are ordinarily distributed over twenty-four hours, into eight hours, making three complete cycles in a day. Better results can be obtained by three short rounds each day than one or two long ones. Short rounds break and drill better, save explosives, and are more quickly ventilated.

The shaft is vertical and was bottomed at 115 ft. at the beginning of operations. Two compressors supplied air, averaging from 100- to 115-lb. pressure. Hoisting was done through two compartments by separate hoists electrically driven. The crossheads were eliminated the first few hundred feet to avoid accidents and facilitate the work. We lined each of the hoisting compartments with two vertical lagging on the inside, equally spaced to prevent the buckets from catching the timbers. Non-rotating hoisting cable is absolutely essential when operating in this manner.

The buckets were dumped by an automatic discharger. Through this ingenious device, developed by H. L. Connelly, master mechanic of the Chief Consolidated Mining Co., the hoisting of muck was greatly accelerated. The timbers used were 8 in. x 8 in., sets being spaced at 5-ft. intervals. Outside shaft dimensions are 15 ft. 6 in. x 5 ft. 9 in. divided into three compartments of 4 ft. 4 in. x 4 ft. 6 in. each. The entire shaft was lined on the outside by 2 in. x 12 in. lagging. The manway was carried in the third compartment with a staggered ladderway. In this compartment was also carried the ventilation pipe and air line.

A set of steel I-beams to protect the set timbers in the bottom against the blasting of the rock was suspended by two chain blocks below the last set. By lowering it sufficiently to install a set of timber it also served as a platform on which the timbermen might work without interfering with the operations of drilling and mucking in the bottom. This method is indispensable for speed and affords additional protection for the men.

We wished to follow our accustomed plan of bonusing the men, but with the monthly footage we had in mind no ordinary base could be used, and it was feared any reasonable award would seem beyond their reach. The additional speed we had planned was not to be obtained through increased efforts on their part alone, but a proportion was to be gained through the methods and supervision applied. We finally decided upon the following table of rates and bonus, and, establishing our pace almost immediately, the men soon saw the possibilities and applied themselves with great enthusiasm.

WATER LILY SHAFT WAGE RATE

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

BONUS

[illegible]	[illegible]	[illegible]
212	$15	
262	30	$15
287	45	
312	60	[illegible]
337	75	
362	90	45
387	105	
412	120	60
437	135	
462	150	75

With creditable pride the men were anxious to establish a record and also to receive the award of a silver medal offered by *Engineering and Mining Journal*. As the shaft was situated six miles from Eureka, it was deemed advisable to take the men to and from work by motor truck, rather than camp them on the job. Small temporary camps are unpopular and make it difficult to retain some desirable workers. The monthly labor turnover speaks for itself, considering the fact that there were only four changes made during this period. The crew itself made short work of any slackers. Men usually work more efficiently for a contractor, because as a rule they can earn more money and make a better showing through the individual attention they receive.

The machines used consisted of seven Denver Rock Drill Manufacturing Co.'s "Waugh Clipper-55," one Ingersoll-Rand "DCR-14," and one Sullivan "DP-33 air tube rotator." An average of five machines were operated each shift. Seven-eighths-inch hexagon hollow drill steel with the double taper bit was adopted for the work.

All but 60 ft. of the record run passed through a porphyry formation of average hardness, and the remainder was limestone. Almost the same rate of speed was maintained in both formations. In another thirty-one-day period an advance of 416 ft. was made through hard limestone. Hercules Gelatine LF powder of 35 per cent was sufficient in the porphyry, but considerable 50 per cent was necessary in the limestone. The powder was detonated by Dreadnaught fuse and No. 8 Hercules blasting caps. No water was encountered.

A blower conveyed fresh air through an 8 in. galvanized pipe to the bottom of the shaft.

J. D. Matheson, general foreman, and Henry Jarvis, shaft foreman, are entitled to great credit for the methods employed and the skillful supervision applied.

The following table of averages, I think, will supply all the remaining details of interest:

World's shaft sinking record	427½ ft. in thirty-one days
Size of buckets	17 cu ft.
Power per ft.	15.25 lb.
Average footage per day	13.80 ft.

	Number
Buckets hoisted per shift	72.5
Sets timber installed per day	2.8
Timbermen per day	4.8
Shaftmen per shift	5.7
Holes drilled per round	23.9
Rounds per day	3.0
Hours delay in thirty-one day period on account of repairs and power failures	13.0

The following men, members of the sinking crew at the Water Lily Shaft, will receive the silver medals:

J. D. Matheson, general foreman; H. W. Jarvis, shaft foreman; R. C. Farrell, Henry Johnson and John Osborn, shift bosses; P. C. Carman, head timberman; M. Anderson, Ben Benson, Mark Borcik, B. Broadbent, George Close, W. H. Currie, R. T. Davis, William Erickson, A. J. Foley, G. Green, M. Jones, Paul Kish, Eugene Lambson, Tony Laris, Joe Miller, Martin Neilson, R. D. Runnells, John Severson, W. V. Spencer, and A. F. Woodruff, shaftmen; George Atcheson, William Hoskins, Lee Hayward, W. Okeson, and A. Webb, shaft and timber men; E. W. Carter, Tom Householder, E. H. Osborn, Julian Peterson, A. Richmond, and J. Savage, hoistmen; Art Brown, D. Chandler, R. E. Ferguson, A. R. Nelson, M. D. Richmond, and H. Van Wagner, topmen.

CONSULTATION

Centrifugal vs. Reciprocating Pumps

"We have tried to secure reliable data regarding pumping equipment for mines, particularly as to the best type of pumps to use. The pump specialists seem to be divided into two camps—viz., those favoring the centrifugal type of pump and those preferring the plunger type. Can you give me any further light on the subject?

"Our power is electricity, and no steam is available. For sinking we use centrifugal pumps. For station pumps we now use three-stage centrifugal pumps, which have not proved satisfactory. Probably a better-designed centrifugal pump station would have given entire satisfaction. We propose ordering two ——— triplex pumps of the plunger type, each with a capacity of 500 gal. per minute at 230 ft. head. We should like to get data regarding the type of station pump generally installed now by experienced managers. If you know of any publication, book, or pamphlet recently published, and which contains the information sought, we shall consider it a favor if you will tell us of it."

Both reciprocating and centrifugal pumps have advantages and disadvantages that give each type its particular field. Thus, for pumping a large volume of water under a low head, the centrifugal pump is excellently adapted, but for pumping under unusually high heads or greatly varying heads the reciprocating pump is more efficient. Between these extremes lies a zone covered by both types of pumps.

In general, the reciprocating pump is positive in action, rugged in construction, operates efficiently under many heads, and can often be run by more than one motive power. On the other hand, the centrifugal pump is simpler than the reciprocating type, has fewer moving parts, requires less attention, and is more compact, and hence requires less space than a plunger pump of the same capacity. However, it works best at a specified head, operation above and below which entails a sacrifice in efficiency. In general, the limit of single-stage centrifugal pumping is 75 to 200 ft. Multi-stage centrifugal pumps are in use to overcome the limitation of single-stage operation.

The centrifugal pump can be suddenly overloaded without damage to its mechanism, whereas an overload of a reciprocating pump through an obstruction or otherwise may seriously injure the machine. The ratio of efficiency between plunger and centrifugal pumps is about 4:3. The advantages of the centrifugal pump make its use particularly desirable in a mine where pumping is generally done under a fixed head. However, an investigation conducted by *Engineering and Mining Journal* for the purpose of ascertaining to what extent each type of pump is used in the mines, smelters, and mills of Canada and Mexico, as well as in those of the United States, indicates that the reciprocating type is the more generally favored.

A detailed tabulation of pumping installations in North America from companies willing to supply this information as follows. The data are not always complete and the survey is not comprehensive enough to give more than a general idea of pumping practice. We know of no publication giving this information.

MINE PUMP INSTALLATIONS IN NORTH AMERICA

LEGEND

S. Steam
A. Air
E. Electric
Cent., Centrifugal
Simp., Simplex
Dup., Duplex
Tri., Triplex
Ex., Expansion
Quin., Quintuplex
Com., Compound
Recip., Reciprocating

Metal Mined and State	Number of Mines Using	Number of Pumps	Drive	Type	Capacity, Gal per Min	Head Feet	Service
Copper	1	2	S.	Tri. Ex. Dup.	1,400	450	Drainage
Arizona		1	S.	Tri. Ex. Dup.	900	650	Drainage
Company No.1		1	S.	Tri. Ex. Dup.	900	850	Drainage
		4	S.	Tri. Ex.	1,200	650–950	Drainage
		1	E.	Triplex	600	200	Drainage
		2	E.	Triplex Plunger	400	400	Drainage
		2	E.	Triplex Plunger	200	400	Drainage
		1	E.	Quin. Plunger	1,000	650	Drainage
		2	E.	Quin. Plunger	1,200	600	Drainage
		2	E.	Cent.	1,600	650	Drainage
		2	E.	Cent.	1,000	450	Drainage
Company No.2	1	1	E.	Quin.	300	1,500	Drainage
		3	A.	Sinkers	200 600–350	200	Drainage
Company No 3	4	6	E.	Vert. Tri.	100–175	290–470	Drainage
Gold	2	2	E.	Tri.	200	1,783	Drainage
California		2	E.	Tri.	100	650	Drainage
		3	A.	Simp.	38–58	500	Sinking
Lead ..	1	1	E.	Cent.	1,800	840	.
Colorado		4	E.	Cent.	1,500	450	..
Phosphate	8	6	S.	Tri. Ex. Dup	2,000	280	Hydraulic.
Florida		5	S.	Tri. Ex. Dup	2,600	280	Hydraulic.
Company No.1		1	S.	Cr. Com. Dup.	5,600	300	Hydraulic.
		2	S.	Cr. Com. Dup.	4,800	300	Hydraulic.
		3	E.	Cent.	3,500	400	Hydraulic
Company No 2	1	1	E.	3-stage Cent.	3,700	365	Hydraulic.
		1	E.	4-stage Cent.	4,000	400	Hydraulic.
		10	E.	1-stage Cent.	10	100	Hydraulic.
		14	E.	1-stage Cent.	12	100	Hydraulic
Lead	3	1	E.	Tri.	176	1,000	Drainage
Idaho..........		1	E.	Tri.	200	450	Drainage
Company No. 1		1	E.	Tri.	200	200	Drainage
		3	A.	Plunger	200	200, 400 and 600	Drainage
			A.	Plunger	500	200	Drainage
Company No.2	1	1	E.	Cent.	50	200	Drainage
Lead-Silver. Idaho	1	1	E.	Cent.	50	200	Drainage
Gold . . . Idaho ..	1	2	A.	Simp.	...	600	Drainage
Lead and Fluorspar	2	3	S.	Recip.	300–1,000	200–520	Sta. pumps
Illinois. .		1	E.	Plunger	500	200	Sta. pumps
Company No.1		3	S.	2 Simp. and 1 Comp.	500	400–500	Sta. pumps
		1	S.	Simp.	250	300	Sta. pump
		1	S.	Simp.	150	200	Sinking pump
Company No 2	3	5	S.	Comp.	300–1,200	300–500	Drainage
		1	S.	Comp. Dup	500	200	Drainage
		2	S.	Dup	300–400	100–300	Drainage
		1	S.	Dup	1,000	300	Drainage
		1	S.	3-stage Cent.	1,300	500	Drainage
Copper	2	4	E.	Plunger	300	1,000	Drainage
Montana.... .		4	A.	Dup	150	200	Drainage
Company No.1		2	A.	Simp.	150	200–400	Sinker
		2	E.	Dup.	150	600	Drainage
Company No.2	1	3	S.	Com. Dup.	570	300–400	Drainage
		1	S.	Dup.	650	300	Drainage
		1	S.	Com. Dup.	1,000	800	Drainage
		1	A.	Dup.	100	60	Drainage
		1	E.	Quin.	500	600	Drainage
		1	E.	Quin.	825	1,200	Drainage
		2	E.	Cent.	500	25	Drainage
		1	E.	Cent.	300	25	Drainage
Company No.3	30	23	E.	Quint	600	1,000	Acid Mine water
		1	E.	Tri.	350	600	Acid Mine Water
		1	E.	Quint	250	900	Acid Mine Water
		7	S.	Dup	600	200	Sinker
		2	S.	Dup.	250	200	Sinker
Company No. 4	2	1	E.	Plunger	300	1,016	Drainage
		1	A.	Dup.	300	1,016	Drainage
		1	E.	Plunger	300	989	Drainage
		1	A.	Dup	300	989	Drainage
		2	E.	Dup	150	400–600	Sinkers
		2	A.	Dup	150	200	Sinkers
		1	E.	Tri.	300	504	Drainage
		1	E.	Tri.	100	200	Drainage
		2	A.	Plunger	100	100–200	Sinkers

Metal Mined and State	Number of Mines Using	Number of Pumps	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Copper Nevada	2	2	S.	Comp.	1,800	1,200	[illegible]
Gold	1	1	E.	Tri.	100	200	Drainage
Nevada		2	E.	Tri.	400	200	[illegible]
Company No. 1							
Company No. 2	1	2	E.	Sinker	400	[illegible]	[illegible]
Silver- Manganese	1	1	S.	Dup.	300	[illegible]	[illegible]
		1	S.	Dup.	200	[illegible]	[illegible]
Nevada		1	S.	Dup.	600	250	[illegible]
		1	A.	Sinker	250	150	[illegible]
Silver-Gold	3	2	E.	Cent.	350-500	200	Drainage
Nevada		1	E.	Cent.	500	1,600	Drainage
		2	E.	Plunger	110-140	1,500	Drainage
		1	E.	Plunger	340	1,600	Drainage
		1	E.	Plunger	150	1,200	Drainage
		3	A.	Plunger	150-300		[illegible]
		2	E.	Cent.	300		[illegible]
Iron	6	4	E.	Cent.	900	1,300	Drainage
Michigan		4	E.	Cent.	900	300	Drainage
Company No. 1			E.	Tri.	100-400		Drainage
Company No. 2	1	4	S.	Plunger	50–500	30-800	Drainage
		1	S.	Cent.	500	800	Drainage
		2	S.	Plunger	500–700	300-500	Drainage
Company No. 3	3	2	E.	Plunger	400–600	120–500	Drainage
		1	E.	Tri.	50	350	Drainage
		1	E.	Cent.	100	40	Drainage
		1	S.	Tri.	100	50	Drainage
Iron	1	1	E.	Tri.	350	250	Drainage
Minnesota		1	S.	Com.	350	250	Drainage
Company No. 1		1	S.	Simp.	200	250	Drainage
Company No. 2	3	2	E.	Dup.	1,000–1,600	300	Drainage
		4	E.	Cent.	1,000–1,200	300	Drainage
		2	E.	Tri. Dup.	150	300	Drainage
		1	E.	Cent.	50	50	Drainage
Company No. 3	6	6	E.	Tri.	350-2,000	100-235	Drainage
		1	E.	Tri.	100	200	Drainage
		4	E.	Cent.	365-2,000	100–235	Drainage
		2	E.	Cent.	300	50	Drainage
		2	E.	Dup.	. .	. .	
Company No. 4	3	1	S.	Tri. Ex. Dup.	875	1,000	Drainage
		1	S.	Com. Dup.	875	1,000	Drainage
		1	S.	Com. Dup.	900	500	Drainage
		1	S.	Com. Dup.	400	1,000	Drainage
		1	S.	Tri. Ex. Dup.	500	1,000	Drainage
		1	E.	Tri. Ex. Dup.	250	200	Drainage
		1	E.	Tri. Ex. Dup.	200	1,200	Drainage
		1	E.	Cent.	100	300	Drainage
		1	E.	Cent.	1,000	300	Drainage
Company No. 5	5	1	E.	Recip.	150	118	Drainage
		1	E.	Tri.	150	175	Drainage
		1	E.	Tri.	60	204	Drainage
		3	S.	Simp.	150 200 800	204 175 220	Drainage
		1	E.	Tri.	500	220	Drainage
		1	E.	Cent.	150	250	Drainage
		1	E.	Tri.	75	220	Drainage
		1	S.	Simp.	25	220	Drainage
		1	E.	Recip.	250	220	Drainage
		1	E.	Dup.	1,350	220	Drainage
Company No. 6	6	2	E.	Tri.	800–2,000	235	Drainage
		1	E.	2-stage Cent.	2,000	235	Drainage
		1	E.	Tri.	500	145	Drainage
		1	E.	Cent.	300	50	Drainage
		1	E.	Tri.	500	130	Drainage
		2	E.	Cent.	365	130-165	Drainage
		2	E.	Tri.	350	100–200	Drainage
		1	E.	Dup.	100	130	Drainage
		1	E.	Dup.	40	40	Drainage
		1	E.	Tri.	100	200	Drainage
		1	E.	Cent.	600	100	Drainage
		1	E.	Cent.	75	40	Drainage
Zinc	1	1	E.	Recip.	65	285	Drainage
Missouri.......							
Company No. 1							
Company No. 2	2	3	S.	Dup.	.	175	Drainage
		2	E.	2-stage Cent.	500	200	Drainage
Company No. 3	2	3	E.	Cent.	4,000	230	Drainage
		4	E.	Deep Well	2,000	230	Drainage
Company No. 4	3	1	S. or A.	Recip.	250	190	Drainage
		2	S. or A.	Recip.	190	310	Drainage
		4	E.	Cent.	750	310	Drainage
		1	E.	Deep Well	750	210	Drainage
		1	S.	Lift	400	160	Drainage
		1	S.	Recip.	350	160	Drainage
Gold-Silver ... New Mexico....	1	1	E.	Tri.	100	500	Drainage
Pyrites........ New York	1	2	E.	Cent.	150	100	Drainage
Iron .... New York....	2	2	E.	Cent.	300	800	Drainage
		2	E.	Cent.	250	70	Drainage
		9	E.	Cent.	300	325–375	Drainage
		2	A.	Plunger	200	300	Drainage
Lead....... .... Oklahoma......	1	1	E.	Cent.	200	200	Drainage
		1	E.	Tri.	250	250	Drainage
		4	S.	Simp.	300–500	225	Drainage
Gold.. .... South Dakota...	1	2	E.	2-stage Cent.	500	196	Drainage
		1	E.	3-stage Cent.	500	310	Drainage
		8	E.	3-stage Cent.	1,000	315	Drainage
[illegible]		[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]		[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	750	17	[illegible]
[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	S.	[illegible]	750	40	[illegible]
[illegible]	2	2	[illegible]	Dup.	650	[illegible]	[illegible]
		1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	[illegible]	[illegible]	[illegible]	550	[illegible]
		1	[illegible]	[illegible]	900	[illegible]	[illegible]
		1	S.	Dup.	650	550	[illegible]
		1	[illegible]	Tri.	300	[illegible]	[illegible]
		1	S.	[illegible]	[illegible]	250-90	[illegible]
		1	S.	[illegible]		[illegible]	[illegible]
		2	S.	[illegible]	[illegible]	[illegible]	[illegible]
		1	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		2	S.	[illegible]	[illegible]	[illegible]	[illegible]
		1	[illegible]	[illegible]	1,200	200	[illegible]
[illegible] Utah	1	2	E.	Cent.	750	[illegible]	[illegible]
Lead-Copper Utah	1	1	E.	Plunger	[illegible]	[illegible]	[illegible]
		1	E.	Plunger	250	[illegible]	[illegible]
		1	A.	Sinking P		[illegible]	[illegible]
Silver Utah	1	1	S.	Plunger	[illegible]	214-100	[illegible]
		1	E.	Cent.	1,600	214	[illegible]
		1	E.	Cent.	1,500	250	Drainage
		1	E.	Cent.	[illegible]	250	[illegible]
		2	E.	Cent.	300	100	[illegible]
		1	E.	Cent.	500	125	[illegible]
		1	E.	Cent.	125	100	Drainage
		1	E.	Cent.	182	100	[illegible]
Copper Utah	2	1	A.	Simp.		175	[illegible]
		1	A.	Simp.		175	[illegible]
		1	A.	Simp.	100	120	[illegible]
		1	A.	Simp.	60	100	[illegible]
		1	A.	Simp.	[illegible]	175	[illegible]
		1	A.	Simp.	60	125	[illegible]
		1	E.	Cent.	40	.	[illegible]
		1	E.	Tri.	12	....	Drainage
Open-Pit Iron Mine	2	1	S.	Dup.		60	[illegible]
Virginia .		1	S.	Dup.		100	[illegible]
Zinc.............	3	4	E.	Cornish	75–150–200	148	Drainage
Wisconsin .					and 350	174	Drainage
		1	E.	Cent.	200	172	Drainage
		1	E.	Cent.	650	174	Drainage
		1	E.	Cent.	400	151	Drainage
Zinc . .. Eastern United States	2	2	E.	Tri.	100	1,336	Drainage
		2	E.	Cent.	350	525	Drainage
		2	E.	Cent.	275	225	Drainage
		3	E.	Cent.	450	977	Drainage
		2	E.	Cent.	200	166	Drainage
		1	E.	Cent.	925	166	Drainage
Gold-Silver.......	5	2	E.	Cent.	600	150	Sinkers
Mexico		2	E.	Cent.	500	650	Drainage
Company No. 1		2	E.	Tri.	300	500	Drainage
		1	E.	Cent.	500	600	Drainage
		6	E.	Tri.	150 300	600 600	Drainage Drainage
		2	E.	Cent.	250	600	Drainage
		1	E.	Cent.	100	100	Sinkers
Company No. 2	6	6	E.	Tri.	100-200	400–600	Drainage
		1	A.	Dup.	60	300	Sinker
		1	A.	Dup.	70	700	Sinker
		1	A.	Dup.	100	300	Sinker
Company No. 3	2	3	E.	Tri.	75–125	300–650	Drainage
Company No. 4	1	2	E.	Cent. 2-stage	1,000	400	Unwatering
Zinc-Pyrites. .	1	3	E.	Tri.	200–300	200–225	Acid Mine Water
Canada..		2	S.	Plunger	100–200	150-172	Acid Mine Water
Gold-silver Ontario........	1	1	S.		250	200	Drainage
		1	S.		300	300	Drainage
		1	E.	Tri.	260	200	Drainage
		1	E.	Tri.	200	300	Drainage
		3	A.	Dup.	40–60–100	200	Drainage

It will be noted that the reciprocating pumps greatly outnumber the centrifugals, a circumstance that may be due partly to the older age of the reciprocating pump and its slow displacement by the centrifugal pump (if displacement is going on). Centrifugal pumps, however, seen to be fairly well intrenched in mill work. As a similar investigation too long to reproduce here discloses, of 430 pumps used in various mills of this continent 326 were centrifugal and 104 reciprocating.

Our correspondent fails to state the cause of the failure of the centrifugal pump, which may possibly have been due to excessive grit in the mine water.

HANDY KNOWLEDGE

Neighborly Chats With the Foreman

Powder Densities

BY DUNCAN MACGREGOR

Written for Engineering and Mining Journal

Another complaint, Jim, and this time about your powder costs. You said that your men always used the same number of sticks to a hole in spite of all that you have been telling them about cutting down on the powder to suit the ground. That's a natural thing for them to do and they have been doing it for a long time. Habit is hard to break and men forget what you tell them. I think that it's a good plan to let them go on doing it for a while.

A stick of powder is a stick of powder but the weight of a stick depends on the grade of the explosive. Get busy with your superintendent and get him to talk things over with the powder salesman. I read something on this recently in the *Engineering and Mining Journal*.[1] Some of the powder companies are making powder that will run 100, 135 and 150 1¼ x 8-in. sticks to the 50-lb. box, depending on the grade. Get the superintendent to order some of these bulky powders and serve them out to the men for the easy ground. They will use the same number of sticks to a hole but they will weigh less to the charge. You can save a nice amount on this alone. Serve out your powder by counting the sticks. As your men are thinking in number of sticks and not weight of powder, just do the same yourself. Post the mine records in sticks of powder used. Get your men into the habit of tamping their holes thoroughly and see that they have the proper stemming in the proper "cartridges." Then get next to the superintendent and persuade him to work out a powder bonus. Split the savings you make on powder with the men and get them interested in greater economy. A little extra coin jingling in the pocket on payday will make every man as wise as a Scotchman when it comes to using powder. In time you will get them to judge the ground for themselves and then it will be plain sailing for the mine.

Shaking Screen and Slime Pump

BY CHARLES LABBE

Written for Engineering and Mining Journal

In a laboratory where pulp samples are not regularly handled, inexpensive devices have to be used. Rather large samples have to be screened oftentimes and to avoid hand labor the following may be found of value: A screen 12 x 30 in. in dimensions is hung from the ceiling by three adjustable rods. A shaking motion may be imparted to it by the movable jaw of the sample crusher on which is bolted a slotted piece of ¼ x 1½-in. flat iron, with a ⅜-in. bolt with thumb nut which can be screwed up or down, to vary the length of stroke. As the crusher is needed at the same time as the screen this arrangement is quite simple.

Screens of various meshes may be used, but they are all of the same dimensions, 12 x 30 in. They are held tight in the frame with a tapered wood key on each side, thus providing for quick removal and easy cleaning. The device is shown in Fig. 1.

To draw samples of partly settled slimes, decant or transfer small quantities of slimes. The pump shown in Fig. 2 is made of pipe and fittings and has given satisfaction.

The foot piece is a short nipple having one end split and spread for intake, the other being screwed in a 2-in. coupling. The foot valve, which is located in the coupling, may be made of a 1⅝-in. iron ball which seats itself on an iron washer 2¾ in. in diameter with a 1¼-in. hole. The upward travel of the valve is limited by a ¼-in. bolt 2¾ in. long. This bolt also limits the downward stroke of the plunger.

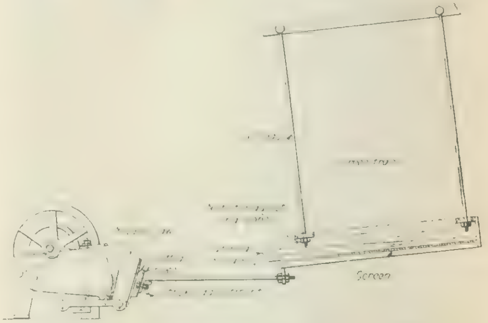

FIG. 1. A LABORATORY SHAKING SCREEN

The plunger is made of 1¼-in. pipe, the lower end of which is threaded for about 2 in. The packing is made of washers cut out of used rubber belting and held on the plunger by a 1¼-in. pipe locknut which has been trimmed off so as to go freely in the 2-in. pipe (the pump cylinder). The packing is held tight by a 1¼-in. pipe cap which screws up against it. A ¹⁵⁄₁₆-in. hole is bored in the end of the cap and a 1⅛-in. iron ball completes the valve. Six ⅝-in. holes are bored in the plunger for the pulp discharge. For a handle a ½-in. hole is bored in the upper end of the plunger and a ½-in. bolt, 12 in. long, passed through it clamping a piece of ½-in. pipe 5 in. long on each side. The plunger is guided to prevent side-play by a 2 to 1½-in. bushing screwed in the tee. For the discharge any piece of 2-in. pipe may be used of the length to suit the work.

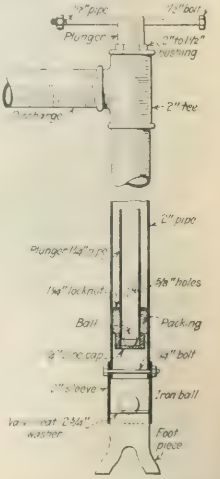

FIG. 2. A SLIME PUMP

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[1] *Engineering and Mining Journal*, Nov. 26, 1921, p. 862.

THE PETROLEUM INDUSTRY

Natural-Gas Gasoline in the United States In 1920

The term "natural-gas gasoline," as used by the U. S. Geological Survey, means gasoline recovered by all methods from both "wet" and "dry" natural gas and is synonymous with "casing-head gasoline" and "natural gasoline," terms used in the trade. The Association of Natural Gasoline Manufacturers, soon after its organization, proposed the term "natural gasoline," which is now being generally used, but the Survey considers "natural-gas gasoline" the more appropriate term.

The output of natural-gas gasoline continued to increase in 1920 and exceeded that made in 1919 by 31,776,791 gal., or 9 per cent, as compared with an increase of 24 per cent in 1919, according to the U. S. Geological Survey. The figures for 1920, however, are subject to revision. The average daily production of natural-gas gasoline in 1920 was 1,050,170 gal., as compared with 963,110 gal. in 1919.

Natural-gas gasoline is extracted from natural gas by two distinct methods, the compression method, which includes also refrigeration, and the absorption method. About 73 per cent of the output in 1920 was produced at the compression plants and the remainder at the absorption plants. The compression method is applied to the "wet" gas, which contains more gasoline. The absorption method is used in treating "dry" gas, which contains only a small proportion of gasoline vapors—less than a gallon in a thousand cubic feet of gas. As dry gas cannot be treated successfully by the compression method the absorption method was devised and is being used with good results.

The total quantity of gasoline produced in the United States in 1920 was 5,133,435,658 gal. Of this quantity 4,750,123,841 gal., according to statistics compiled by the Bureau of Mines, was obtained from crude petroleum, and 383,311,817 gal., or 7 per cent of the total, from natural gas. The annual output of natural-gas gasoline averages between 7 and 8 per cent of the total annual gasoline output in the country. This percentage in itself is small, but as natural-gas gasoline has a high volatility, it is blended with refinery products, such as naphtha, and is therefore a means of utilizing these blending materials which otherwise would have less value.

The value of the total output of natural-gas gasoline in 1920, as computed from the prices received at the plants, increased $7,337,355. The value of the gasoline produced by the compression method increased $4,509,541 and that produced by the absorption method increased $2,827,815. The average price was approximately the same in 1920 as in 1919—18c. a gallon for the total output, 17½c. for compression gasoline, and 20½c. for absorption gasoline.

November Petroleum Production

The accompanying figures, compiled from company reports to the U. S. Geological Survey, show the quantity of petroleum transported from producing properties. Oil consumed on the leases is not included. This item and net changes in producers' stocks at the beginning and end of the year are obtained by annual canvass and are included in the final statistics of production as issued by the Survey.

PETROLEUM PRODUCED IN THE UNITED STATES IN OCTOBER, 1921, NOVEMBER, 1921 AND NOVEMBER, 1920

Barrels of 42 U. S. Gallons

	October, 1921 (a)		November, 1921		November, 1920	
State	Total	Daily Average	Total	Daily Average	Total	Daily Average
Oklahoma	9,716,000	313,419	9,445,000	314,833	9,028,000	300,933
California(b)	7,065,000	227,903	8,804,000	293,467	9,340,000	311,333
Central and Northern Texas	4,846,000	156,322	5,760,000	192,000	6,711,000	223,700
Coastal Texas	2,730,000	88,065	2,813,000	93,767	2,762,000	92,067
Kansas	2,825,000	91,129	2,709,000	90,300	3,215,000	107,167
Northern Louisiana	1,817,000	58,612	1,752,000	58,400	2,462,000	82,067
Coastal Louisiana	124,000	4,000	114,000	3,800	153,000	5,100
Wyoming:						
Salt Creek	959,000	30,935	1,049,000	34,967	740,000	24,667
Big Muddy	141,000	4,548	132,000	4,400	159,000	5,300
Rock Creek	110,000	3,548	83,000	2,767	178,000	5,933
Grass Creek	99,000	3,194	94,000	3,133	126,000	4,200
Elk Basin	49,000	1,581	36,000	1,200	70,000	2,333
Other districts	123,800	3,994	104,400	3,480	67,000	2,234
Total Wyoming	1,481,800	47,800	1,504,400	50,147	1,340,000	44,667
Arkansas	(c) 1,300,000	41,936	(c) 1,250,000	41,667		
Illinois	890,000	28,710	837,000	27,900	847,000	28,233
Kentucky	716,400	23,110	717,800	23,926	723,000	24,100
West Virginia	628,000	20,258	607,000	20,233	656,000	21,867
Pennsylvania	580,000	18,710	594,000	19,800	603,000	20,100
Central and Eastern Ohio	405,000	13,064	409,000	13,634	437,000	14,567
Northwestern Ohio	166,000	5,355	157,000	5,233	165,000	5,500
Montana	153,000	4,936	143,000	4,766	92,000	3,067
Southwestern Indiana	70,000	2,258	70,000	2,333	59,000	1,967
Northeastern Indiana	22,000	710	16,000	533	22,000	733
New York	77,000	2,484	68,000	2,267	75,000	2,500
Colorado	8,200	265	8,600	287	8,000	266
Tennessee	600	19	1,200	40	1,000	33
Totals	35,621,000	1,149,065	37,780,000	1,259,333	38,699,000	1,289,967

(a) Revised. (b) Average of figures reported by Standard Oil Co. and Independent Oil Producers' Agency. (c) Estimated in part.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Mining and Metallurgical Society Holds Annual Meeting

New President Elected—Papers Discussed—Sir John Cadman Talks on Petroleum—Society Medal Presented to Charles W. Goodale

The Mining and Metallurgical Society of America held its annual meeting at the Harvard Club, New York, on the afternoon and evening of Jan. 10. During the afternoon session, at which J. E. Spurr presided, three papers were presented, one by G. F. Loughlin, of the U. S. Geological Survey, on the national mineral policy; the second by Dr. John E. Teeple, on the "Position of the Domestic Potash Producers," and the third by George J. Young on "Some Phases of Technical Education."

At the evening session Walter R. Ingalls presided. The secretary presented the results of the ballot for officers and the following were declared officers for 1922: A. H. Rogers, president; W. Y. Westervelt, vice-president; B. Britton Gottsberger, secretary; W. R. Ingalls, councilor of the first district; R. A. F. Penrose, councilor of the fifth; Seeley W. Mudd, councilor of the eleventh; Reno H. Sales, councilor of the twelfth.

Mr. Spurr, the retiring president, addressed the society members upon the subject of the society and its relations to the Institute of Mining and Metallurgical Engineers. He emphasized the fact that the field of the Institute concerned itself with technical subjects, whereas the Society confined itself to the broad questions affecting the industry. The effort of the Institute to absorb the society had failed chiefly because the Society members did not want to have their organization another notch on the gunstock of the Institute, nor did it especially like the idea of a bronze tablet on the walls of the Institute.

A. H. ROGERS
President of Mining and Metallurgical Society

Mr. Spurr reviewed the year's work of the society and concluded with the statement: "For the future I see in my mind's eye the destiny of the society as a fair and lofty structure which we may rear. We need, as I said, enthusiasm; we need the contribution of work; we need intelligent guidance; and we need money. A society with a limited membership and small dues is naturally very poor, with all the limitations of usefulness which that implies. I doubt whether we should try to remedy this by increasing the dues; but I do believe that the society should secure, from time to time, endowments from those that can afford it; that it may thereby eventually secure a proper and dignified home, and be established upon a basis not to be shaken."

CHARLES W. GOODALE

Mr. Rogers, the new president, discussed the work of the past year and stated that the program for the coming year would consist largely of concluding the work already begun. He indicated the desirability of reviving the San Francisco section and starting new units, and also securing an increase in membership. He suggested that the society should take up the subject of capital and labor.

Sir John Cadman, the guest of honor, was introduced, and informed the society that he was greatly impressed with his luck at being able to attend such a phenomenal meeting of the Society, including as it did a retiring president, an incoming one, and a gold medal presentation. He illustrated the significance of the word phenomenal by telling a story the point of which was that "a cow sitting on a thistle and singing like a lark would be phenomenal." With the subsidence of the mirth, Sir John plunged into a discussion of the British and American relations in the petroleum industry. He to a considerable degree convinced his audience that the British government was not in the oil business, did not purpose to discriminate against American capital or Americans in the exploitation of oil deposits, and that the British had respect for the ability and resourcefulness of American oil men and our petroleum engineers. He laid about with all the vigor of a red-blooded, two-fisted man in his earnest endeavor to lay the international petroleum banshee to rest.

At the conclusion of Sir John Cadman's address, Mr. Ingalls introduced Dr. Manning. Dr. Manning eulogized Charles W. Goodale. Professor Kemp followed with more good words for Mr. Goodale. Mr. Spurr presented the society's medal to Mr. Goodale for distinguished service in the promotion of safety in mining. Mr. Goodale in his reply discussed safety operations at Butte.

National Mineral Policy

Smith, Spurr, and Leith Address Council On Foreign Relations at Hotel Astor

Following an excellent dinner quantitatively adjusted so as to interfere least with mental clarity, the Council on Foreign Relations, Inc., on the evening of Jan. 6, listened to a thorough presentation of the subject of "Mineral Resources and Their Distribution as Affecting International Relations." The Hon. David F. Houston presided. The speakers were George Otis Smith, J. E. Spurr, and C. K. Leith, all of whom are pioneers of the subject and have had opportunity for detailed study of it.

In substance Mr. Smith said: "The great war put mineral resources upon the map and made their significance apparent. It is now necessary to pass the gospel along. Franklin K. Lane recognized that mineral resources are one of the foundations of national power. It is essential to appraise our mineral resources not in dollars but in tons, as this is the significant measure of mineral wealth. During the past four decades mineral output has increased many fold. The rapidly increasing rate of consumption is the changing standard by which we must measure our unmined resources. The best quality and most easily mined coal is being rapidly depleted and industries in the East face the certainty of decreasing quality and increasing cost.

"There is overdevelopment of certain parts of our mining industry, particularly in copper, iron, and zinc, and consequently a need for export markets. This need for export markets should be a background for national policy.

"Our outlook should be broad enough to include the world. American capital must realize its obligations to insure our future by reaching out into foreign countries to participate in the control of mineral resources. Pioneering with capital and engineering brains will be helpful to other nations as well as our own. A nation cannot live unto itself alone."

Mr. Spurr said, in brief: "We mining engineers and geologists have a message to our mining industry to the thinkers of the country outside of the profession and to our Government. Our modern civilization is machine-made, and depends upon metals and other raw products for its continuance. Metal crops do not grow—the mining industries are wasting industries. What an active industrial country does not possess in metallic resources she must acquire in trade. Under existing rapidly increasing rates of consumption, the mineral resources of the world are susceptible of exhaustion.

"What should we have as a policy or policies? Should we not take an inventory of our approximate stock in trade of each mineral or metal and frame up a separate policy based upon our supplies, our consumption, and the needs of the rest of the world? Should not these policies determine our governmental acts touching these mineral supplies?

"I take it for granted that the national welfare rather than the interests of a small group should dictate our governmental policies. It is not so much a question of conservatism that we have to deal with as efficient management of what nature has left with us.

"American interests finding their efforts in this country already circumscribed have reached out and own, control, and mine an ever increasing amount of copper, tin, iron, petroleum, and other materials outside our borders. When it comes to government policy, where are the limits we shall draw? Are not the limits of the entity or domain we wish to protect our commercial rather than our political limits? We shall have no lasting friendship between nations and no world peace while we have commercial struggles between great nations, discriminations, and recriminations. Only one kind of entente or alliance can eventually survive—the commercial alliance."

C. K. Leith said that there was need for a program for the handling of minerals on a national basis. Governments were becoming interested because competition was becoming keen. Mineral deposits were so distributed that for each kind a few definite trade channels were marked out. For some of our mineral products there is an exportable surplus; for others we will never have a sufficient supply. Tariffs may or may not be desirable. By means of an artificial wall, some believe that we can build up a supply of a much needed mineral, but overlook the continuance of that supply when exhaustion of the scanty deposits takes place. An economic and political policy around the great trade channels characterizing the movements of minerals is essential. Freedom of exploration is desirable. It is the right of stronger nations to bring pressure to bear upon weaker nations to develop minerals which the world needs. Exclusive concessions should not be made. With proper enlightenment on the subject there would be less talk of tariffs and embargoes. To get results there should first be recognition of the fundamental facts about distribution, and, second, the getting together on an affirmative program rather than by negative international agreements.

MEN YOU SHOULD KNOW ABOUT

Etienne A. Ritter, of Colorado Springs, is in New York en route to Europe.

E. J. Collins, of Duluth, has recently returned from examination work in the Isle of Pines.

T. A. Gowling, of the E. J. Longyear Co., has returned from a trip through the oil fields of Mexico.

K. C. Browne returned to Creighton Mine, Ontario, this week after a three months' stay in the vicinity of New York.

Frederick Bradshaw, of San Francisco, general manager of the Tonopah Belmont Development Co., is in Tonopah.

R. C. Moore, State Geologist of Kansas, has been in Washington conferring with officials of the U. S. Geological Survey.

John G. Kirchen, general manager of the Tonopah Extension Mining Co., has returned to Tonopah from San Francisco and Virginia City.

William Kent, formerly smelter superintendent of the International Nickel Co.'s works at Copper Cliff, Ont., is in New York.

E. F. Burchard has been granted a year's leave of absence by the U. S. Geological Survey, to undertake private work in oil geology in South America.

Ernest N. Patty, formerly mining engineer for the Washington Geological Survey, is now manager of the Gorrier Zinc Mines, near Northport, Washington.

Julien Raick, mining engineer of Liege, Belgium, after spending fifteen months in the various mining districts of the United States, has returned to Belgium.

H. F. Hilliard, formerly with the Tonopah Belmont Development Co., has been appointed mill superintendent for the Simon Silver Lead Mines Co. near Mina, Nev.

J. M. Hill, V. C. Heikes, C. W. Henderson, and **C. N. Gerry** of the western offices of the U. S. Geological Survey, spent the week of Jan. 2 in the Washington office.

Percival G. Butler, since 1916 assistant superintendent of the Douglas smelter of the Copper Queen Branch of the Phelps Dodge Corporation, has been made superintendent.

Dr. Solon Shedd, head of the department of geology at Washington State College, Pullman, Wash., has returned after a six months' leave of absence, which he spent teaching at Stanford.

Miles S. Milward, formerly manager of the Palmarito Leasing Co., and **Edward R. Haggin** have recently formed a partnership under the name of Milward & Haggin, with addresses at P. O. Box 7, Culiacan, Sinaloa, Mexico, and 627 Grosse Building, Los Angeles, Cal.

Mining and metallurgical engineers visiting New York City last week included: **Lester S. Grant**, Golden, Col.; **Donald C. Barton**, Houston, Tex.; **F. B. Burbridge**, Denver, Col.; **Oliver Bowles**, Washington, D. C.; **Arthur W. Jenks**, Berkeley, Cal.; **J. Taniguchi**, Tokio, Japan; **E. P. Dargin**, Cincinnati, Ohio; **E. C. Holden**, Baltimore, Md.; **J. H. Hill** and **Robert S. Hill**, Rapid City, S. D.

OBITUARY

Donald G. Hoyt, mine supervisor of Kennecott Copper Co., was killed recently in a snowslide near Cordova, Alaska.

William Preston Daniels died on Dec. 23, at Denver. Mr. Daniels was sixty-five years old. For the last twenty-five years he had been president and general manager of the Big Five Mining Co.

A. B. Coates, iron mine operator of Virginia, Minn., died Jan. 10 at his winter home near Orlando, Fla. He was fifty-two years old. Mr. Coates was a pioneer developer of the Mesabi Range and was one of the largest independent iron ore operators in that region.

S. R. Porter died on Dec. 14 in his home at the Leland mine, Oatman, Ariz. Mr. Porter has been active in mining development in Colorado and California, but particularly in the Oatman section. He was sixty-three years old.

John Dern died at the age of seventy-one in Salt Lake City on Jan. 2. Mr. Dern's name is most prominently associated with the Consolidated Mercur Gold Mines Co., of Utah. He had large interests in the Tintic district and was, for a number of years, president and general manager of the Uncle Sam Mining Co., vice-president and general manager of the Lower Mammoth Mining Co., and president of the May Day Mining and Milling Co.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

A strike has been declared at the gold and coal mines in the Transvaal, South Africa, according to a dispatch. The matter of employing native labor more extensively is involved.

The Cash Boy and Tonopah Extension companies have ratified the agreement recently drawn up, to avoid apex litigation.

Wages are dropping in various Utah camps. A 50-cent wage cut has just been announced in several districts.

Miners at Mount Morgan, Queensland, are still on strike. Various proposals made, looking to a resumption, have failed.

War minerals relief claimants are said to be hard to locate, now that the Commission is seeking to get in touch with them in consequence of the liberalization of the relief legislation.

The permanent tariff bill is expected to be reported to the Senate before the end of January, it is expected. Considerable opposition awaits it.

Gold Miners on Rand Vote To Strike

Action Results From Proposal To Widen Use of Colored Labor—Wage Reduction Refused

Miners in the gold and coal mines in the Transvaal, South Africa, voted to strike beginning Jan. 9, thus bringing to a culmination the protracted dispute over the attempt of the companies to reorganize their forces by employing native (black) labor to a greater extent, particularly in the semi-skilled occupations. This must be done, according to the companies, in order to reduce costs so as to permit operation under the decreased price of gold. The strike will include all of the plants of the Victoria Falls & Transvaal Power Co., thus effectively shutting down the gold mines of the Rand. The strike was voted for by the men in spite of a plea by the Premier, General Smuts, to accept a reduction in wages.

Breitungs Sued for Commission in Mining Deal

Edward N. Breitung, Charlotte G. Breitung and Mary Breitung, individually and as members of Breitung & Co., Inc., were sued in the New York Supreme Court recently for $420,000, which Ralph Ingalls, the plaintiff claims as commission for selling some Michigan mining properties for $8,000,000, according to the daily papers.

Ingalls says the Breitungs had an interest in the Michigan property which accrued by virtue of their ownership of the majority stock of the Marquette Iron Company. Ingalls was retained to find a purchaser. He interested A. B. Shepherd, of Pittsburgh in the proposition. Shepherd represented the Jones & Laughlin Steel Co., the Jones & Laughlin Ore Co., and the Interstate Ore Co. The sale was effected through his efforts, Ingalls alleges, but the defendants failed to pay him the agreed commission.

Cash Boy and Tonopah Extension Ratify Agreement

Two Companies Settle Differences Avoiding Costly Apex Litigation

The agreement between the Cash Boy Consolidated Mining Co. and the Tonopah Extension Mining Co., whereby costly apex litigation is avoided was ratified Dec. 30. The property of the Cash Boy has been deeded to the Tonopah Extension in accordance with the terms of the agreement. The Cash Boy receives 100,000 shares of Tonopah Extension stock and $20,000 cash.

Iron Ore Producers at Bilbao Anxious Over Competition

By Reuters Agency

Madrid, Dec. 20—During the week ended Dec. 17, 13,000 tons of iron ore was exported from Bilbao, Spain. Of this quantity 3,200 tons went to Germany and the rest to Great Britain. According to calculations made at the mines stocks at Bilbao total 1,600,000 tons. Anxiety is beginning to be felt owing to the competition of Algerian and Tunis ores.

Wages Dropping in Various Utah Mining Camps

Wage reductions are being made in various Utah camps. At Bingham Canyon, men who are receiving more than $3 a day will be reduced 50c. per day; and there will be a reduction of 40c. for those who receive less than $3. Six mining companies in that camp have announced these reductions which will become effective Jan. 16. The list is: Utah Consolidated, affecting fifty men; Utah Apex, twenty; United States Mining, 350; Bingham Mines, sixty-five; Utah-Boston, forty; Utah Copper, sixty. In the Tintic district, beginning Jan. 16, there will be a general reduction of 50c. a day. The remaining camps of the state are also making reductions.

Mines in Tri-State District Change Hands

Homestake, Blue Ribbon and Muncie Sold To Chicago Interests—Price Between Quarter and Half Million

Confirmation has just been made of the most important sale of mining properties in the Joplin-Miami district in more than a year, one wherein the Homestake, Blue Ribbon and Muncie mines of the Baxter-Picher section of the field were purchased by Chicago parties for a consideration not definitely given but officially stated as being "more than $250,000 and less than $500,000."

The Homestake mine is located just west of Baxter, and includes a small mill and a 40-acre lease. It was owned by Frank Childress, of Galena, Kan., and R. L. Kidner, of Kansas City. The Muncie mine is located about three miles west of the Homestake, has a good concentrator, and has been a consistent producer during the year. It has been owned by Oklahoma parties, headed by S. C. Clover, of Tulsa, Okla. It has been operated most of the year by Childress under a lease. The Blue Ribbon is located on a 20-acre tract east of Picher, in Oklahoma, and was formerly owned by Childress, his brother, G. L. Childress, and R. L. Kidner.

Frank Childress retains a considerable interest in the properties and will be retained as general manager. All the other interests have been taken over by the Chicago parties.

Canada Mints Coins of Nickel

In view of the fact that Canada is the largest producer of nickel, the adoption of a nickel coinage to replace small silver has for many years been advocated. It has now been carried into effect and on Jan. 3 the first Canadian nickel 5-cent pieces were struck off at the mint at Ottawa. The coin is composed of pure nickel and weighs 70 grains, being 835 of an inch in diameter.

Oregon Dredging Co.'s Property Sold

The property of the Oregon Dredging Co. was recently transfered to the Superior Dredging Co. Revenue stamps on the deed indicate the sale price as $146,000. The record of the transfer indicates an escrow agreement between the two companies. The property consists of a gold dredge on Clark creek, a tributary of Burnt River, near Bridgeport, Ore. The Oregon Dredging Co. operated for a number of years under the management of W. T. Tanner. The Superior company recently held a stockholders' meeting at Baker, but no formal statement as to price was made.

Colorado River Commission To Meet

Herbert Hoover Secretary of Commerce, expects to call a meeting of the Colorado River Commission on Jan. 26. The meeting will be held in Washington. Later it is the intention of the commission to hold hearings in the Southwest. At the Washington meeting a general plan of procedure will be agreed upon and limits placed on the scope of the work to be done.

Baker Mines Co. Cut Last Chance Vein in Adit

For the past year the [illegible] of Cornucopia, Ore., has been at work driving a long [illegible] to [illegible] the deeper [illegible] of the Last Chance vein. This [illegible] was started from the [illegible] of the Cornucopia Mines Co., an associated company. The vein was cut [illegible] ft. below the present [illegible] workings and a pay [illegible] ft. wide exposed. This confirms the opinion of the engineers and geologists that the gold veins of the Cornucopia district are of the deep-seated type.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

War Minerals Relief Claimants Hard To Find

Many Fail To Answer Notices Advising Them Legislation Has Been Liberalized

Great difficulty is being experienced by the War Minerals Relief Commission in finding claimants. A considerable percentage of the notices sent out, advising them of the liberalization of the law and conditions under which a rehearing of claims may be had, have been returned, due to change in the claimant's address. Only a few of the fifty claimants who were disbarred originally by the fact that their claims were not received within the time limit have been found. More than two years have passed since the commission has had any contact with these claimants, and now that their claims have been admitted to consideration, the War Minerals Relief Commissioner is anxious to obtain the present address of the miners who submitted the claims.

A hearing was conducted before the War Minerals Relief Commissioner on Jan. 6 and 7 on the claim of George H. Crosby and of the Whitmarsh Mining Co., of which Mr. Crosby is the president. The aggregate of the amounts claimed in these two cases is $385,818. John Lind made the principal argument for Mr. Crosby.

War Minerals Relief Commissioner Robinson concurs in the conclusion of the former commission that the expense of prospecting is not a proper item to include in a relief claim and that only expense incurred after discovery can be considered. Appeals have been taken on this particular point, however, and the Secretary of the Interior will be asked to rule on it.

As the activities of the War Minerals Relief Commission are now largely legal, rather than engineering, the commissioner is reporting directly to the Secretary of the Interior. The Bureau of Mines now has no formal relationship with the administration of the War Minerals Relief Act.

Permanent Tariff Bill Likely To Be Reported Soon

Senate Committee May Succeed by End of January—Some Leaders Against Measure

Unquestionably an earnest effort is being made by the Finance Committee of the Senate to report out the traiff bill at the earliest moment. Some of the Republican leaders, however, continue to be of the opinion that this is no time to attempt a permanent revision of the tariff and prefer to see the bill delayed still further.

The probabilities seem to be that the committee will be allowed to have its way, and that it will report out a bill before the end of January. Though it is known that there will be material changes in the House bill, including a material reduction in the level of most rates, no definite information as to its plans has gone out from the committee. The committee is supporting American valuation, but it is apparent that it is beset with uncertainties as to the possibility of making a practical application of that plan.

Consideration of the tariff on the floor of the Senate is certain to be more extended than usual. It is true that the Republicans have a majority of twenty-four in the Senate, but views on the tariff are much less partisan than they were when the Payne-Aldrich measure was enacted.

Hard Money Would Improve Currency Situation

In the light of the stabilizing effect of the use of gold and silver coin in Mexico as the sole circulating money, some economists in Washington are of the opinion that several European countries would improve their currency situations were they to do likewise. There also are some who believe important benefits would follow the more extended use of gold and silver, particularly gold, as circulating mediums, even in the United States.

Mining Dependent on Exports, Smith Points Out

Capacity of Country's Mines Greatly in Excess of 1921 Production—Petroleum a Shrinking Asset

That the mining industry is dependent to a material extent upon exports is pointed out by Dr. George Otis Smith, Director of the U. S. Geological Survey. Accurate calculations which have been made from the Survey's statistics show that the capacity of the coal mines of the country is nearly one-third larger than the peak of war production and is nearly double the 1921 output. The capacity of the country's copper mines is approximately equal to peak production, but is five times the 1921 output. The capacity of the iron mines of the country equals the blast-furnace capacity. It is double the peak production and is five times greater than the 1921 output. The capacity of the country's zinc mines is well above the maximum requirements ever placed upon them. The retort capacity is 20 to 40 per cent above peak production and from three to four times the 1921 output. In a recent public address, Dr. Smith made this statement:

"A measure of the rapidly increasing drafts we are making on our mineral balances in Nature's treasury is afforded by the fact that in the last fifteen years we have mined and smelted more lead than in nearly two centuries before; in the last thirteen years we have mined more coal and in the last eleven years more iron ore than in the whole of the century and more before; in the last nine years more copper than in the sixty-seven years before; and in the same nine years more zinc than in the fifty-four years since zinc mining began in the United States. Most thought-provoking, however, is the fact that our country has produced more petroleum since the outbreak of the World War than in all the years before August, 1914. In terms of these seven and one-half eventful years American petroleum is truly a shrinking asset."

NEWS BY MINING DISTRICTS

London Letter

Bwana M'Kubwa Capital To Be Reorganized — Burma Corporation's Plans Held Up—Cape Copper Reports Loss

By W. A. Doman

London, Dec. 30—The Bwana M'Kubwa Copper Mining Co., which has been in existence for many years and has never made a cash return to the shareholders, is about to enter upon a new phase — upon something, in fact, which promises at least to be profitable to those who have risked their capital in the undertaking. A. B. Emery, who had much experience at the Messina copper mine, in the Transvaal, was recently employed by an influential group to examine the Bwana M'Kubwa, and he has made a satisfactory report. In brief, he says that the primary ore is of deep-seated origin; that the tonnage of ore estimated and classed as assured and reasonably to be expected down to only the 450 level is 3,000,000. He assumes, further, that 1,000,000 tons will be developed for each 150 ft. in depth below that level; the average grade is 4 per cent copper.

Minerals Separation has installed a plant at the property, and has obtained highly favorable results, and Mr. Emery has had checks made confirming the previous results. The Minerals Separation people apparently are strong believers in the future of the mine, for they are supporting the scheme for the reorganization of the capital. Shareholders are rather drastically treated, as for each fully paid share of 10s. each now held, they are to receive one share of 5s. each, credited with 2s. 6d. paid, the new capital being £400,000.

It does not yet appear that the Burma Corporation has derived much benefit from transferring its head office from London to Rangoon, though doubtless this is in part due to the fall in the price of metals. In 1919, the intention was to build a new smelter and refinery capable of producing 60,000 tons of refined lead and 6,000,000 oz. of silver annually, as well as to provide for the development of the Namma coal field. Owing to the financial slump, the board had been under the necessity of borrowing from the bank, and to conserve funds, the zinc works in India were closed, the erection of the smelter is uncompleted, and the development of the Namma coal field is postponed. At June 30, the ore reserves were estimated to be 4,369,686 tons, of an average grade of 23 oz. silver, 25.1 per cent, lead, and 17.6 per cent, zinc, the figures including 335,681 tons of copper ore assaying 11 per cent.

It is by no means a cheerful report that the directors of the Cape Copper Co. have presented to their shareholders for the twelve months ended Aug. 31. The company went to Rakha Hills, in India, with great hopes, which have been disappointed so far. There is a deficiency for the year of no less than £184,535, the total debit to profit and loss being £373,975. This disastrous result is attributed to loss on realization and revaluation of copper stocks, to heavy charges for interest, and to breakdowns in the power and other plant. No development was done at Rakha Hills during the period, and the ore reserves are estimated at 297,575 tons of 3.74 per cent copper, and 31,576 probable tons of 2.34 per cent copper. The balance sheet is far from healthy. Investments stand in the books at £103,243, but the market valuation is only £72,681, and these investments are pledged to the bankers, whose advances, with interest, amount to £334,956.

KOREA

Oriental Consolidated Finds Labor Scarce and Unruly

Unsankinko — The Oriental Consolidated Mining Co. obtained $102,000 from its December cleanup. That for November was $101,946.03. Tonnage milled in November was 17,816. The Tabowie mill tonnage was lower than before, because there is so much waste to handle from the new shaft crosscuts and raises that it is impossible to furnish full tonnage for the mill.

The Taracol cyanide plant treated 2,042 tons of concentrate worth $53,125.46 and secured $48,465.66 in bullion, an extraction of 91.2 per cent. The extraction is always good during cold weather. The mills are being run on steam power. Labor continues scarce. Those who do work are unruly.

SPAIN

Conditions Better in Mining Industry

The mining and metallurgical industries in Spain are improving to a slight extent, according to the Department of Commerce. Coal strikes in northern Spain have been abandoned by the miners involved without securing the concessions desired. The iron mines of Bilbao have experienced a resumption of activities due to the securing of contracts for 2,000,000 tons of ore for the export market during the coming year. Increasing cost of living and falling wages have aggravated industrial unrest.

BURMA

Namtu—The Burma Corporation's lead production for November was 3,899 tons gross: refined lead production 2,922 tons: refined silver production approximately 354,850 oz.

AUSTRALIA

Queensland

Mount Morgan Men Still Idle—Tin Mining in Progress—Sapphire Selling Agreement Canceled

Brisbane, Nov. 28—The Mount Morgan men have followed the advice of their leaders and refused to resume work under the 20 per cent reduction of wages awarded by the Arbitration Court, and the mine remains idle. Union leaders are trying to find work for some of the men elsewhere, but have not met with much success. The men, who are out of work and refuse to return to their jobs except at a wage which there is no possibility of the industry being able to pay, are receiving government allowances for food as well as a small dole contributed by other unionists. There are bitter complaints about the insignificance of this latter contribution, but the men are still standing out "on principle," which means no reduction of wages either at Mount Morgan or anywhere else.

It is unfortunate for Queensland that the many hundreds of miners who are out of work cannot be brought to see how effectually they are not only "killing the goose that lays the golden egg" at Mount Morgan, but have strangled the copper-mining industry of the state also. Though the Mount Morgan men will not work even at the wage fixed by the arbitration tribunal, the Cloncurry mining and smelting companies say it is quite impossible for them to resume operations at the rate awarded by that tribunal for the Cloncurry district. The minimum wage for a laborer in that district is 17s. 6d. per day, or 4s. more than that fixed for Mount Morgan, which is a gold as well as a copper mine. No mine in the commonwealth that only produces copper could pay the Cloncurry wage at the present time, much less the Cloncurry mines, which are more than 500 miles from port, but on every hand one hears of the fixed determination of all trade unions to accept "no reduction."

What this is leading to is being strikingly exemplified in the iron and steel trade. No part of the loan recently obtained by the Queensland government from New York can be devoted to the proposed iron and steel works at Bowen, but even if that were possible, it would be difficult to persuade the public that it would be wise to start those works at the present juncture. Owing to a scarcity of orders, the big works of the Broken Hill company at Newcastle, in New South Wales, are curtailing operations, and smaller concerns in the same industry in that state announce their intention of completely closing down. The reason for this is that imported iron and steel is cutting out the locally manufactured product. It is asserted that wages are much lower, both in America and Great Britain, than in Australia, where they are said to be the highest in the world, and that iron and steel in the former countries, in spite of a protective tariff, can be manufactured and sent to Australia at a lower cost than it can be produced for here.

A small company operating the Tyrconnell mine, on the old Hodgkinson gold field, in North Queensland, has lately declared its first dividend. This field has been worked for over forty years, and the "oldest inhabitant" does not remember a company operating at this camp having ever before paid a dividend, though small individual operations in shallow ground ofted paid well years ago.

Despite the low price of tin, there is still considerable tin mining in Queensland. This is mostly done by small parties of men who possess their own "shows." At the richer mines the ore raised is at once disposed of at a profit, but in some projects of lower grade it is being held awaiting a better market. In others just enough is sold to provide the miners with "tucker," the rest being held for better times. In the Herberton district, inland from Cairns and one of the oldest tin-mining centers in the state, this class of mining is still much in evidence, and during the past quarter yielded 180 tons of tin oxide, valued at over £16,000. On the Kangaroo Hills field, north of Townsville, on which the now famous Sardine tin mine is situated, there was in the same period a yield of 137 tons of tin, worth £11,500. In the Stanthorpe district, in the extreme south, where four dredges are at work, the production of alluvial tin was worth about £2,500; and the Cooktown district, in the far north, with the aid of hydraulic sluicing, made an output of tin worth £3,000, notwithstanding a scarcity of water customary at this season. Of course, these returns are low compared with those of the same districts when tin values were about £200 per ton, but they are sufficient to show that the bottom has not entirely dropped out of this branch of mining in Queensland, as is almost the situation with copper.

The amended agreement with Messrs. Rubin Bros., of Paris, for the marketing of Queensland sapphires, has not been ratified by the government after all. The miners by ballot agreed to the main terms of this contract, though by only a small majority, but the firm asked that a limit be placed on the quantity of gems they might be called upon to take. The Minister for Mines refused to agree to this limitation, and the project has fallen through. There is therefore now open buying and selling on the Anakie field, as before the first agreement made with the Paris firm came into operation last January.

CANADA

British Columbia

Silversmith Mines Starts Operations at New Concentrator

Trail—Ore handled in 1921 at the smelter of the Consolidated Mining & Smelting Co. of Canada, Ltd., was slightly in excess of 400,000 tons, making a year's record for the quantity of material put through the furnaces. Low metal prices, however, made a decline in the value of the output, as compared with the preceding year, the figures being $6,694,865 and $7,326,925, respectively. There was 100 per cent increase in lead output compared with 1920, 44 per cent increase in zinc, 20 per cent increase in gold and 7 per cent increase in silver. Copper showed a decline of about 25 per cent. Comparative figures as to output for the two years are as follows:

	1920	1921
Gold, oz.	42,636	51,037
Silver, oz.	1,097,930	1,173,890
Copper, lb.	4,501,594	3,556,517
Lead, lb.	26,474,652	57,051,110
Zinc, lb.	36,995,394	53,131,270

The bulk of the smelter's tonnage was supplied by the company's mines. Of the total of 406,000 tons for the year, 399,196 came from this source. None of the company mines were operated on company account except the Sullivan and Rossland properties. The supposition is that the bulk of the 399,196 tons came from the Sullivan, in East Kootenay. This material is a highly complex ore, carrying silver, lead, and zinc. The Rossland mines, with values in gold and silver, furnished a part of the company tonnage, and the increased gold output indicates their operation at a slightly increased capacity in 1921 as compared with 1920.

Of the tonnage received from independent shippers, totaling 9,286, more than a third came from the state of Washington, the receipts from there being 3,888 tons. Nearly all of this came from Republic camp. The combined contribution of Slocan, Ainsworth and Lardeau districts was 2,785 tons, and East Kootenay independent shippers furnished 805 tons; Boundary-Similkameen districts, 890 tons; Rossland, 804 tons, and Nelson and Arrow Lakes districts 114 tons.

Sandon—The first of the year was marked by the starting of milling operations at the new mill of Silversmith Mines, Ltd., at this place. Silversmith's operation is practically the first milling activity in the Slocan within a year, a period of inactivity without a parallel in the history of the district. Ore reserves at the Silversmith mine are estimated as sufficient to maintain operation on a considerable scale for from four to five years. It is expected that about eighty men will be employed in general operations from now on. Output will go partly to Trail and partly to Kellogg, Idaho, for treatment.

Nelson—The Consolidated M. & S. Co. has relinquished the bond held by it for some time upon the Big Four group, on Cultus Creek.

Victoria—A. W. Bevan, Nelson, formerly secretary-treasurer of the Lucky Jim Zinc Mines, Ltd., whose holdings were transferred to Senator McMeans, of Winnipeg, and associates, under foreclosure proceedings last February, has secured a ninety-day option upon the property, which is situated in the Slocan, and if the necessary capital can be obtained, plans to organize a new company to be known as the New Lucky Jim Mines, Ltd., capitalized at $500,000. Senator McMeans and a number associated with him in the mortgage will be interested in the new company, if formed. The property, which has at different times in the past been noted for a remarkable high-grade zinc production, is extensively developed, and is regarded as having a future, under favorable conditions and management.

Kaslo—The No. 1 level of the Whitewater mine has been in process of cleaning out and retimbering by leasers, with a view to mining any ore left there under operations during the earliest history of the mine. Leasing operations have hitherto been confined chiefly to the lower levels.

Ontario

Kirkland Lake Properties Delay Cutting Wages—Foreclosure Proceedings Against North Crown Porcupine

Cobalt—The annual report of the Coniagas for the year ended Oct. 31, last, shows the company treated 113,279 tons, averaging 11.3 oz. per ton, and recovered 1,305,515 oz. which is considerably greater than for the three previous years. Costs were 33.5c. per oz., compared with 49c. the previous year, and an average during the life of the mine of 19.73c. an oz. The profit amounted to $400,000. The financial statement shows quick assets of $1,500,000. Ore broken on the stulls is over 100,000 tons. Total production to date is 29,490,000 oz., and dividends $10,940,000.

The Kerr Lake company announces that it will not consider the resumption of operations before next spring.

The winze at the Violet property, of the La Rose, has reached a depth of 600 ft., and crosscutting has been started. On the 530 level above, an ore shoot, averaging 33 oz. to the ton, was developed over a length of 225 ft.

No ore was shipped from Cobalt during the week ended Dec. 31.

Kirkland Lake—Kirkland mines have not yet followed the action of the Porcupine companies in making a general reduction in wages, but it is anticipated that they will do so very shortly. Plenty of good men are available, and, as the new scale in Porcupine is above the Cobalt scale, there is now no particular reason why Kirkland should not follow suit.

It is stated that the Teck Hughes is treating approximately 160 tons per day, and that profits are running close to one thousand dollars a day.

Some high-grade ore is being taken from the shoot recently found on the 300 level of the Kirkland Lake Gold Mining Co.

As an indication of the manner in which the Kirkland camp is progressing, it is understood that the consumption of explosives increased 80 per cent during 1921.

Porcupine—In an address before the American Association for the Advancement of Science, A. F. Brigham, manager of the Hollinger, stated that this mine was producing gold at the rate of $11,000,000 a year. This means that eight northern Ontario mines are now producing at the rate of approximately $20,000,000 a year. When the power difficulty in Porcupine is finally settled, it will be found that this rate will be considerably exceeded.

The Vipond should realize $71,000 from the sale of its treasury stock, but its debts amount to $12,000 and it will cost $9,000 to unwater and put the plant in shape. The company will have $50,000 available for new work.

The Trusts & Guarantee Corporation, Ltd. have taken foreclosure proceedings against the North Crown Porcupine Mines, Ltd., claiming $200,000 principal and $4,871 interest, and four parcels of land aggregating 160 acres in Porcupine. The land comprises the Porcupine Crown and the Thompson-Krist mines. This action arose out of the failure of the Thompson-Krist company to put up money with the Porcupine Crown for development.

OREGON

Gold Hill District in Southwestern Section Active

Gold Hill—The Gold Ridge gold mine three miles south of Gold Hill, which began operating a 5-stamp mill early last summer has been making mill runs ranging from $1,500 to $1,700 weekly on a 10-hour shift. The company started running day and night Jan 1.

Two miles north of the Gold Ridge is the Millionaire gold mine, which was reopened last year at an expense of $100,000. It is an old time producer which was idle nearly 20 years. The present work consists of a new 200-ft. shaft and a new level drifting both ways on the vein. The mill equipment, which is reducing the ore from the new works and old dumps, consists of two 1,500-lb. Nissen stamps, rock crushers, amalgamating plates, and concentrating table, all driven with electric power.

One mile below the Gold Ridge mine is the Centennial placer diggings, which have been re-equipped at an expense of $110,000. The present equipment consists of a drag-type dredge.

One mile east of the Gold Ridge the Revenue "pocket" mine is being reopened.

MONTANA

Davis-Daly Awaiting Better Smelting Rates—East Butte Cutting Wages Jan. 16 With Other Companies

BY A. B. KEITH

Butte—Experienced miners have been so badly scattered by the prolonged shutdown that any material increase in production in the near future is regarded as out of the question by the Anaconda Copper Mining Co. The present surplus of copper will undergo a considerable shrinkage before Anaconda's resumption of operations, scheduled for Jan. 16, will have a telling effect, it is believed.

Anaconda has persisted in a policy of generally holding aloof from selling its copper at sacrifice prices and when the metal market has again regained its feet the company will be found offering its metal at somewhere in the neighborhood of what it cost to produce it. It showed assets amounting to approximately $68,000,000, consisting principally of unsold metal as of Dec. 31, 1921.

The advantages which lie in the direction of merchandising, it is said, first became apparent to the Anaconda company in connection with its Chicago white lead plant. From this cue the definite formulation of the idea to branch out in all the manufacturing lines which follow in the wake of the metals and minerals which it produces has resulted.

Copper shingles and its brass manufacturing plans temporarily have shaded the Anaconda company's fertilizer program. Unless Henry Ford's Muscle Shoals plans reach fruition along the popularly supposed lines, Anaconda in time will become the leading producer of fertilizer in the country.

The arsenic plant at the Washoe works was started some time ago as was the zinc works at Great Falls, and the Washoe smelter will get under way on a curtailed basis as soon as possible. Butte & Superior has started shipments of zinc concentrates to the Anaconda's electrolytic plant at Great Falls. The Anaconda is reported practically bare of zinc metal stocks and it plans immediate resumption of zinc production up to 6,000,000 to 7,000,000 lb. monthly.

The Davis-Daly Copper Co. will resume production just as soon as it is given what it considers to be fair smelting rates. With East Butte lopping off 50c. a shift beginning Jan. 16 and securing a reduction of $2 per ton of coke there is a possibility of it being able to offer the Davis-Daly better terms. The Anaconda also shortly will be starting its smelters and relief is looked for in this direction.

Schoettner Studios, Butte

ANACONDA COPPER MINING CO.'S ORIGINAL MINE, BUTTE, MONT.

The four mines of the Anaconda Copper Mining Co., at which operations will be resumed on Jan. 16 are the Badger State, Leonard, Mountain View and Mountain Consolidated, according to a report from Butte. The New York office said, however, that all the properties were in about the same condition and that those to resume might be other than the ones named.

WASHINGTON

First Thought Mine May Have New Concentrator

Orient—Interesting developments are expected this year at the First Thought mine, near Orient, which is credited with a notable production of gold in the past. It is possible that a mill will be built.

UTAH

Holiday Period Cuts Shipments From Tintic and Park City Districts

(From Our Special Correspondent)

Eureka—Shipments for the week ended Dec. 31 amounted to 110 cars, as compared with 156 cars the week preceding. The holiday intermission was responsible for the reduction. Shippers were: Tintic Standard, 41 cars; Chief Consolidated, 28; Iron Blossom, 10; Victoria, 10; Eagle & Blue Bell, 6; Swansea, 4; Grand Central, 4; Dragon, 3; Colorado, 3; Gemini, 1.

Some phenominally rich ore has been taken from the new strike at the Iron Blossom. A car shipped by a lessee ran 700 to 760 oz. silver, and is expected to bring about $35,000.

The output of the mines in the Tintic district in 1921 was 8,042 cars, or approximately 381,995 tons, as compared with 7,397 cars or approximately 351,357 tons in 1920. Tintic is a silver district producing silver-lead and dry siliceous ores. Early in the year there was a curtailment for a time in the output of dry silver ores, as the smelters found it was impossible to take too large a tonnage of these ores. This was due to suspension by a number of copper smelters, which were receiving little or no copper ores following the curtailment or cessation of operations by most copper producing mines (notably the Utah Copper) whose ores supplied the necessary fluxing charge for the dry silver ores.

A new process for the treatment of dry silver ores was worked out at the Garfield smelter of the A. S. & R., and shipments of dry silver ore from Tintic were resumed, and kept up, with the exception of another short intermission toward the end of the year, which was not important. The heavier tonnage is due to increased shipments from the Tintic Standard, which during 1920 shipped 2,824 cars of ore operating its mill and keeping up the output of shipping ores; and to shipments of fluxing ore from the Dragon and Iron King. A number of older properties at which lessees were operating also shipped silver ore. The second largest producer was the Chief Consolidated, which shipped 1,887 cars. The Eagle & Blue Bell, which early in the year reduced its working forces, nevertheless gave a good account of itself. The Victoria, the newer of the two properties, both of which are controlled by the Bingham Mines, made shipments almost equal to those of the older property.

Schoettner Studios, Butte

ANACONDA COPPER MINING CO.'S LEONARD NO. 2 MINE, BUTTE

Toward the end of the year the Grand Central was reopened under a new plan. A large number of leases have been let here, and production is increasing. The Chief Consolidated began operating its limestone quarry during the year and shipped the material to the smelters and sugar factories of the state. This company also acquired new ground.

Shippers were: Tintic Standard, 2,824 cars; Chief Consolidated, 1,887 cars; Dragon, 568; Iron King, 509; Eagle & Blue Bell, 506; Victoria, 472; Iron Blossom, 453; Swansea, 162; Colorado, 137; Centennial-Eureka, 114; Gemini, 90; Grand Central, 86; Mammoth, 71; Bullion Beck, 69; Sunbeam, 46; Alaska, 27; Gold Chain, 26; Empire Mines, 22; Eureka Hill, 20; Eureka Mines, 17; Tintic Drain Tunnel, 7; Joe Bowers, 4; Yankee, 4; Ridge & Valley, 3; Eureka Bullion, 3; Little May, 3; Martha Washington, 2; Silver Park, 1; Showers, 2; Primrose, 1; Uncle Sam, 1; George Castleton, 1; Plutus, 1.

Park City—Shipments for week ended Dec. 31 amounted to 1,813 tons, as compared to 2,602, the lessened output being due to the holiday intermission. Shippers were: Judge allied companies, [illegible] tons; Silver King Coalition, 610, and Ontario, 325.

Park City during 1921 produced 83,414 tons of ore, compared with 102,187 tons the year preceding. Low metal prices and a controversy between two important producers, the Silver King Coalition and the Daly West, and one of the smelting companies, which resulted in a suspension of shipments by these companies for several weeks, were instrumental in bringing about the reduction. A new shipper came in during the year, the Park-Utah, one of the companies controlled by the same interests as the Judge, Daly and Daly West, and shipping under the head of the Judge allied companies. The list of shippers is as follows: Judge allied companies, 34,711 tons, compared with 41,571 tons in 1920; Silver King Coalition, 26,556 tons, compared with 25,829 tons in 1920; Ontario, 21,092 tons, compared with 25,929 tons in 1920; Naildriver, 1,005 tons, compared with 3,078 tons in 1920; and New Quincy, 50 tons.

NEVADA

Option on Middlemines Taken By M. R. Ward and Associates — Tonopah's Production Over $5,641,000 in 1921

Virginia City—An option has been taken upon the Middlemines on the Comstock Lode by Dr. M. R. Ward, president of the Tonopah Extension Mining Co., and associates. Detailed examination is planned.

Tonopah—The Tonopah *Bonanza* has compiled figures showing the 1921 production of the Tonopah district to be 340,924 tons of ore with a gross value of $5,641,371. Production was curtailed during nearly four months of the year due to walkout of miners and mill men on April 16 in protest against wage reduction, actual work not being resumed until September. The tonnage handled at the principal properties was as follows: Tonopah Belmont 124,304 tons, West End 75,000, Tonopah Extension 78,325, Tonopah Mining 50,000, and MacNamara 13,395.

The coroner's jury was unable to definitely ascertain the cause of the fire of Dec. 23, which destroyed the "Big Ship" boarding house, and in which three miners lost their lives and thirteen were injured. Considerable testimony was heard and there was evidence tending to prove the fire to have been of incendiary origin but the evidence was not specific enough to justify a decision to that effect. The general impression remains, however, that the fire was the work of radicals in an indirect attempt to interfere with mining operations in this district.

Eureka—The Uncle Sam Mining Co. has purchased the Hamburg mine, three miles south of the town of Eureka and adjacent to the Uncle Sam ground. The Hamburg is an old mine, long ago closed down in which several orebodies were developed to a depth of 850 ft. by vertical shaft and laterals. There is said to in a large tonnage of ore of milling grade in the old workings, only the shipping ore having been extracted. The Uncle Sam tunnel is being driven to a connection with the old workings of the [illegible] with about 500 ft. yet to go.

Round Mountain—The placer season for this year has practically ended, and the cleanup by the Round Mountain Mining Co. will be completed in January. Production for the season was about $125,000. The recent heavy snows indicate an early and prosperous season for 1922. About forty lode leases are being operated in the Round Mountain district, the ore being shipped to the mill of the Round Mountain Mining Co. Although no lode mining is being done at present on company account it is likely that work will soon be started on promising veins exposed during the season's placer operations.

PHELPS DODGE CORPORATION'S NEW COPPER QUEEN CONCENTRATOR, WARREN DISTRICT, ARIZONA

ARIZONA

Work Stopped at Zonia Property—Amalgamated Copper Mines Co. Answers Condemnation Suit—Copper Queen Mill Nearly Ready

BY JAMES H. MCCLINTOCK

Phoenix—Operations have been suspended on the Zonia copper property, near Kirkland, permitting the assumption that sufficient ore has not been found to justify further expenditures. Deep exploration by shaft and tunneling has been pushed for the last eighteen months. P. G. Spilsbury was engineer in charge. It is understood that the work was backed by interests identified with the Inspiration Consolidated Copper Co.

In the local Superior Court, the Amalgamated Copper Mines Co. has filed answer to a condemnation suit against it, seeking entry upon its lands for the purpose of constructing a dam across Cave Creek, to hold water and thus secure protection for western suburbs of Phoenix, including the Capitol grounds. The answer recites that the proposed dam would injure the company in the sum of $200,000 and that the place chosen for the dam is an improper one, where no safe structure of the sort could be erected. Strong local demand is urging immediate construction of the dam. On Jan. 3 a large part of the western suburbs of this city, including a part of the Capitol grounds, was inundated by the discharge of Cave creek, which debouches upon the plain about twelve miles north of the city.

The Dos Cabezas Gold Ridge Mining Co. has been sued in Tucson by J. H. Huntsman, its president, who alleges indebtedness of $37,000, mainly on notes alleged due and payable. M. J. Kiley has been appointed receiver for the Schuylkill Mining Co., at Chloride.

Ajo—The Black Prince Mine, forty-three miles east of Ajo, is being developed by the Ajo Mines Corporation, mainly composed of Douglas and Bisbee mining men. The property, of ten claims, lately was deeded the corporation by John E. Newberry, trustee. A new shaft has been sunk 150 ft. A hoist has been moved from the Bisbee-Ajo to a property adjoining the old Gunsight, lately acquired by C. P. Sheehan, who has started upon deepening the 400-ft. shaft. The mine was worked as early as 1864, and at one time was known as the Ida.

Jerome—The shaft of the Verde Central mine is bottomed at 600 ft. in ore of commercial quality, in Yavapai schist containing much chalcopyrite. Drifting is to be started at once to determine the extent of the ore.

Returns from a carload of ore shipped by the Shea Copper Co. to El Paso give $111 a ton in gold, silver and copper and a net return, deducting freight, of $3,412. The ore was notably high in silver, averaging for the forty-seven-ton shipment nearly 100 oz. The copper averaged 4.82 per cent.

Douglas—A San Francisco corporation, the Painted Desert Mining Co., has leased the marble quarries of the Golden Rule Mining Co., forty miles from this point. The twenty-four claims of the group are said to include a large body of good marble. About $25,000 has already been expended upon the property.

A recent visit to Bisbee found operations of Phelps Dodge Corporation Copper Queen Branch, on Sacramento Hill, at a standstill, there appearing no present advantage in further development, inasmuch as the stripping of the remaining overburden can be conducted more advantageously at the time of ore extraction after the new mill shall have been put into operation. There are two ore zones of this low-grade deposit, known as the east and west orebodies. The stripping of the west orebody has been a rather delicate task, by reason of the fact that upon one side of the hill lies part of the city of Bisbee, together with a main-line railroad, a trolley line, and a section of the district's principal highway. On the farther side of the hill now yawns a deep cut, down through the capping of silica breccia and porphyry which lies exposed in readiness for attack by the steam shovels. This porphyry averages over 1½ per cent copper, though very high-grade ore is found in spots, including lenses of glance. Thus it happens that some smelting ore has already been steam-shoveled for the Douglas furnaces; also 180,000 tons of milling ore, which has been placed in a stockpile and over 315,000 tons of lower-grade, which has gone to the leaching heap near Don Luis.

The new Copper Queen mill lies two and a half miles from the hill, with which it is connected by a high-line, broad-gage road. The ore will be loaded on steel dump cars of twenty and twenty-five-cu.yd. capacity and transported to a crushing plant adjacent to the mill, there to be separated, the smelting, concentrating, and leaching ores thence being diverted to Douglas, to the mill, and to the leaching heaps. The leaching operation is an experiment, pure and simple, yet one believed to be worth while. There is expectation of recovery, within six years, of 70 per cent of the metal contained. This would appear a slow turnover of capital, but it is one attended with little more expense than if the material were piled as waste. Water for the mill is to be secured from the Calumet & Cochise shaft, just over the hill to the northward, where, from a station at 1,800 ft. depth, is being run a long drift. From this shaft is expected delivery of 1,200 gal. of fresh water a minute. This flows to a 1,000,000-gallon reservoir.

The leach ore will be washed with copper-bearing mine water. The leaching heaps are built 20 ft. high, with culverts provided through which oxidizing air may reach every part and through which the acid copper-bearing water may be conducted to a precipitation plant, where the metal will be recovered through its affinity for iron.

The new mill is close to completion, after plans made by H. Kenyon Burch. The mill is understood to have many features resembling that at the Inspiration plant, though only one-fifth of the capacity of that 20,000-ton mill. Mill construction was started in June, 1918, but in October of that year was stopped, as, owing to war conditions, it was impossible to obtain steel. Construction work was resumed in August, 1919, and has been continuous since then. Most of the machinery and material was bought at high prices.

CALIFORNIA

Moment Position of Mining Industry in State

From Our Special Correspondent

San Francisco—With the opening of the year, gold mines of California, lode, drift, placer and dredger properties, are resuming to a marked extent. There has been sufficient readjustment of supply costs and wages and greater efficiency to give the gold miners a fighting chance at profits. In addition, many small prospects are being opened up under option; and thus there is vitality in the prospect situation. Grass Valley, Plymouth, Sutter Creek, Jackson and Melones have now resumed their customary activity and may be said to be approaching normal. The Mother Lode region further south is also active, although not to the extent of former years. Greater attention than formerly is being paid to drift mining and small placering. Gold dredges which were shut down because they were being worn out without securing profit are being put back into operation.

The copper companies are becoming interested in the increasing price of copper, but it is doubtful if copper mining will be resumed in the Shasta region until the copper price has made additional gains and lower costs are possible of attainment. The Plumas County copper districts are more or less active, with the Engels company operating at a good rate, but other mines engaged in desultory work. With a strengthening of the copper situation there should be a marked improvement here.

The Randsburg silver district has been very active and development upon claims other than discovery claims has been encouraging. Unless the litigation which has already started prevents, this district should give a good record in 1922.

The petroleum industry has recovered from labor troubles, and 1922 promises to be a record year for production, but it is not unlikely that new wells drilled will be fewer than in 1921. The industry as a whole is well consolidated and in a position to make the most of market possibilities as they develop.

E. E. Paxton, general manager of the Engels Copper Mining Co., has issued a formal reply to the charges made by Henry Engels, president of the company, in the letter recently sent out asking for proxies for the annual meeting on Feb. 13.

MICHIGAN

The Copper Country

Copper Range Mines Gradually Increasing Force — Favorable Report on Mohawk Expected

By M. W. Youngs

Houghton—Working forces are being gradually built up at the Copper Range mines, particularly at Champion, which added about seventy-five men to its underground crew in December. Champion's production has been steadily increasing from month to month, the daily tonnage now being 2,400 or approximately 62,000 tons a month. The yield here has fallen off only slightly and is now about 39 lb. to the ton, refined. Baltic is hoisting around 16,000 tons of rock per month and Trimountain, 13,000. There is no change in yield in these mines and Trimountain is maintaining the improvement in quality of rock that has been in evidence for several months. Production, refined, for the three mines is estimated at 2,700,000 lb. per month, which is 60 per cent of the output of normal years such as 1915 and 1916. As men are taken on the amount of drifting being done in Champion and Baltic is increased and a full program of opening work will be under way in both of these mines in another month. A heavy program of drifting has been in progress at Trimountain for several months.

A most favorable report on Mohawk operations in 1921 is expected here. Mohawk increased production last year and was able to materially reduce costs. It cost Mohawk 13.1c. per lb. in 1920 and it is believed the 1921 report will show costs under 12c. It also is believed Mohawk received close to 13c. per lb. for copper sold in 1921 and that earnings were somewhat in excess of 1c. per lb. Based on estimated production of 14,000,000 lb., Mohawk should report a net profit of approximately $1.50 per share on 1921 operations. No construction work involving heavy costs is contemplated at Mohawk this year. Connection, however, will be made with the Calumet & Hecla water system, which was extended north last fall. This will enable Mohawk to drain all of its wells and other surface water which will result in a lessening of mine pumping costs.

Arcadian Consolidated has reached a depth of 1,050 ft. in its new sinking operations in the New Baltic shaft, which is being lowered from the 942 level to a depth of about 1,100 ft. to correspond with the 1,050 level of the New Arcadian shaft. The shaft is again in the vein and the rock being brought to surface is heavily charged with copper. The shaft was sunk 108 ft. in December and should reach its objective about the middle of January. A drift south will then be started. Work in the south drift from the 9th level has been resumed and the vein here is also yielding a splendid grade of rock.

No. 2 Gratiot shaft of the Seneca will be one of the most modern shafts in the district. It will have three compartments. Work of preparing the shaft for a resumption of sinking is progressing favorably. The steel work for the collar is completed and ready for the pouring of concrete. It will be necessary to clean out the shaft, widen it and put in new timber before sinking can be resumed. It is expected the shaft will be ready for sinking and the new hoist, now on the ground, installed by spring. Opening work in the Seneca shaft from the 3rd to the 7th levels, inclusive, continues.

Mayflower reports an improvement in the north drift at the 1,450 level. At the 1,750 level work is still proceeding in the crosscut through the fault encountered in the south drift.

Calumet & Hecla shipped over 2,000,000 lb. of copper by rail in December.

JOPLIN-MIAMI DISTRICT

Tailings Pond Dam Dynamited at Circle Mine — Severe Storm Damages District Properties—Vantage Co. Makes Record Output

By P. R. Coldren

Joplin — A boy's quarrel over the privilege of skating on the mill pond of the Connecticut Zinc Co.'s Circle mine at Oronogo, Mo., resulted in dynamiting the pond dam and causing damage that will prevent the property from starting operation the middle of January, as had been planned. It is expected that repairing the damage and getting fresh water into the dam will require the better part of a month. The Circle mine, which has the largest and most complete concentrator in the entire Tri-State field, has been idle for over a year. A. J. Burnham, of Joplin, is district manager.

An unusual wind and hail storm, accompanied by an electrical disturbance, caused considerable damage to city and mining property in this field on the night of Jan. 3. The Premier mine lost a dummy elevator and smokestacks. The St. Joe mine lost smokestacks. The Black Hawk mine lost a tramway. And part of mills of the Bluebird and Skelton companies were materially damaged.

An exceptionally good output record is reported by the Vantage Co., of Picher, Okla. At the company's No. 1 mine at Picher a total of 7,293 tons of zinc ore and 3,808 tons of lead ore was produced from only 79,476 tons of dirt. The recovery of the zinc was 9.17 per cent (in local parlance) and that of lead 4.79 per cent, or a total of 13.96 per cent. O. A. Sneed is superintendent.

MEXICO

Parral—Seventeen men were killed by a landslide at San Francisco del Oro, near Santa Barbara, recently. They were employed in digging down an old tailings dump to be re-treated in the new mill erected by the San Francisco del Oro Mining Co., when the upper part caved. Others went to their rescue, and while attempting to uncover them a second slide added two more to the death list.

THE MARKET REPORT

Daily Prices of Metals

Jan.	Copper, N. Y., net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
5	13.50	31.75	32.25	4.70	4.375@4.40	4.80
6	13.50	31.875	32.375	4.70	4.375@4.40	4.80
7	13.50	32.00	32.[illegible]25	4.70	4.375@4.40	4.75@4.80
9	13.50	31.875	32.375	4.70	4.375	4.75@4.80
10	13.50	31.875	32.25	4.70	4.375	4.75 - 4.775
11	13.50	31.75	32.375	4.70	4.375	4.75

*These prices correspond to the following quotations for copper delivered: Jan. 5 to 11 inc., 13.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Jan.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
5	66	66⅞	73½	167⅝	169⅝	24⅜	24⅜	27	27⅜
6	65⅝	66½	73½	167¾	169¾	24½	24⅜	27⅛	27½
7	...	...	...	....	....	...	..	...	...
9	65¾	66¾	73½	166¾	168¾	24⅜	24⅜	26⅞	27¼
10	65⅜	66¼	73	165¼	167	24½	24¼	26¾	27⅛
11	65¼	66	73	165⅝	167⅜	24⅜	24¼	26½	26⅞

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Jan.	Sterling Exchange "Checks"	Silver			Jan.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
5	418	99⅝	64¼	34½	9	421½	99⅝	66¼	35½
6	419¼	99⅝	64[illegible]	34⅞	10	422½	99⅝	66⅜	35½
7	419½	99⅝	64⅞	34¾	11	422¼	99⅝	66	35⅜

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Metal Markets

New York, Jan. 11, 1922

No buying of importance has yet marked the new year. Some large consumers of copper have been in the market, but trading in all of the metals has been exceedingly quiet so far as most trading interests are concerned. It is generally believed, however, that the lull is only a temporary one, inasmuch as general business conditions seem to be unimpaired. Cheap call money, at 3½ per cent today, is a favorable factor.

Copper

Some of the large producers have shown a tendency to meet the market during the last week, and it is possible to buy at 13.75c. delivered in an increasing number of directions. Some large orders have been booked during the week at this price, as well as somewhat above, when later deliveries were wanted. Trading in small lots of one or two hundred tons has been very meager indeed, and this has made the market appear more quiet than usual when, as a matter of fact, domestic sales have mounted into a higher tonnage than for several weeks. It is significant that some of the larger interests are considering copper purchases at present prices advisable. The wire business seems to be good. Brass makers are not expected to be in the market much before February.

Export sales have fallen off somewhat during the last week, though the Export Association has booked some business to the usual destinations at 14.125c. c.i.f. European points. Outside interests have cut this price 10 to 15 points without stirring up much business. Foreign buying is no doubt affected by the deliberations of the conference which has recently assembled at Cannes.

Lead

The official contract price of the American Smelting & Refining Co. continues at 4.70c., a level which has now been maintained for almost four months. The New York market has been quiet at unchanged prices, although there is somewhat less disposition to charge more than 10 points' premium on corroding grades. Although sales have not been large, producers are not pressing any metal on the market; in fact, many of them have entirely sold their January output, and are willing to accumulate a little lead if necessary, believing higher prices sure to come. The European demand is holding up particularly well, and prices are being realized somewhat above London parity in many instances. No more sales of domestic lead to foreign buyers have been reported, but this possibility is always near with the present condition of the market.

In St. Louis there has been some pressure, and the 4.40c. quotation of last week has not been maintained. Careful buyers were able to get lead for 4.375c. as early as last Thursday; in fact large lots could no doubt have been obtained at all times at this price had any one wanted them. Some producers continue to quote 4.40c., but they are the ones who are not at all anxious to sell. Freight rates in Central Freight Association territory have not yet been adjusted to the satisfaction of all parties, and another meeting is scheduled for Chicago on the seventeenth at which the matter should be settled.

Zinc

The market has been noticeably softer since Saturday of last week, although several producers dropped out of the market when it became apparent that a decline was inevitable. Zinc was sold in a fairly large tonnage on Saturday for 4.775c. and on Tuesday for 4.75c., St. Louis, which is the market today. The decline is attributed to the lessening of demand from the steel industry more than to any pressure on the part of producers to dispose of their production. Trading has not been particularly heavy, and the lower prices have not produced additional business. High-grade zinc continues to be in good demand at 6c. with freight allowed.

Tin

Consumers have taken average amounts of tin during the last week, prices varying but little from day to day. The tin-plate orders reported do not seem to have activated the market to any great extent. The interest involved probably bought large quantities of tin last month. Chinese tin is again being offered here for January shipment, and was yesterday obtainable at about three-quarters of a cent under the price asked for spot Straits. American electrolytic is still available only in extremely limited amounts, but there seems to be some prospect that Bolivian producers will again begin shipment soon, as they are better satisfied with present prices. Production of concentrates was virtually suspended when the price of tin dropped to around 25c. last fall.

Straits tin for forward delivery has sold at approximately the same prices as spot.

Arrivals of tin, in long tons: Jan. 3d, Straits, 150; 6th, Liverpool, 25; London, 50; 9th, Straits, 375.

Gold

Gold in London: Jan. 5th, 98s. 4d.; 6th, 97s. 11d.; 9th, 97s. 6d.; 10th, 97s. 2d.; 11th, 97s. 5d.

Foreign Exchange

Foreign exchanges have generally advanced since our last report a week age. On Tuesday, Jan. 10, francs were 8.305c.; lire, 4.3125c.; and marks, 0.58c. New York funds in Montreal, 6$\frac{9}{16}$ per cent premium.

Silver

An improvement in Shanghai and Hongkong exchange rates has brought China into the market again as a buyer. The Indian bazaars also bought, although there have been resales from this quarter. Sales of silver from the Continent continued. The result of these factors has brought about higher prices in both London and New York, to which the strength of sterling exchange has contributed in local prices.

Mexican Dollars—Jan. 5th, 48¾; 6th 49⅜; 7th, 49⅜; 9th, 50⅜; 10th, 50⅜; 11th, 50¼.

Other Metals

Quotations cover wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony—Chinese and Japanese brands, 4.50c.; W. C. C. brand, 5.25@5.75c. per lb. Cookson's "C" grade, spot, 9c. per lb. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—7½c. per lb.

Cadmium—$1@$1.10 per lb. in 1,000-lb lots. Smaller quantities, $1.10@$1.25 per lb. Demand is somewhat improved.

Palladium—Nominal, $55@$60 per oz.

Platinum—$84@$93 per oz. Market stronger.

Quicksilver—$52 per 75-lb. flask. San Francisco wires $48.70.

The prices of the following metals remain unchanged from the figures published in these columns on Jan. 7: Bismuth, Cobalt, Iridium, Molybdenum, Monel Metal, Nickel, Osmium, Rhodium, Selenium, Thallium and Tungsten.

Metallic Ores

The market is generally exceedingly quiet, and prices on the following ores remain unchanged from the figures published in the Market Report in the Jan. 7 issue: Chrome, Iron, Magnetite, Manganese, Molybdenum, Tantalum, Titanium, Tungsten, Uranium, Vanadium, Zircon, and Zirkite ores.

Zinc and Lead Ore Markets

Joplin, Mo., Jan. 7—Zinc blende, per ton, high, $31.10; basis 60 per cent zinc, premium, $29; Prime Western, $28; fines and slimes, $27@$25; average selling price, all grades of zinc blende, $28.56.

Lead, high, $62.80; basis 80 per cent lead, $60; average settling price, all grades of lead, $58.96 per ton.

Shipments for the week: Blende, 7,925; lead, 3,226 tons. Value, all ores, $418,550.

Purchases this week were about 7,000 tons, 925 tons under the shipment, marking a further decrease in reserve stocks. Outputting is estimated at from 6,000 to 6,500 tons. Although a number of mills have been restarted, this has little apparent bearing on an increase of production, which is explained by prominent mine owners and buyers by the fact that the mines that were producing steadily during the last year cut the ore reserves almost to nothing and are weekly showing a lower production record. It is likewise contended that with all mines preparing to start, the output will not reach the highest level of 1921, and it is believed it cannot average as high as the 6,300-ton average of last year.

Platteville, Wis., Jan. 7—Blende, basis 60 per cent zinc, $30. Lead ore, basis 80 per cent lead, $58 per ton. Shipments for the week: Blende, 370 tons to smelters and 780 tons to separating plants.

Non-Metallic Minerals

Generally dull markets exist for the non-metallic minerals, and there is no quotable change in the following from the prices published in our Jan. 7 issue: Asbestos, Barytes, Bauxite, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Kaolin, Limestone, Magnesite, Mica, Monazite, Phosphate Rock, Pumice Stone, Pyrites, Silica, Sulphur and Talc.

Mineral Products

Sodium Sulphate—For 95 per cent material, $12.50 per ton, f.o.b. in bulk, Western mines, spot and six months' contract; $18@$21 per ton, New York.

Prices of Copper Sulphate, Potassium Sulphate and Sodium Nitrate are unchanged from the quotations published Jan. 7.

Ferro-Alloys

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 11½c. per lb. of chromium contained; 4 to 6 per cent carbon, 12c., f.o.b. works.

No quotable changes have taken place in the following ferro-alloys from the prices quoted in the Jan. 7 issue: Ferrotitanium, Ferrocerium, Ferromanganese, Ferromolybdenum, Ferrosilicon, Ferrotungsten, Ferro-Uranium and Ferrovanadium.

Metal Products

Prices of Copper Sheets, Lead Sheets, Nickel Silver, Yellow Metal, and Zinc Sheets are unchanged from the quotations published on Jan. 7.

Refractories

Prices on the following are unchanged from the figures published in the Jan. 7 issue: Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick and Silica Brick.

The Iron Trade

Pittsburgh, Jan. 10, 1922.

Production of steel ingots was at the rate of 20,000,000 tons a year in December, against fully 23,000,000 tons in October and November, the highest rate since February. There was a sharp decline in the rate in the latter part of December, and operations have not regained the former rate yet, though they probably will by the end of this month.

Operations are heaviest at the pipe mills, and the sheet, tin plate, and wire mills come next in order. Production of bars, shapes, plates, and rails is light.

The finished-steel markets have been quiet since the first of the year, except that some interests have had heavy bookings of tin plate, which promises to be in full demand in 1922. Demand for tubular goods has been falling off.

Steel prices have been practically stationary for three weeks, the only change recently, a minor one, being a reduction from 3.75c. to 3.50c. in the price of the American Steel & Wire Co. for cold-rolled strip, following price cutting by independents.

Pig Iron—W. P. Snyder & Co. have sold 1,500 tons of bessemer to an Ohio manufacturer at $19.50, furnace, or 50c. under the price nominally quoted since Aug. 1. Basic is altogether inactive. There was a fair movement in foundry iron in December, for January and February shipment, the market now being dull. We quote: Bessemer, $19.50; basic, $18.25; foundry, $19.50 to $20, Valley, freight to Pittsburgh being $1.96.

Coke

Connellsville—Furnace, $2.75@$3; foundry, $3.75@$4.50.

American Brass Output in Ten Years

Not until the subject of a merger with the Anaconda Copper Co. opened up the affairs of the American Brass Co. to greater publicity have even the shareholders of that concern had an adequate conception of the size of its business, according to the *Boston News Bureau.* The part that the company played in the war is visualized in the production of finished materials in the years of 1916, 1917 and 1918, in one of which it produced 564,853,928 lb. of fabricated copper and brass. We trace the output by years since 1911 (in lb.)

1911	233,839,101	1916	497,324,042
1912	312,461,536	1917	500,790,548
1913	297,253,789	1918	564,853,928
1914	233,961,384	1919	369,591,018
1915	387,059,514	1920	405,178,719
Total	1,464,575,324	Total	2,337,738,255

It will be seen that in the five years from 1916 to 1920 inclusive American Brass produced over 1,160,000 tons of finished goods, an amount which explains why the company has long been known as the world's largest copper consumer. In some of the periods enumerated it must have melted into brass or fabricated into copper wire or sheets well over 350,000,000 lb. of copper.

During the twenty years ended Dec. 31, the company earned a gross profit of $78,155,000, against which it charged almost $25,000,000 for improvements and depreciation, leaving a net profit of $53,768,000, or $377.54 per share on the company's 150,000 shares. These profits were in large measure expanded by the huge war demand for the company's products. Today its mills are running at little or no profits, as for the first nine months of 1921 the operating loss was $2,193,000.

Dividend Records of Ontario Mines

Up to the end of 1921 dividends paid by the gold and silver mines of northern Ontario amounted to $115,437,727. In view of the fact that the Cobalt camp was discovered late in 1903, and hardly began producing until 1905, this record is one of which Ontario can well be proud. Dividends paid by the Cobalt mines amount to $92,283,820, which represents practically 50 per cent of the gross value of the production. Porcupine mines have paid $22,355,281, and Kirkland mines $798,625.

The following is a list of mines which have paid $2,000,000 or over, and it will be seen that Nipissing is the outstanding company and is likely to maintain this position for a considerable time.

1. Nipissing	$24,223,297
2. Hollinger	16,558,000
3. Coniagas	10,940,000
4. Kerr Lake	9,160,000
5. La Rose	7,505,409
6. Crown Reserve	6,190,849
7. McKinley	5,955,391
8. Mining Corporation	5,499,867
9. Buffalo	3,637,000
10. McIntyre	2,548,198
11. Dome	2,397,083
12. Temiskaming	2,159,156

In addition to the above companies, twenty-five other mines have paid a total of over $18,000,000.

Transvaal Gold Production

The following table summarizes Transvaal gold production since 1917:

RAND GOLD OUTPUT, 1917–1921, IN FINE OUNCES

	1921	1920	1919	1918	1917
January	681,382	670,503	676,059	714,183	782,634
February	671,123	625,330	636,728	659,759	721,321
March	588,137	707,036	712,379	696,281	787,094
April	651,593	686,979	694,944	717,099	742,778
May	687,776	699,041	724,995	741,217	729,385
June	678,490	715,957	702,379	727,696	759,724
July	689,555	736,099	725,497	736,199	757,890
August	711,526	702,083	706,669	740,210	756,658
September	691,026	682,173	698,558	708,206	738,231
October	707,825	662,472	723,722	679,764	751,290
November	704,236	633,737	677,970	658,701	722,839
December		632,215	650,191	641,245	722,419

Ore and Metal Movements for November, 1921

Imports and exports of the more important metals and ores as reported by the Department of Commerce for November, 1921, and the figures for November, 1920, as finally revised, are as follows:

IMPORTS, NOVEMBER, 1920 AND 1921

In Pounds, Unless Otherwise Stated

	November 1920	November 1921
Antimony ore, contents	71,591	....
Antimony matte, regulus or metal	354,699	1,545,895
Brass, fit only for remanufacture	8,010,304	8,516,832
Copper		
Ore, contents	3,320,237	5,669,284
Concentrates, contents	2,895,750	1,414,356
Matte and regulus, contents	927,623	213,943
Imported from		
Spain	1,147	1,003,920
Canada	1,786,384	419,716
Mexico	3,030,498	45,706
Cuba	....	2,187,558
Chile	1,942,902	2,833,889
Peru	256,499	82,560
Venezuela	....	514,291
Other countries	126,180	209,943
Unrefined, black and blister	20,827,205	10,561,454
Refined, in bars and plates	8,319,937	7,825,099
Old, for remanufacture	1,556,453	2,091,382
Composition metal, copper chief value	444,493	47,762
Lead		
Ore, contents	931,431	928,773
Bullion, contents	18,985,702	12,197,411
Imported from		
Canada	635,830	555,167
Mexico	19,262,918	12,359,496
Other countries	18,385	211,521
Pigs, bars, and old	7,716,344	2,916,234
Manganese ore, long tons	74,477	8,620
Imported from		
Cuba, long tons	1,040	....
Brazil, long tons	44,900	8,600
British India, long tons	17,250	....
Tungsten ore, long tons	272	83
Pyrites, long tons	8,600	28,057
Imported from		
Spain, long tons	....	26,597
Canada, long tons	5,600	....
Tin ore, long tons	2,831	854
Bars, blocks and pigs	9,550,535	6,886,085
Imported from		
United Kingdom	336,250	478,220
British Straits Settlements	6,992,086	5,828,407
Hongkong	1,930,999	225,379
Australia	123,200	197,120
Zinc		
Ore, contents	2,752,221	....
Imported from		
Mexico	2,752,221	....
Zinc dust	410	29,724

EXPORTS OF COPPER, LEAD AND ZINC

In Pounds	November 1920	November 1921
Copper		
Ore contents	(a)	(a)
Concentrates, contents	(a)	(a)
Unrefined, black and blister	58,343	40,683
Refined, in ingots and bars	38,496,030	69,377,438
Exported to		
Belgium	1,861,441	1,793,752
France	12,987,092	12,813,094
Germany	6,347,098	27,362,115
Italy	112,087	6,519,079
Netherlands	3,350,232	3,352,404
Spain	....	1,850,666
Sweden	1,916,865	1,927,358
United Kingdom	4,738,717	2,576,124
Canada	1,424,510	3,605
Japan	....	5,251,936
Other countries	1,757,988	5,927,305
Composition metal, copper chief value	173,834	6,167
Old and scrap	132,892	102,079
Pipes and tubes	338,425	85,656
Plates and sheets	913,767	416,432
Wire, except insulated	2,499,075	423,466
Lead		
Pigs and bars		
Produced from domestic ore	274,062	183,557
Produced from foreign ore	1,019,382	11,726,575
Exported to:		
United Kingdom	....	6,722,048
Canada	49,065	69,971
Argentina	224,000	31,997
Brazil	725	224,013
China	....	11,200
Japan	672,000	336,000
Other countries	347,654	4,514,903
Zinc		
Dross	567	61,690
Spelter		
Produced from domestic ore	72,379	185,959
Produced from foreign ore	50,126	....
Exported to:		
France	....	56,028
Canada	34,506	....
Mexico	53,636	6,530
Other countries	34,363	123,401
In sheets and strips	1,118,063	276,974

(a) No exports.

COMPANY REPORTS

The Coniagas Mines, Ltd.

A report of operations of the Coniagas Mines, Ltd., for the year ended Oct. 31, 1921, shows a net profit of $347,378.11. Three dividends were paid, one of $600,000 and two each of $100,000. Silver output totaled 1,301,515 oz., for which 70.80c. per oz. was realized and which cost 33.52c. per oz. to mine and concentrate. Smelting, refining, shipping, and marketing costs amounted to 6.33c. Working and loss and gain accounts follow:

Debit	
Head office and administration	$ 16,563.29
Mines' office and supervision	26,634.34
Camp expense	14.63
Lands and roads	471.11
Mining	132,783.83
Sale of ore and bullion (refining, treatment, and other charges)	82,416.00
Legal expense	1,259.93
Milling	212,832.79
Transportation and traveling	694.60
Taxes and royalties	33,108.43
Fire insurance	4,289.68
Maintenance of houses	3,831.84
Employees' bonus	4,011.12
Loss and gain	398,722.01
	$ 917,633.60
Credit	
Silver revenue	$ 911,555.06
Copper revenue	991.60
Camp revenue	187.00
Rents	4,309.25
Cash discounts	590.69
	$ 917,633.60

LOSS AND GAIN ACCOUNT

Debit		
Donations and sundry expense		$ 678.94
Directors' fund		3,000.00
Maidens McDonald and Montgomery Maidens properties net expenditures		635.56
Examining prospects		5,838.82
Flume construction expense		8,137.19
Adjustments on account of previous years' operations		20,802.37
Profit before providing for depreciation and other reserves		422,238.93
		$ 461,331.81
Credit		
Balance from working account		$ 398,722.01
Sundry sales		141.56
Interest on Victory loan bonds		52,334.94
Bank and other interest		4,323.14
Interest charged to the Coniagas Reduction Co. Ltd.		5,810.16
		$ 461,331.81
Debit		
Profits for year before providing for depreciation and other reserves		$ 422,238.93
Adjustment of reserve on account of Victory loan bonds		19,157.50
		$ 441,396.43
Credit		
Reserve for contingencies		$ 18,288.32
Reserve for depreciation accrued		28,000.00
Amounts written off properties		47,730.00
Net profits for year		347,378.11
		$ 441,396.43
Debit		
Dividend No. 51	$ 600,000.00	
Dividends Nos. 52 and 53	200,000.00	$ 800,000.00
Balance		$ 1,695,889.78
		$ 2,495,889.78
Credit		
Balance Nov. 1, 1920, brought forward		$ 2,148,511.67
Net profit for year		347,378.11
		$ 2,495,889.78

Capitalization is 800,000 shares of $5 each, fully paid.

Camp Bird, Ltd.

A report of operations of Camp Bird, Ltd., for the year to June 30, 1921, states that all operations on the Camp Bird mine were suspended on Nov. 30, 1920, and the property was on that date placed in care of watchmen. In the opinion of the general manager, however, the work was not considered as completed, nor was the outlook discouraging. The accounts for the year show a surplus of expenditure, £17,535, and the company carries forward a balance of £19,905, against £37,440 brought in. The company's holding in the Santa Gertrudis Co., Ltd., is 808,351 shares.

Sulphide Corporation

A report of operations of the Sulphide Corporation, Ltd., for the year ending June 30, 1921, states that the past year has been one of much anxiety owing to the prolongation of the Broken Hill strike until early in November, 1920. The award as to wages, hours of work and other conditions, coupled with the heavy fall that has since taken place in the price of the metals which the corporation produces, has made work at Broken Hill extremely difficult and precarious. Nevertheless mining and milling operations were recommenced about the end of November, 1920, and have since been continued under the new and adverse conditions which have prevailed.

Operations at the mine and smelting works have resulted in a small working profit of £2,480, although, apart from the profit obtained from the acid and superphosphate plants at Cockle Creek, there would have been a substantial loss.

This working profit has been augmented by sundry credit items in the profit and loss account, due mainly to successful trading in lead and to interest and profit on investment, the final net result being a profit of £30,009.

The tonnage of bullion treated in the refinery was 15,102 tons which yielded:

Gold, Oz.	Silver, Oz.	Soft Lead, Tons	Antimonial Lead, Tons
6,189	1,298,985	12,649	35

Mexican Corporation, Ltd.

A report of operations of the Mexican Corporation for the year ended June 30, 1921, shows that after allowing for interest paid and accrued on the seven-year notes and writing off £11,472, or one-third of the expenses of the issue, there was an excess of expenditure amount to £38,427, which has been carried forward. The corporation has now advanced to the Mexican company—the Mexican Corporation S.A.—£1,132,813.

The plant on the Fresnillo mine began operations at half capacity in August, and will, it is anticipated, be completed and working at full capacity—75,000 tons per month—in December. The general manager anticipates that on this basis, and with silver at 62½c. per fine oz., there will be a gross working profit of $75,000 per month.

At the Teziutlan property smelting was discontinued owing to the low price of copper, but recently a high-grade orebody has been struck, which promises well when operations are resumed.

The English company's holding in the British Equatorial Oil has not been increased since the closing of the accounts. Advice has been received of oil having been struck in the first well drilled on this company's property in Venezuela.

Santa Gertrudis Co., Ltd.

A report of operations of the Santa Gertrudis Co., Ltd., for the year ended June 30, 1921, states that during the period there was treated 475,360 dry tons of ore, of which 200,487 was received from the Santa Gertrudis mine and 274,873 from the El Bordo. The bullion recovered contained 21,680 oz. fine gold and 4,533,338 oz. of silver. The financial result to the milling company does not appear in the report, but no dividend was declared by it. Santa Gertrudis, Ltd., the English company, had a balance over from 1919-20 amounting to £28,982, and after paying the expenses of the year and interest on the 8 per cent five-year notes, and writing off £10,000 or one-third of the expenses of issue of the notes, there was a balance left to carry forward amounting to £453.

The operations of the year were adversely affected by the shortage of power, owing to drought, and the earnings were seriously reduced by the fall in the price of silver. The advisory engineer considers that a reduction in costs is to be looked for within a reasonable time.

MINING STOCKS

Week Ended January 7, 1922

Stock	Exch.	High	Low	Last	Last Div.	
		COPPER				
Ahmeek	Boston	63	60	60	Sept. '20, Q	$0.50
Alaska-Br. Col., new	N. Y. Curb	2¼	1⅞	1⅞	......	
Allouez	Boston	24	24	24	Mar. '19	1.00
Anaconda	New York	50⅛	47¾	49	Nov. '20, Q	1.00
Arcadian Consol.	Boston	3½	3	3	......	
Ariz. Com'l	Boston	9½	8½	8¾	Oct. '18, Q	.50
Big Ledge	N. Y. Curb	*27	*25	*27	......	
Bingham Mines	Boston	13	13	13	Sept. '19, Q	.25
Calumet & Arizona	Boston	59	57	57½	Dec. '21, Q	.50
Calumet & Hecla	Boston	275	265	265½	June '20, Q	5.00
Canada Copper	N. Y. Curb	*38	*35	*35	......	
Centennial	Boston	9¾	9½	9½	Dec. '18, SA	1.00
Cerro de Pasco	New York	34⅛	32½	32½	Mar. '21, Q	.50
Chile Copper	New York	16¼	15⅜	15⅜	......	
Chino	New York	27½	26½	26⅝	Sept. '20, Q	.37½
Columbus Rexall	Salt Lake	†*16	†*11	*11½	......	
Con. Arizona	N. Y. Curb	*4	*2	*3	Dec. '18, Q	.05
Con. Copper Mines	N. Y. Curb	1⅜	1⅜	1 7/16	......	
Copper Range	Boston	39	37½	37½	Sept. '20, Q	.50
Crystal Copper	Boston Curb	*64	*61	*63	......	
Davis-Daly	Boston	6¾	6½	6⅝	Mar. '20, Q	.25
East Butte	Boston	11½	10½	10½	Dec. '19, A	.50
First National	Boston Curb	*80	*75	*80	Feb. '19, SA	.15
Franklin	Boston	†2½	†1⅞	1⅞	......	
Gadsden Copper	Boston Curb	†*50	†*40	*50	......	
Granby Consol	New York	28½	26½	26½	May '19, Q	1.25
Greene-Cananea	New York	27½	26	26	Nov. '20, Q	.50
Hancock	Boston	2¼	2¼	2¼	......	
Howe Sound	N. Y. Curb	2½	2⅜	2⅜	Jan. '21, Q	.05
Inspiration Consol.	New York	40	38	38⅝	Oct. '20, Q	1.00
Iron Cap	Boston Curb	7½	7	7	Sept. '20, K	.25
Isle Royale	Boston	23¾	23¼	23¼	Sept. '19, SA	.50
Kennecott	New York	26⅝	25½	26	Dec. '20, Q	.50
Keweenaw	Boston	1⅝	1½	1⅝	......	
Lake Copper	Boston	2⅜	2⅜	2⅜	......	
La Salle	Boston	1¾	1½	1¾	......	
Magma Copper	N. Y. Curb	28½	26½	27½	Jan. '19, Q	.50
Majestic	Boston Curb	†*5	†*3	*4	......	
Mason Valley	Boston	1½	1⅜	1⅜	......	
Mass Consolidated	Boston	3	2⅜	2¾	Nov. '17, Q	1.00
Miami Copper	New York	27	26⅝	26½	Nov. '21, Q	.50
Michigan	Boston	2	2	2	......	
Mohawk	Boston	55	54	54	Nov. '20, Q	1.00
Mother Lode Coa.	N. Y. Curb	7½	6⅞	7⅜	......	
Nevada Consol.	New York	15	14¼	14½	Sept. '20, Q	.25
New Cornelia	Boston	18	17½	17½	Aug. '20, K	.25
North Butte	Boston	13⅜	12½	12½	Oct. '18, Q	.25
North Lake	Boston	†*25	†*20	*24	......	
Ohio Copper	N. Y. Curb	....	....	*8	......	
Old Dominion	Boston	23½	23	23	Dec. '18, Q	1.00
Osceola	Boston	30½	30½	30½	June '20, Q	.50
Phelps Dodge	Open Mar.	†175	†160	....	Jan. '22, Q	1.00
Quincy	Boston	43½	42½	42½	Mar. '20, Q	1.00
Ray Consolidated	New York	15	14⅜	14½	Dec. '20, Q	.25
Ray Hercules	N. Y. Curb	*12	*6	*6	......	
St. Mary's Min. Ld.	Boston	43½	43	43	Dec. '21, K	1.00
Seneca Copper	Boston	....	....	24½	......	
Shannon	Boston	1⅛	1	1	Nov. '17, Q	.25
Shattuck Arizona	New York	8½	8⅜	8½	Jan. '20, Q	.25
South Lake	Boston	†1	†*55	*60	......	
Superior & Boston	Boston	1⅛	1⅛	1⅛	......	
Tenn. C. & C. cfs.	New York	10⅜	9½	8½	May '18, I	1.00
Tuolumne	Boston	*84	*70	*74	May '13	.10
United Verde Ex.	Boston Curb	29½	28½	28	Nov. 21, Q	.25
Utah Consol.	Boston	2	1½	1½	Sept. '18,	.25
Utah Copper	New York	64	61⅜	61⅜	Dec. '21 Q	.50
Utah Metal & T.	Boston	1½	1 1/16	1 1/16	Dec. '17,	.30
Victoria	Boston	2	1½	1½	......	
Winona	Boston	*40	*30	*30	......	
Wolverine	Boston	10¾	10½	10½	......	
		NICKEL-COPPER				
Internat. Nickel	New York	12¼	11⅜	11⅜	Mar. '19,	.50
Internat. Nickel, pf.	New York	65⅜	60	62½	Nov. '21, Q	1.50
		LEAD				
National Lead	New York	86	85	85	Dec. '21, Q	1.50
National Lead, pfd.	New York	108	108	108	Dec. '21, Q	1.75
St. Joseph Lead	New York	12¾	12¾	12¾	Dec. '21, Q	.25
		QUICKSILVER				
New Idria	Boston	†1½	†1	1½	......	
		ZINC				
Am. Z. L. & S.	New York	13½	12¾	13	May '20,	1.00
Am. Z. L. & S. pfd.	New York	39⅜	38⅜	39⅜	Nov. '20, Q	1.50
Butte C. & Z.	New York	5¾	5⅜	5½	June '18,	.50
Butte & Superior	New York	22	20⅜	21½	Sept. '20,	1.25
Callahan Zn-Ld.	New York	6½	5½	5⅝	Dec. '20, Q	.50
New Jersey Zn.	N. Y. Curb	124¾	124½	124¾	Nov. '21 Q	2.00
Yellow Pine	Los Angeles	*50	*50	*50	Sept. '20, Q	.03

*Cents per share. †Bid or asked. Q, Quarterly SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.	
		GOLD				
Alaska Gold	New York	[illegible]	[illegible]	[illegible]	......	
Alaska Juneau	New York	[illegible]	[illegible]	[illegible]	......	
Carson Hill	New York	12⅝	11	11¾	......	
Cresson Consol. G.	N. Y. Curb	2¾	2 7/16	2½	June '20, Q	$0.10
Dome Extension	Toronto	*73	*69	*73	......	
Dome Mines	New York	20½	18½	20¼	Oct. '21, Q	.25
Florence Goldfield	N.Y. Curb	*28	*25	*25	......	
Golden Cycle	Colo. Springs	*70	*69	*69½	June '21, Q	.02
Goldfield Consol.	N. Y. Curb	*4	*4	*4	Dec. '19,	.05
Hollinger Consol.	Toronto	7.83	7.75	7.81	Dec. '21, 4 wks.	.05
Homestake Mining	New York	55	55	55	Dec. '21, M	.25
Kirkland Lake	Toronto	*33	*27	*32	......	
Lake Shore	Toronto	1.37	1.30	1.32	Nov. '21, K	.02
McIntyre-Porcupine.	Toronto	2.31	2.15	2.29	Jan. '22, K	.05
Porcupine Crown	Toronto	*19	*11	*13½	July '17,	.03
Porcupine V. N. T.	Toronto	*24	*17½	*20	......	
Portland	Colo. Springs	*39½	*39½	*39½	Oct. '20, Q	.01
Schumacher	Toronto	*34	*31	*33	......	
Silver Pick	N. Y. Curb	....	....	*50	......	
Teck Hughes	Toronto	*22	*16	*21	......	
Tom Reed	Los Angeles	*40	*38	*40	Dec. '19,	.02
United Eastern	N. Y. Curb	2½	2 7/16	2 7/16	Oct. '21, Q	.15
Vindicator Consol.	Colo. Springs	*21	*21	*21	Jan. '20, Q	.01
White Caps Mining	N. Y. Curb	*5	*5	*5	......	
Yukon Gold	N. Y. Curb	1⅛	1 1/16	1 1/16	June '18,	.02½
		SILVER				
Batopilas Mining	New York	....	....	⅛	Dec. '07, I	.12½
Beaver Consol.	Toronto	*20	*18	*19	May '20, K	.03
Coniagas	Toronto	1.50	1.30	1.50	May '21, Q	.12½
Crown Reserve	Toronto	*14½	*9½	*13½	Jan. '17,	.05
Kerr Lake	N. Y. Curb	3½	3⅜	3⅜	Oct. '21, Q	.12½
La Rose	Toronto	*33½	*33	*33	Apr. '18,	.02
McKinley-Dar.-Sav.	Toronto	*15	*14	*15	Oct. '20, Q	.03
Mining Corp. Can.	Toronto	1.15	1.00	1.00	Sept. '20, Q	.12½
Nipissing	N. Y. Curb	6⅝	6½	6½	Oct. '21, Q	.15
Ontario Silver	New York	4½	4½	4½	Jan. '19, Q	.50
Ophir Silver	N. Y. Curb	....	....	*12	Jan. '12,	.10
Temiskaming	Toronto	*32½	*25	*30	Jan. '20, K	.04
Trethewey	Toronto	*7	*6	*6½	Jan. '19,	.05
		GOLD AND SILVER				
Boston & Montana	N. Y. Curb	*94	*84	*86	......	
Cash Boy	N. Y. Curb	....	....	*5	......	
Dolores Esperansa	N. Y. Curb	1⅛	*90	*90	......	
El Salvador	N. Y. Curb	*6	*4	*4	......	
Jim Butler	N. Y. Curb	....	....	*6	Aug. '18, SA	.07
Jumbo Extension	N. Y. Curb	*4	*4	*4	June '16,	.05
MacNamara M.& M.	N. Y. Curb	*7	*6	*7	May '10,	.02½
Tonopah-Belmont	N. Y. Curb	1½	1 1/16	1 1/16	Jan. '22, Q	.05
Tonopah-Divide	N. Y. Curb	*67	*63	*64	......	
Tonopah-Extension	N. Y. Curb	1⅝	1⅝	1⅝	Jan. '22, Q	.05
Tonopah Mining	N. Y. Curb	1½	1½	1½	Oct. '21, SA	.05
West End Consol.	N. Y. Curb	*80	*74	*80	Dec. '19, SA	.05
		SILVER-LEAD				
Caledonia	N. Y. Curb	*7	*5	*7	Jan. '21, M	.01
Cardiff M. & M.	Salt Lake	†1.00	†*90	*92	Dec. '20,	.15
Chief Consol.	Boston Curb	3	2¾	3	Aug. '21, Q	.05
Consol. M. & S.	Montreal	....	....	18½	Oct. '20, Q	.62½
Daly Mining	Salt Lake	†3.00	†1.00	....	July '20, Q	.10
Daly-West	Boston	†3	†1½	2	Dec. '20, Q	.25
Eagle & Blue Bell	Boston Curb	†3	†2¼	2¼	Apr. '21, K	.05
Electric Point	Spokane	*4	*4	*4	May '20, SA	.03
Federal M. & S.	New York	9	9	9	Jan. '09,	1.50
Federal M. & S., pfd	New York	39	38	38½	Dec. '21, Q	1.00
Florence Silver	Spokane	*19	*17	*18	Apr. '19,	.01½
Grand Central	Salt Lake	†*45	†*36	*41	Jan. '21, K	.01
Hecla Mining	N. Y. Curb	4¾	4⅝	4¾	Dec. '21, Q	.17
Iron Blossom Con.	N. Y. Curb	*32	*20	*20	Dec. '21, Q	.02½
Judge M. & S.	Salt Lake	†3.00	†2.00	2.50	Sept. '20, Q	.12½
Marsh Mines	N. Y. Curb	*5	*5	*5	June '21, I	.02
Prince Consol.	Salt Lake	*11	*11	*11	Nov. '17,	.02½
Rambler-Cariboo	Spokane	*4	*3½	*4	Feb. '19,	.01
Rex Consol.	N. Y. Curb	*7	*7	*7	......	
South Hecla	Salt Lake	....	†*12½	....	Sept. '19, K	.15
Standard Silver-Ld.	N. Y. Curb	....	....	*10	Oct. '17,	.05
Stewart Mines	N. Y. Curb	*2	*2	*2	Dec. '15	.05
Tamarack-Custer	Spokane	2.25	2.20	2.20	Jan. '21 K	.04
Tintic Standard	Salt Lake	2.00	1.85	2.00	Dec. '21, Q	.05
Utah Apex	Boston	3⅜	2⅜	2⅜	Nov. '20, K	.25
Wilbert Mining	N. Y. Curb	*2	*2	*2	Nov. '17,	.01
		VANADIUM				
Vanadium Corp.	New York	32¾	30½	31⅜	Jan. '21, Q	1.00
		ASBESTOS				
Asbestos Corp.	Montreal	48½	48½	48½	Oct. '21, Q	1.50
Asbestos Corp., pfd.	Montreal	....	....	77	Oct. '21, Q	1.75
		SULPHUR				
Freeport, Texas	New York	14⅛	13	13	Nov. '19, Q	1.00
Texas Gulf	New York	41⅛	38½	40¾	Dec. '21, Q	1.00
		MINING, SMELTING AND REFINING				
Amer. Sm. & Ref.	New York	45¾	43⅝	44	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf	New York	87	86⅛	86½	Dec. '21, Q	1.75
Am. Sm. pf. A.	New York	†100	†100	87½	Jan. '22, Q	1.50
U. S. Sm. R. & M.	New York	36	35¾	35¾	Jan. '21, Q	.50
U.S.Sm.R.& M. pf.	New York	84¾	82	82¾	Oct. '21, Q	.87½

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Volume 113 New York, January 21, 1922 Number 3

Annual Progress Number

Industrial Analysis

Copper in 1921

By H. A. C. Jenison*
Geologist in charge of Copper, U. S. Geological Survey

THE FUTURE OF THE COPPER INDUSTRY is influenced by many unmeasured factors. Certain world-wide tendencies are evident, but the effect of such tendencies in individual countries is obscure. A revival of the domestic industry during the first half of 1922 is expected by some, but is mainly dependent upon general business revival here and in Europe.

Recently much has been said about new uses for copper, the increased electrification and the return of copper to its old place in the building industry and the household, but, because of the time necessary for the development of these uses, it appears that in the immediate future the consumption of copper will be almost entirely limited to the present fields.

Despite the low price of copper, exports of copper and its manufactures in 1921, including those to Japan, probably will not have exceeded 650,000,000 lb., which is considerably below the annual exports from 1907 to 1913. Germany was our largest pre-war customer, but her buying power is now greatly restricted and will probably continue to be for some time. It therefore appears unlikely that the export market will greatly improve for some time.

In considering the capacities of domestic and foreign markets, the relation of present domestic productive capacity to potential consumption is of interest. At the pre-war rate of increase, normal domestic consumption in 1922 should be about 1,100,000,000 lb., and from the present outlook it is unlikely that this figure will be exceeded.

The present productive capacity of domestic mines is at least 2,000,000,000 lb., and the refinery capacity at least 2,500,000,000 lb. The excess of refinery capacity is for copper from foreign mines which are likely to operate at as full capacity as the domestic mines. If mines and refineries operate at full capacity in 1922 or 1923, about 1,400,000,000 lb. will be available for export—more than our foreign markets are likely to absorb annually for a long time to come. It appears, therefore, that revival of the domestic mining and metallurgical industry will be gradual.

The more distant future of the industry is obscure. The domestic market apparently has many possibilities, among which is the creation of new uses for copper. The campaign conducted for this purpose already appears to be meeting with slight success, and may accomplish more than is now considered possible. In household uses copper is apparently meeting with a worthy rival in Monel metal, which, from all that can be learned, may prove to be more suitable for such uses than copper or aluminum, and can compete in price with either. The ultimate economy of copper roofing does not yet appear to have enthused the majority of builders and no great increase in the use of copper roofing in competition with other roofing materials is to be expected under existing conditions.

Electrification of railroads is considered one of the greatest future uses of copper. According to past experience, 10,000 lb. of copper used per mile of single track electrified is a very liberal estimate; in fact 6,000 lb. per mile is probably closer to the real consumption. For one mile of double track much less is required than for two miles of single track. Power plants, substations, transmission lines, and other equipment necessary to furnish power for electrified roads are estimated to require less than 10,000 lb. per mile of track electrified, and some of the lines most favorably situated for electrification would require less than those upon which the estimate is made. Even assuming electrification for the next decade at the rate of 20,000 lb. per mile and 4,000 miles per annum (two liberal assumptions), the maximum total requirements of copper would not exceed 80,000,000 lb. per year.

Electrical engineers of the Superpower Survey of the U. S. Geological Survey estimate that the amount and rate of copper consumption in the electrification of factories and railways in the "superpower zone" will be such as to have little or no effect upon the market price of the metal. Hydro-electrical development will consume considerable copper, but will be gradual, and the replacement rate in electrical apparatus is low.

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It seems that the plumbing and small-hardware industry offers the best field for increased domestic consumption, and the replacement rate in such a field would probably be higher than in most others. In this connection a most hopeful feature is the campaign against unreasonable retail prices and the disposition of large producers to enter the fabricating industry. Reduction of cost to the ultimate consumer will probably do more toward increasing domestic consumption than any other thing. The experience of certain steel companies is a notable case in point.

Another promising field for increasing domestic consumption is in the electrification of tools. Individual tools and machines driven by individual electric motors are far more economical and satisfactory than a number of tools or machines driven from a single shaft. Electrification of auxiliary machinery in plants now operated by steam prime-movers also appears promising.

FUTURE EXPORT MARKET

The export market after the next two or three years is also uncertain. The questions of exchange and the rehabilitation of European industry are apparently only part of the problem. Though Germany's buying power is now limited, it is believed by some that her replacement needs will offer a great market for domestic copper. Much of Germany's apparent pre-war consumption, however, was merely a scheme for the creation of great reserves by inducing the consumption of copper in such forms as to be readily available for war purposes. Copper was consumed in Germany in the decorating and covering of shop fronts and in a variety of other unnecessary uses which probably will never be renewed in Germany or in any other country suffering from the war while cheaper material can be obtained. The electrical industry of Europe, as in other regions, will probably recover and expand slowly.

Foreign competition for the European market within the next decade may well be considered. The Chile Copper Company is reported upon good authority to be planning enormous increases in ore treated. The first increase is to raise the capacity to about 27,000 tons of ore per day, or more than 300,000,000 lb. of copper per annum. The second will raise it to 40,000 tons per day and the third to 50,000 tons per day. A large plant for the treatment of ores which do not leach readily is also contemplated. Plans and specifications are supposed to be complete for the plant of 40,000-ton capacity, but progress on it has been delayed on account of high costs. With this increased capacity, the company should have available for European market within the next decade about 500,000,000 to 600,000,000 lb. of electrolytic copper at a relatively low cost.

The Union Minière du Haut Katanga has recently started the construction of a 4,000-ton concentrating plant for ores not amenable to leaching and of too low grade for direct smelting, and a leaching plant reported capable of producing 110,000,000 lb. of copper per annum. Both installations are reported to be the initial units of a much larger plant. The company is also undertaking development of sufficient hydro-electric power for the refining of all copper produced. At this rate the company should produce in the near future about 200,000,000 lb. of refined copper, available for the European market at a low cost, and it is probable that within a few years the company's production may be increased to about 400,000,000 lb. per annum. These two great companies, if their planned output is realized, should, together with the Spanish producers, make from 800,000,000 to 1,100,000,000 lb. of copper per annum, available to the European market at a price with which competition will be difficult.

With allowance for the increased output of these producers, productive capacity within the next decade should be nearly 4,000,000,000 lb., of which about 2,000,000,000 to 2,500,000,000 lb. will be available to the European market, a large part of which may be at a cost with which producers in the United States cannot easily compete. In short, both the slow recovery of the European market and the growing competition for it are possibilities that our producers must bear in mind in planning for the future.

The smelter production of copper from domestic ore in 1921 based upon actual figures for the first eleven months and estimates for December was about 461,000,000 lb. The refinery production on the same basis was about 601,000,000 lb. from domestic sources and about 320,000,000 lb. from foreign sources.

According to the records of the Department of Commerce, total imports for the first eleven months of copper, in ore, concentrates, matte, blister, and refined copper, were about 318,000,000 lb., of which 68,000,000 lb. was refined copper and 157,000,000 was blister copper. Exports for eleven months totaled about 567,000,000 lb., of which about 538,000,000 lb. was new refined copper and 29,000,000 lb. was manufactured.

The total supply of new refined copper for the year was about 989,000,000 lb., which includes refinery production from foreign and domestic sources and refined copper imported. The stocks of refined copper in hands of domestic refineries Dec. 31, 1921, excluding those in transit, were about 496,000,000 lb. Stocks of blister on that date in hands of smelters, in transit to refineries, and in hands of refineries, including materials in process, were about 297,000,000 lb. The amount of new refined copper withdrawn upon domestic account for 1921 was about 614,000,000 lb., as given in Table I.

TABLE I.—PRODUCTION, STOCKS, IMPORTS, EXPORTS, AND CONSUMPTION OF COPPER, 1919-1921.

	In Pounds 1919	1920	1921
Smelter output from domestic ores	1,286,000,000	1,209,000,000	461,000,000
Refinery production of new copper from domestic and foreign ores	1,768,000,000	1,635,000,000	921,000,000
Stocks at the end of the year, at smelters and refineries	904,000,000	1,125,000,000	(a) 783,000,000
Imports	429,387,594	486,000,000	(b) 68,000,000
Exports	516,627,775	623,000,000	(b) 538,000,000
Apparent domestic consumption	877,000,000	1,053,000,000	(c) 614,000,000

(a) Amount contains 496,000,000 lb. of refined copper and 297,000,000 lb. of blister copper. (b) Total for eleven months ending Nov. 30, 1921, from records of the Bureau of Foreign and Domestic Commerce. (c) Estimated.

TABLE II.—MONTHLY AVERAGE PRICE OF COPPER

	New York		London			
	Electrolytic		Standard		Electrolytic	
Month	1920	1921	1920	1921	1920	1921
January	18.918	12.597	118.095	70.964	123.238	79.119
February	18.569	12.556	120.188	70.925	126.950	75.925
March	18.331	11.976	109.533	67.565	118.348	71.190
April	18.660	12.438	103.025	69.381	111.500	71.786
May	18.484	12.742	96.750	73.196	109.200	74.298
June	18.065	12.697	87.864	71.852	101.909	75.682
July	18.576	12.170	90.148	71.155	106.455	75.286
August	18.346	11.634	93.935	68.614	111.143	72.705
September	18.144	11.948	96.381	67.977	111.905	72.295
October	15.934	12.673	93.327	67.327	104.905	73.476
November	14.257	13.035	84.807	66.614	94.614	74.386
December	13.188	13.555	75.702	66.706	85.905	74.525
Year	17.456	12.502	97.480	69.356	108.839	74.223

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead Mining

By Clinton H. Crane
President, St. Joseph Lead Co.

CONDITIONS DURING 1921 in the lead-mining industry, particularly in the United States, were most discouraging. The selling price of the metal had returned to the pre-war level, but costs, certainly at the beginning of the year, were still on the war level. Mining, milling, and smelting costs had more than doubled since 1914; wages had increased in no districts less than 75 per cent, and in many operations over 100 per cent; efficiency had dropped; materials, supplies, and railroad freights had in general more than doubled, and on some roads quadrupled. Unless costs could be brought down, most of the ore in the United States would cease to be ore in the generally accepted sense.

Wages, representing in most enterprises about half the total cost of production, could be reduced. In well-established camps wage reductions were welcomed as an alternative to a complete shutdown, but wages could not be reduced anywhere to the pre-war level, for the cost of living had not returned to that level, and in the mining districts still remained at from 25 to 40 per cent above the pre-war scale.

Materials, in the order of their importance, coal, coke, powder, steel, and general supplies, were subject to the law of supply and demand, and some reductions took place as business slackened. In general, for lead-mining districts having no water power, by the end of 1921 coal under the boilers was costing from 50 to 80 per cent of what it did at the end of 1920, but still at least double the 1913 price. For various localities, at the end of 1921, the cost of coke was from 65 to 100 per cent of that at the end of 1920; the cost of powder ranged from 90 to 95 per cent, and that of drill steel from 80 to 90 per cent; but in each of these items the costs were still much higher than in 1913.

Despite reductions in wages and materials, it is probable that the cost of producing ore is still 40 to 60 per cent higher than it was before the war, and the cost of producing lead from ore of the same grade has increased in like proportion. Only the lower-cost producers can exist under the present conditions, and these low-cost producers must sacrifice their high-grade deposits to live at all.

The increase in freight rates effective June 25, 1918, and a further increase on Aug. 26, 1920, have very greatly affected the cost of everything in the country, but the mining industry has been especially penalized. Although general rates in June, 1918, were increased only 25 per cent, the average increase on all mine and smelter products was 55 per cent. This, together with the advance in August, 1920, raised freight on these products by more than 110 per cent. These freight increases have magnified the differentials between properties in different parts of the country and have opened to foreign competition, on the Atlantic seaboard, markets which otherwise would have been closed.

No new metallurgical or mechanical improvements have recently been developed. Without flotation many mines that are operating today would be shut down. Flotation in milling and the one-man drill in mining had already come to the help of the industry just before the war started. Excepting extensions of known ore areas in the Tri-State district, no new deposits of lead were discovered in 1921, and with the present conditions there is no inducement for intensive exploration.

The United States lead-mining industry has developed to its present proportions with the help of protective tariffs, under which enough lead has been produced to supply domestic needs, with no surplus for export. Thus, there has been no foreign market for it to lose. Correspondingly, except in boom times or under inadequate and irrational tariffs such as that now in force, there has been no room for imports; but during the last two years so much foreign lead has been imported that many American mines are closed down; and unless the country's usual tariff policy is resumed they will remain closed down to make place for the more cheaply produced metal of Mexico and Spain.

The outlook for 1922 in the lead-mining industry is much brighter than it was at the beginning of 1921. Most districts have held their working forces intact and have returned to a pre-war efficiency. The early enactment of an adequate specific tariff is anticipated. Furthermore, certain reductions in freight rates on bullion and refined metal have recently been made.

With a revival of business, particularly in the building industries, more lead should be needed, but unless costs can be still further lowered, largely by additional reductions in freights and in the cost of important raw materials, a larger volume of lead can be produced only at higher price levels.

Zinc Mining

By Arthur Thacher
Mining Engineer, St. Louis, Mo.

THE year 1921 was most disastrous to the zinc miners. The effects of the war produced a financial crisis which required a drastic curtailment of all expenditures and brought about a hand-to-mouth rate of expenditure extremely detrimental to the industry and to general prosperity and well-being, which involves providing for future as well as present requirements. As a result, the consumer used all his supply before purchasing, while the dealer waited till his stock was exhausted before ordering. This increased the stocks at the smelters, as they were carrying what would ordinarily be in the hands of the dealer and consumers. The smelters in turn diminished their ore stocks, thus increasing the ore stocks in the hands of the miner. The miner had no one to pass his stock on to, and his only relief was to curtail or stop mining.

With most of the mines closed and in financial trouble there has been only the average improvement in methods and equipment. Some improvement is always taking place. Perhaps one exception can be noted in the use of underground loading machines. In common with all advances and improvements in practice, the introduction of machine loaders is making slow headway and has not yet, on the whole, afforded the zinc miner radically cheaper mining costs. The field looks promising, but the miners of zinc must be patient before expecting any great change in their cost sheets.

The great change that is now taking place is a mental one. The war was fought on autocracy, which is only another name for peonage. The peonage idea has existed since the beginning of history, and has only been slowly dying. The war marks only one victory, but a great one. Real civilization consists of co-operation and the square deal. The war aroused mental activity and encouraged thought in the right direction. The first efforts naturally resulted in chaotic conditions, but this is passing, and the world is coming into a new and greater era. We are prone to overlook this human factor and attribute success to natural resources, science, and machinery. No doubt these are great factors, but without intelligent co-operative human effort they bring little results.

Though 1921 was a year of discouragement and despair to the zinc miner, this is only a temporary condition, and we can look forward to a future which will make the past look small.

As indicated before, the world has been living on its accumulation, the real consumption being greater than we realize. There is no reason to believe that larger stocks than were necessary were being carried before the war, and therefore with the return to steady conditions we will find that the stocks at the mines and smelters, large as they now appear, are insufficient to build up to the supply carried in pre-war days.

With respect to the future demand for zinc, it is to be noted that this country has been an active producer for about fifty years and that the production has more than doubled every ten years; the last doubling being in about nine years. If it is objected that the war caused this in the last nine years, we only have to take the preceding years. Moreover, this condition is confirmed by world figures and the figures on iron, steel, copper, and lead, although the figures for the doubling vary from nine up to fifteen years or more. It is immaterial in this connection just what the number of years are. The important point is that in less than fifteen years, probably in not over ten years, the world will call for double the present average output and a total of more zinc than the world has so far produced. This can and will be supplied by better operation and at a higher price, which will enable us to work lower-grade material that is now not even classed as ore. This is the history of the past.

It may be urged that increase of price would curtail consumption. This is true of most finished articles, but is not strictly true in relation to the ore or crude metals. To the ultimate user who finally pays the bill the total cost of the ore, or even the crude metal, is not over 5 per cent of what he pays, and even a doubling of the original cost of the ore would not make any great difference to him.

The world is in a metal age, and the twentieth century has already used more metals than were produced in all preceding time. The results are inevitable, but how rapidly they will come depends on man. The great controlling factor is co-operation, or combining efforts, and the accomplishment of this depends on the mining engineer.

In the past the labor problem has loomed large, but that has been principally because we viewed it from the side of peonage and its attendant side lines, and with a truer realization of co-operation and the square deal the labor situation will change and the results will constantly improve, as they have in the past.

We have had only one generation of civilization developed on metals, and with this start and our increased knowledge, coupled with the war victory, the coming twenty-five years will show remarkable advance.

Gold Mining

By Sidney J. Jennings

Vice-president, United States Smelting, Refining & Mining Co., New York

A STUDY of a table of statistics showing the output of gold by countries for the last year indicates as an outstanding fact that 67 per cent of the output came from those constituting the British Empire. The cost of labor, materials and transportation necessary to produce this gold was paid for in the depreciated paper currency of the different countries forming that commonwealth of states and dominions.

The premium that gold commanded varied not only from country to country but also from month to month, and it is impracticable at this time to say what the weighted average premium was. The maximum was somewhere near 50 per cent in the Transvaal and the minimum about 10 per cent in Canada. The United States, which produced 14 per cent of the gold, and Mexico, which produced 4 per cent, did not have this advantage. This premium on gold will disappear as the rates of exchange between the United States and the different countries of the British Empire return to a normal basis. The recent rapid rise in the value of the pound sterling expressed in terms of United States dollars shows that the length of time before this occurs may be shorter than many expect.

The leaders of the gold-mining industry in the Transvaal, which is producing about 48 per cent of the world's supply of gold, constantly point out in their reports and speeches the fact that the continued operation of a number of so-called "low-grade mines" is entirely dependent upon the premium received for their gold. If this premium disappears, as apparently it may do in a short time, one of two things will have to happen. Either the wages of the laborers in the gold mines and the cost of supplies will have to be materially reduced or else these mines must close down. An analysis of the cost of producing gold at certain of the mines in the Transvaal shows that, even with any reduction that is within reasonable probability in wages and cost of supplies, some of them are unable to produce gold except at a loss, and these will undoubtedly be compelled to discontinue.

In addition to the before-mentioned factors, several mines on the Rand are reaching the end of their ore reserves, and will in consequence cease producing. The new mines that are being developed on the Far Eastern Rand cannot produce enough gold to make up for the losses occasioned by the factor mentioned. It therefore seems fairly certain that the Transvaal has reached the apogee of its gold production and will continue at even a more rapid rate the decline which has been taking place in the last few years.

PRODUCTION OF AUSTRALASIA, CANADA AND INDIA LIKELY TO DECLINE

The production of gold in Australasia has shown a steady decrease, and no new production looms up on the horizon of sufficient importance to stay this decline.

The production in Canada and India has been maintained, but in both countries the producing mines are reaching increasing depth and no new large ones are being opened. It seems inevitable that a decrease in gold production in these two countries must take place, in the cost of supplies and labor which took place during may hold out surprises in the direction of new production.

In the United States the decline in the production of gold continued throughout 1921. The small reduction in the cost of supplies and labor which took place during 1921 was not sufficient to warrant starting up many of those properties that were closed down during the peak of the rise in price. The production of gold in the United States has also been diminished by the closing down of the copper mines, from which a certain amount of gold was produced as a byproduct.

HOPE LIES IN ALASKA

In Alaska, the exhaustion of the old placer deposits, without the discovery of new ones of magnitude, has brought about a diminished production. The mines at Douglas Island have not been reopened after the disaster which overtook them some years ago, and the poor success of the mines on the mainland, where the anticipated expectations have not as yet been achieved, also brought about a decrease in production. There is, however, considerably more interest being shown in gold mining at the present time, and when the anticipated reductions in freight rates, cost of coal, powder and steel and reduced wages, become a fact, a slow resumption of gold mining will undoubtedly take place, which may be in sufficient volume not only to arrest the decline in production in the United States but to increase production.

The decline in production of gold in Russia has been due to political causes, and until a stable form of government is established, and one more conducive to fostering the production of wealth, the resumption of gold mining on any large scale will not take place in that vast territory.

This rapid survey of the chief gold producing countries shows that on balance the production of gold will decline in the immediate future. No epoch-making metallurgical discoveries have taken place, nor has any new method of mining been devised which will bring into the realm of commercial ore, material which though gold-bearing, has not a sufficiently high content to warrant its exploitation.

NEED OF GOLD AS A CURRENCY BASIS

The demand for gold or some metallic currency which will provide a sound money for the peoples of Central Europe and Russia is going to increase enormously. It is difficult to say at what point a paper currency becomes worthless as a medium of exchange, but it seems probable that this point will be reached in a comparatively short time by the currencies of Central Europe and Russia. No matter how patient or obedient to their governments peoples may be, the time will come, as it did in France in the time of the Revolution, and as it did in Mexico four years ago, when the workmen will say, "I will not work and be paid in a medium the value of which decreases 10 per cent a week."

Experience proves that when a people once discards the use of an inconvertible paper currency, that people will not return to paper money, however well secured, as long as the governments are run by those who have caused suffering by the ruin and misery brought on by an inconvertible paper money.

When once started, the power of these European countries to absorb gold or silver or both will be great and increasing. The price of their products measured in the terms of these metals will be small and decreasing, and it very well may be that the value of gold measured in terms of commodities will be so great that material which is now looked upon as worthless rock, though gold-bearing, can be worked at a profit. It is possible that the financial experts of these countries may perceive this tendency and seek to counteract it by the use in some measure of silver as a circulating medium. This use of silver will tend to stabilize prices, a consummation much to be desired in every community.

Whether silver is used as a circulating medium or not, the demand for gold will increase greatly in the not distant future, and with this increased demand for gold will come an increased interest in and more active search for gold mines.

Silver Mining

BY FELIX EDGAR WORMSER

Assistant Editor, *Engineering and Mining Journal*

AMERICAN SILVER PRODUCERS were little concerned in the fluctuations of the silver market in 1921, for they received a fixed price for their product under the provisions of the Pittman Act. This price, fixed by law at $1 per oz., varied within a fraction of a cent of that amount, depending upon the delivery point for the metal, whether the Denver, San Francisco, or Philadelphia mint. About 58,563,000 oz. was bought by the Government during the year, bringing total purchases to 88,570,000 oz. since May 13, 1920. A further amount of 119,430,000 oz. remains to be purchased, which will require about two more years. The closing of the copper mines and the depression in lead and zinc has not had the effect anticipated upon production—estimated to have been 50,364,000 oz., compared with 55,361,000 oz. in 1920. Copper mines, the largest producers of silver, have been unable to take full advantage of dollar silver. Straight silver producers, in Nevada particularly, have been the most fortunate.

As a result of the flow of American silver into the United States Treasury, exports of silver from the country for the first eleven months of 1921 were only 44,430,350 oz., as compared with 107,535,300 oz. and 208,426,260 oz. for similar periods in 1920 and 1919 respectively. Imports also dropped, reflecting the smaller production of Mexico and Canada, being 57,726,767 oz. for the first eleven months of 1921, compared with 83,434,400 oz. in a similar period in 1920.

The world silver market was erratic throughout 1921.

Early in January foreign silver sold for 65⅜c. per oz., and after many fluctuations dropped to the lowest point of the year on March 5, when a quotation of 52⅜c. was recorded. Then began a steady climb to the highest price for the year, 73⅜c., reached on Oct. 17. For a time it looked as if silver would go even higher, but this hope was soon dispelled by a rather rapid decline. Although the average price of silver for 1921 is above the pre-war level, Mexican and Canadian producers found little encouragement in increasing production, owing to their high costs.

MONTHLY AVERAGE PRICE OF SILVER

Month	New York 1920	New York 1921	London 1920	London 1921	Sterling Exchange 1920	Sterling Exchange 1921
January	132.827	65.950	79.846	39.985	367.082	372.650
February	131.295	59.233	85.005	34.745	337.466	385.932
March	125.551	56.023	74.194	32.479	370.870	389.806
April	119.779	59.337	68.848	34.250	392.438	391.784
May	102.585	59.810	60.010	34.165	383.360	396.580
June	90.957	58.510	51.096	34.971	393.663	377.236
July	91.971	60.260	53.736	37.481	385.538	362.565
August	96.168	61.597	59.875	38.096	360.404	364.505
September	93.675	66.160	59.476	40.082	350.370	371.725
October	83.480	70.970	54.197	41.442	346.460	386.315
November	77.734	68.234	50.952	38.750	342.333	396.315
December	64.774	65.760	41.845	35.645	348.101	414.880
Year	100.900	62.654	61.590	36.841	364.840	384.191

New York quotations cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

The unusually high price of silver in 1919 and 1920, which caused practically every nation to take steps to protect its silver coinage from the melting pot, reaped part of its harvest in 1921. Some countries, because of the great depreciation of their currencies, witnessed the almost total disappearance of silver coins from circulation. Germany actually shipped large amounts of silver bullion from melted coin to the United States to be use as collateral for a loan. Great Britain reduced the fineness of her silver coinage almost in half, from 925 to 500. Other European countries turned to the base metals, copper, nickel, aluminum, and various alloys to satisfy subsidiary-coinage demands. In general, the use of the cheaper metals is the result of the existence of large quantities of depreciated paper currency and the impossibility of maintaining a simultaneous circulation of the precious metals and depreciated paper. Curiously enough, of all nations, Russia was reported during the year to be turning toward the coinage of silver.

China and India continue to be the pillars of the silver market. They were raised to unusually prosperous heights during and for a short time after the war, but the world-wide depression has had its effect upon them as well as upon all other nations. Both countries, being large producers of raw materials, have naturally felt the depression keenly. China and India were both buyers and sellers of silver during 1921. India's purchases were heaviest for the first part of the year. As usual, Far Eastern speculation has played an important part in the silver market, and some of the vagaries in prices can be ascribed to it.

What effect the changed conditions in India and China brought about by the war will have on the future of silver it is idle to attempt to guess. China during the war is estimated to have hoarded from 100,000,000 to 200,000,000 oz. of silver that confidence in government and trade may release. As silver dropped in price, large amounts of gold that had been purchased by China when silver was high were sold and converted into the currency medium of the country, silver.

Much depends upon the trade balances of these Asiatic nations as to the future demand for silver. During 1921 the trade balance of India changed from adverse, which it had been since June, 1920, to favorable. Favorable trade balances for the Far East require shipments of silver and gold in settlement. A good monsoon in India points to a continuation of satisfactory conditions in India for the next few months at least.

The next two years will pass rapidly for the American silver producer. There is nothing on the horizon to indicate that silver will soon cross the dollar line and so prolong the duration of the Pittman Act. No doubt when the time comes, the foreign silver market will reflect months ahead the completion of the United States Government's purchases and the effect of the American supply's addition to the world market.

The destruction of European silver currencies and the reduction of the fineness of others has partly made up for the deficit left by the withdrawal of American silver from the world market. The 500 fine British silver coins are expected to release 40,000,000 oz. of silver to the world's supply, irrespective of the total abandonment of silver by other countries.

Domestic silver consumption is becoming of increasing importance. The moving-picture film industry consumes about one-twelfth the domestic production of silver. It is unfortunate, in view of the attitude of European countries toward silver, that there are not other industrial channels of consumption equally promising. It is an anomaly that while the financial policies of Europe have dispensed with silver, the so-called "backward" nations have not diminished their regard for it.

Platinum

By JAMES M. HILL*

Geologist, U. S. Geological Survey

STOCKS of platinum at the beginning of 1921 were 46,747 oz., nearly 75 per cent greater than in the previous year. Imports for the first nine months of 1921 were 52,200 oz., or slightly lower than in 1920. However, the available platinum was apparently more than sufficient for the decreased demands, particularly of the jewelry industry, as the price for the metal continued to decrease until July, when the low level of $65 per oz. was reached. After midsummer there was an increase in price, and by mid-November $85 was asked for small quantities of platinum. More recently the market has eased, and it appears probable that platinum may decline further.

AVERAGE MONTHLY PRICES OF PLATINUM

Dollars per Troy Ounce in New York Market

Months	1917	1918	1919	1920	1921
January	87.83	105.92	104.85	154.23	73.400
February	103.75	107.68	100.43	151.59	70.227
March	103.33	108 (*nom.*)	99.20	138.56	72.463
April	103.77	108 (*nom.*)	99.85	127.04	73.404
May	105.00	106.27	102.60	97.50	73.740
June	104.75	105.00(*a*)	105.80	85.19	74.942
July	103.88	105.00(*a*)	105.90	83.94	70.440
August	104.55	105.00(*a*)	107.60	111.44	73.222
September	104.13	105.00(*a*)	128.70	115.20	75.960
October	104.00	105.00(*a*)	132.21	101.70	81.800
November	104.52	105.00(*a*)	136.74	84.75	82.609
December	104.38	105.54	151.35	79.62	78.192
Year	102.82	105.95	114.61	110.90	75.033

(*a*) Fixed price

Colombia still continues to supply over half of the crude platinum demand of the United States, though both England and France have contributed considerable metal. Japan has placed an embargo on the exportation of platinum, apparently with the purpose of building up a reserve, for she has taken over half of the unmanufactured platinum exported from the United States and has undoubtedly been in other markets as well.

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Iridium, which was quoted at $325 per oz. at the first of 1921, gradually lessened in demand, apparently reflecting the slump in the automobile industry. By midyear, the price had declined to $160@$170 per oz. and it is reported that toward the close of the year holders of iridium or osmiridium could find no bidders for their metal.

It was hoped that Mr. Urquhart's negotiations in Russia might result in renewed mining activity in that country, but the Soviet government was not ready to listen to reason, so another year has been lost in reopening the world's richest platinum mines.

The Canadian nickel mines were closed in the fall of 1921, which will result in a loss of several hundred ounces of platinum and palladium a year. The Colombia production should continue to increase, and there is every reason to feel that the domestic market should have sufficient supplies during 1922 to assume a somewhat lower price for all of the platinum group metals.

Quicksilver Mining

BY H. W. GOULD
Mining engineer and former manager, New Idria Quicksilver Mining Co., San Francisco, Cal.

DOMESTIC quicksilver mining, and, consequently, quicksilver production, reached the low ebb of its history in 1921. The output from domestic mines in 1921 was less than one-half that of any other year since 1850, and about one-sixth of the average annual production for the last seventy years.

At present, the industry is practically dead, with most of the mines completely closed down, their organizations scattered, and, in most instances, without sufficient capital to resume normal operations. The primary cause of this condition is the large importations of European metal in the last six months of 1920, and about 10,000 flasks during the first nine months of 1921. These importations, together with considerable stocks held by domestic producers on a market already affected by curtailed consumption in the United States on account of the general business depression, has forced the market as low as or lower than pre-war prices.

AVERAGE MONTHLY PRICES OF QUICKSILVER
Per Flask of 75 Lb.

Month	New York 1918	1919	1920	1921
January.	$126.77	$105 50	$90.192	48.440
February . .	119 89	89 84	84 432	49.545
March. . .	121.63	71.56	92.611	46.796
April.	121.87	72.94	102.192	45.423
May.	118.97	83.12	89.560	47.000
June	122.66	93 25	90.154	46.846
July.	126.63	104.68	90.333	44.950
August.	125.56	107 08	83.806	45.028
September . . .	127.81	102.52	75.000	42.660
October.	127.18	86.35	67.200	39.840
November.	124.91	90.74	58.417	39.804
December . . .	117.70	98.27	49.577	49.212
Year . .	$123.47	$92.15	$81.123	45.462

During the last year, I visited the quicksilver mines of Spain and Italy, including the Idria mine, now in Italy but formerly in Austria, and had a splendid opportunity to study the European outlook. Many important changes were effected in the industry in Europe during the war. Prior to 1914, German interests completely dominated the world's quicksilver market. The old Idria mine, producing about one-fourth of the world's quicksilver, was owned by Austria. The Monte Amiata group, in Tuscany, Italy, owned and operated by a German company, yielded about one-fourth of the world's production before the Great War. The great Almaden mine, in Spain, yielded nearly one-third of the world's quicksilver production, its product being sold through the English house of Rothschild. The German interests thus controlled 75 per cent of the world's quicksilver. American production, coming mostly from small, scattered mines, yielded less than 18 per cent of the world's total in 1914. Without adequate tariff protection the domestic industry was slowly dying.

At present, Germany is entirely out of the world's quicksilver market. Italy annexed the Austrian territory that included the Idria mine, and now owns and operates it as a government institution. An Italian company acquired the German interests at Monte Amiata during the war, and today this district is the largest producer in the world, and, with the Idria, gives Italy over one-half, and, possibly, two-thirds, of the world's production of mercury. Though Spain's production dropped from nearly 37,000 flasks in 1914 to less than 25,000 flasks in 1920, the Almaden mine is still yielding about one-third of the world's total. This metal is still sold by the Rothschilds in London, but the German influence has been removed.

WORLD'S QUICKSILVER PRODUCTION
In Flasks of 75 Pounds

	Spain	Italy Idria	Italy Monte Amiata	United States	Miscellaneous	Total
1909	40,933	19,294 (*a*)	22,668	21,075	4,500	108,470
1913	36,619	26,710 (*a*)	31,541	20,213	4,000	119,083
1917	)25,133	25,000 (*a*)	29,300	36,159	4,000	119,592
1921 (*b*)	23,000	10,000	30,000	6,000	2,000	71,000

U. S. output dropped to 16,548 flasks in 1914.
(*a*) Austrian production. (*b*) Estimated by the writer.

The average cost in Europe of producing quicksilver is about $30 per flask. Adding $3 (10 per cent ad valorum duty) and $2 for freight and other charges, to this cost, makes a total of $35 per flask f.o.b. New York. If the European producer can sell at $40 per flask, he makes a fair profit.

If the effort were necessary, even with their present antiquated methods, the Almaden mine, in Spain, could produce quicksilver for less, on account of the very high-grade ore (7 or 8 per cent). The ore of the Italian mines averages from ¾ up to 3 per cent and they have splendid reduction plants, good engineering practice, and—most important—plenty of cheap and efficient labor. Against these conditions, the American mines are seriously handicapped by their very low-grade ore (¼ to ½ per cent) and high labor costs. Under the circumstances, it is doubtful if any American production of importance can be made under $50 per flask, and probably not much at less than $60.

The world's production of quicksilver today is about two-thirds of normal, based upon the pre-war figures. Consumption at the moment is even lower, owing to the general business depression and the absence of demand from Germany, once a large consumer. Any general increased demand can be supplied by the Italian mines.

As for the American quicksilver mines, the best they can hope for is to supply the domestic demand, and to do this an adequate tariff protection is necessary to keep them alive. The new Tariff Bill, already passed by the House, places a duty of 35c. per lb. on mercury, and, if passed by the Senate and signed by the President, it will afford the necessary relief and encourage many American mines to resume operations.

Iron-Ore Mining in the United States

By D. E. A. Charlton
Managing Editor, *Engineering and Mining Journal*

THE SITUATION in iron-ore mining during 1921 necessarily reflects the general conditions that have existed in the iron and steel industry. The latter averaged 38 per cent operation, the decrease being due to steadily declining prices, despite high costs, which can be attributed largely to high freights and restricted operations.

The iron ore mined in the United States in 1921, exclusive of that which contained more than 5.5 per cent of manganese, according to the U. S. Geological Survey, is estimated at 29,547,000 tons, as compared with 67,604,465 tons in 1920. Shipments of ore from the mines in 1921 are estimated at 27,009,000 tons, valued at $89,688,000, a decrease in quantity of 61 per cent and in value of nearly 69 per cent as compared with the shipments in 1920. The average value of the ore per ton at the mines for the whole United States in 1921 is estimated at $3.32; in 1920 it was $4.11. The stocks of iron ore at the mines, mainly in Michigan and Minnesota, apparently increased from 11,378,794 tons in 1920 to 13,872,000 tons in 1921, or 22 per cent. The output of iron ore in 1921 was the lowest since 1904, when 27,644,330 tons was mined.

LAKE SUPERIOR PRODUCTION DECREASES 56 PER CENT

About 86 per cent of the iron ore mined and shipped in 1921 came from the Lake Superior district, in which 25,394,000 tons was mined and 23,155,000 tons was shipped, decreases of about 56 and 61 per cent, respectively, as compared with the quantities mined and shipped in 1920. The ore shipped in 1921 was valued at $81,091,000, a decrease of about 68 per cent. These totals include the ore mined and shipped from the Mayville and the Baraboo mines, in Wisconsin, and ore shipped by rail as well as water from all mines, but exclude manganiferous ores that contained more than 5.5 per cent manganese. The ore is chiefly hematite. The stocks of iron ore in the Lake Superior district apparently increased from about 10,366,738 tons in 1920 to about 12,575,000 tons in 1921, or 21 per cent. The shipments of iron ore by water in 1921 (including manganiferous iron ore), according to figures compiled by the Lake Superior Iron Ore Association, amounted to 22,300,726 tons, a decrease of 62 per cent as compared with these shipments in 1920. The average value of the ore at the mines in the Lake Superior district in 1921 per ton was $3.50; in 1920 it was $4.25.

The Southeastern states, which constitute the second largest iron-ore producing area, including the Birmingham and Chattanooga districts, mined 3,022,000 gross tons of iron ore in 1921, a decrease of 55 per cent as compared with 1920. The shipments of ore from these states to blast furnaces in 1921 amounted to 2,946,000 tons, valued at $6,343,000, a decrease in quantity of 56 per cent and in value of 67 per cent as compared with the quantity and value of shipments in the previous year. The ore contains about 78 per cent of hematite, 21 per cent of brown ore, and 1 per cent of magnetite. The average value of the ore in these states in 1921 per ton was $2.15; in 1920 it was $2.88.

The Northeastern states, which include New Jersey, New York, and Pennsylvania, in 1921 mined 668,000 tons of iron ore, and shipped 444,000 tons, a decrease of 68 per cent from the quantity mined and 79 per cent from the quantity shipped in 1920. The average value of the ore in these states in 1921 per ton was $2.88; in 1920 it was $4.90. Most of this ore is magnetite.

Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Utah, Washington, and Wyoming, the iron-ore producing states in the West, are estimated to have mined and shipped 429,000 tons of iron ore in 1921, a decrease of 42 per cent as compared with the quantity mined and shipped in 1920. The average value of the ore in this group in 1921 per ton was $1.96; in 1920 it was $1.97. Hematite predominates in the Western states, but considerable brown ore and magnetite are mined.

Other states, including Connecticut, Maryland, Massachusetts, and Missouri, in which there are small iron mines that produce chiefly hematite and brown ore, mined about 34,000 tons in 1921, a decrease of 49 per cent as compared with the quantity mined in 1920. The shipments from mines in these states in 1921 are estimated at 35,000 tons, a decrease of 46 per cent from shipments in 1920. The estimated average value of the ore from these states in 1921 per ton was $3.91; in 1920 it was $5.09.

CONDITIONS IN ORE BUSINESS AT END OF SEASON

Regarding the outlook for 1922 in iron mining, the following relates to the Lake Superior districts, and the conditions therein outlined will apply to a greater or less degree to the other iron-producing districts. At the close of navigation in 1921 stocks of ore on lower Lake docks and at the furnaces were slightly under corresponding stocks the year previous. This might appear to be something of an anomaly, but it must be remembered that Lake shipments during the season were extremely light and that late in the fall the railroads announced a reduction in freight rates from lower Lake ports to interior furnaces, apparently with the idea of stimulating business for themselves as well as to give the furnace people the opportunity to take in, before heavy freezing weather should start, whatever ore they thought they might require to carry them over the winter. The result of this was an accelerated movement of iron ore from the lower Lake docks to the furnaces during the last six weeks of the season.

By the middle of December it had become apparent on the ranges, at least at some points, that the long drawn-out period of inactivity at the mines was beginning to tell upon the individual resources of the miners and that help during the winter in definite form would be necessary, to prevent positive suffering. Of course, such contingenies had been foreseen by the individual companies, and plans made to meet the situation. It was doubtless, however, with this situation in mind, that beginning in December, some of the large operating companies issued instructions to reopen certain properties on the different ranges, with the result that probably from fifteen to twenty mines on the Mesabi, Cuyuna, Gogebic, Menominee and Marquette ranges have been placed in production again on some scale—either reduced wages, reduced time, or both.

Last season (1921) between 22,000,000 and 23,000,000 tons of iron ore was brought down the Lakes—the smallest movement in twenty years or more. This compares with around 57,000,000 tons for 1920, which, notwithstanding the large production in one or two of the war years, is probably close to the normal season's requirements today, and, if anything, a little under such normal requirements. Based on the above figures and an estimated operation at furnaces and the steel mills during the next eighteen months, there is a general agreement in the estimate as to the movement of iron ore for the season of 1922. It is expected now that during this next season between 40,000,000 and 45,000,000 tons of ore will be moved down the Lakes. This is, of course, 100 per cent greater than 1921 and cannot be looked upon as anything but a great improvement over that year. By the same token, it will also be seen that this is still considerably below what now appears to be a normal season's movement. Neither is this estimate based on any abnormally favorable operation of furnaces or steel mills. On the contrary, it is assumed that the improvement in operation at these plants will be gradual but steadily better, with the result that perhaps at the end of eighteen months operations will be 80 to 85 per cent of normal.

The movement of 40,000,000 to 45,000,000 tons of ore will create a much broader mining activity on the Lake Superior ranges. Just what it does denote in individual operations cannot be foretold, as this is bound to depend to some extent upon the demand for the various grades of ore that may be produced, and this, in turn, is contingent upon trade requirements and the needs of the furnaces and mills. But it should be remembered that it was only a few years ago that 45,000,000 tons was considered a normal year, and if one looks back and considers what such a year at that time meant in activity upon the ranges, a better comprehension can perhaps be obtained as to what it would still signify, especially as compared to the season just past.

IS MINNESOTA "PROFITS" TAX CONSTITUTIONAL?

During the early part of 1921, action was taken by the Minnesota Legislature on a "profits" tax of 6 per cent on the assumed net profits from mining iron ores, the revenue thereby obtained accruing to the state general funds and not to the municipalities affected. So far, no one seems to know what the result of that tax is to be. Estimates have been made from $1,000,000 a year to $4,000,000 or more, but probably under normal conditions and with an output of 45,000,000 tons the tax will amount to about $2,000,000. That is in addition to the ad valorem taxes now levied for state and local purposes, and which are distributed as other taxes—i.e., to the municipalities, the counties in which the mines are situated, and the state on the regular apportionment basis. The Legislature, in passing the act legalizing this profit tax, specified certain items of cost which it stated were to be the cost of producing ore and which were to be deducted from the price obtained for ore, so as to determine the net value; but it did not include all of these items, and it is probable that the law, if and as enforced, will fail to take cognizance of all cost items, instead of part of them. It is not certain that the law is constitutional, and everyone expects that when it comes to the question of payments under it the mining companies will decline to pay until the courts have interpreted the act and its legality is acknowledged.

Manganese Mining

BY H. A. C. JENISON*
Geologist, U. S. Geological Survey

THE domestic production of high-grade manganese ore in 1921 amounted to about 13,000 tons, more than 10,000 tons of which came from Montana. The production of ore of intermediate grade, containing 10 to 36 per cent of manganese, was about 72,000 tons. The production of low-grade manganiferous ore was about 14,000 tons.

Net imports for the first eleven months of the year amounted to about 386,405 tons of high-grade ore and oxide, valued at $3,288,595. Of this, Brazil contributed 247,568 tons, valued at $7.58 per ton, and India 113,730 tons, valued at $6.46 per ton.

The general business depression of 1921 is only partly responsible for the extremely small domestic production. It is unlikely that a greater steel production would have resulted in a larger consumption of domestic ore, as adequate supplies of higher-grade and cheaper foreign ore were available. The fundamental causes for the decrease in domestic shipments are undoubtedly the higher cost of production, the lower grade of ore in comparison with foreign ore, and the uncertainty of a sufficient supply. A small part of the domestic ore, particularly that of the Philipsburg district, is well suited to chemical uses, and as such enjoys a special market unavailable to most of the domestic ore.

In considering the future of the domestic industry the country's reserves must be divided in three classes: (1) high-grade chemical ore; (2) high-grade ore and ore capable of beneficiation; (3) low-grade ferruginous or manganiferous ores. The future of ore of the first class is fairly bright, as it is of such character and grade, and is produced at so moderate a cost, that it may be sold in profitable competition with foreign ore, except perhaps with Russian ore, and should find a market for an indefinite period. Most of the ore of the second class cannot be mined at a profit under normal conditions in open competition with imported ore. The acquisition of high-grade foreign deposits by American capital, particularly by steel producers, promises production of such ore at reduced cost and the certainty of adequate supplies of desired grade.

According to recent and reliable information, the Soviet government of Russia has recognized unconditionally the Tempo Company's right to the Tchiatouri deposits, which will be worked by the Dutch firm of Vlessing & Co. under an agreement which will give that company a monopoly of the sales of ore from the deposit. This agreement appears to assure a supply of Russian ore of satisfactory grade at American ports at pre-war or lower prices. The pre-war cost of this ore, mined by primitive methods, was about $5.70 per ton aboard ship at the port of Poti.

It has been officially reported that a French syndicate has acquired the Marquesa deposits of Chile, and is installing sufficient equipment to produce 300,000 tons of ore per annum from this source. This ore averages about 50 per cent manganese, 8.5 per cent silica, and 1.5 per cent iron, has a maximum of 0.02 per cent phosphorus, and now costs $3.50 to $4 per ton at Chilean seaport.

The acquisition and development of Brazilian deposits by American and Anglo-American capital, the development of Chilean deposits, the renewal of Russian production upon a modern basis, and the renewal of imports from India promise keen competition among foreign producers for the American market, and a selling price of high-grade foreign ore that will be unfavorable to domestic production.

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To meet foreign competition, a tariff of 1c. per lb. of metallic manganese content in excess of 30 per cent metallic manganese content of ores and concentrates imported has been reported favorably by the House, but is still pending in the Senate. The proposed tariff would impose an import duty of about $4 per ton on Russian, Indian, and Chilean ore, and $3 to $4 per ton on Brazilian ore.

Chromite Mining

By Samuel H. Dolbear
Consulting Mining Engineer, New York

CHROMITE consumption in all parts of the world in 1921 was about 60 per cent of that of 1920. Mines in the United States were for the most part closed down entirely during the year, and the limited tonnage shipped came largely from stocks remaining in producers' hands from as far back as the close of 1918. On Jan. 1, 1919, the U. S. Geological Survey estimated chromite stocks at 42,687 long tons. Shipments from these stocks in 1919 were 5,079 tons, and in 1920, 2,502 tons. The shipments are reported to include some new production, so that the visible supply of domestic ore mined but not shipped still remains at about 35,000 tons, or more than 80 per cent of the 1919 carry-over. Much of this is situated at points so remote from rail that it is not expected to find its way into domestic markets.

California operators mining to a moderate extent in 1919 and 1920 were closed down in 1921, and some of the larger operations were definitely abandoned, as was the situation with the Placer Chrome Co., controlling mines and a concentrating plant near Newcastle. No ore was produced in Wyoming, and but little activity was reported in eastern Oregon.

The industry in the Province of Quebec, Canada, was similarly depressed, and the outlook for 1922 is not considered bright. According to figures of the U. S. Geological Survey, 7,553 long tons was imported from Canada during the first eleven months of 1921.

Under pre-war conditions, New Caledonia and Rhodesia supplied most of the ore for American consumption. The Caledonian mines are so situated as to furnish convenient ballast cargo for Australian shipments of other merchandise, thus commanding a low freight rate. They are also close to water transportation. Rhodesian mines, though less fortunately situated, continue to increase in importance. Some of the mines are large and well equipped, and the chromite-bearing areas are extensive. Production is second to that of Caledonia, and in time will doubtless exceed it under normal conditions.

There are eighteen known chromite deposits in Turkey in Asia, which have been operated, the more important shipments of late coming from the Karli Yer mine. The output in 1920 was said to have been 25,000 tons, but it is believed that not more than a third of this amount was shipped during 1921. Development of the Cuban deposits was begun in 1918 by American steel interests, and in 1919 Cuba shipped more ore to the United States than any other country. In 1920, shipments of ore fell to about 700 tons, no shipments being reported for 1921.

Total imports for the first eleven months of 1921 were 81,835 tons, and for the year will likely show not more than 85,000 tons. A wide difference in the declared value of the ore from different countries is to be noted. From Greece and Turkey the value is over $20 per ton, as compared to $3.40 from Rhodesia and $5.65 from New Caledonia. The average declared value is about $8 per long ton. Imports decreased 65,000 tons, as compared to 1920.

Nickel Mining

By Thos. W. Gibson
Deputy Minister, Department of Mines, Ontario, Canada

THE slow industrial recovery has heavily affected nickel mining. Stocks of the metal accumulated during the war years have not yet been absorbed. Disarmament and scrapping of navies we all rejoice to see, but they mean that one of the most important markets for nickel goes with the navies to the scrap heap. The conditions have brought nickel mining almost to a standstill. The end of 1921 saw all the Sudbury smelters cold, except for one furnace, the mines nearly all idle, and the refineries shut down.

Resumption of activity will come with a revival of manufacturing, especially of steel. The abolition of war will not mean the disuse of nickel. The toughness, tensile strength, and resistance to corrosion which 2.5 to 3 per cent of nickel imparts to steel will insure its use wherever these qualities are essential; for automobile steel, for axles, tires, piston rods, bridge building, railway frogs and switches, resistance wire, nickel-silver, coinage, plating, as a catalyzer for fat hardening, in cooking and kitchen utensils, electrical instruments, acid-resisting equipment, and numerous other uses nickel will be required.

The mines of the Sudbury district, in the Province of Ontario, Canada, produce about 85 per cent of the world's requirements of nickel. The known ore reserves in the Sudbury mines amount to 150,000,000 tons or more. For refining purposes the low-grade matte is sent to Port Colborne, Ont.; Deschenes, Que.; Bayonne, N. J., and Clydach, Wales. The three companies operating the mines are the International Nickel Company of Canada, Ltd., the Mond Nickel Company, Ltd., and the British America Nickel Corporation,, Ltd.

The silver ores of the Cobalt district in Ontario contain nickel and also cobalt, which are recovered in the silver refineries, and nickel oxide, nickel sulphate, and metallic nickel are produced.

The production of nickel in 1921 from the Ontario deposits was approximately 5,200 tons, and of copper 4,800 tons. This contrasts with about 28,000 tons of nickel and 15,000 tons of copper in 1920. The peak production during the war was in 1918, when 45,886 tons of nickel and 23,843 tons of copper were recovered. Besides nickel and copper, the Sudbury ores contain appreciable quantities of gold and silver, and are important sources of platinum and palladium. In 1920, the recoveries of platinum amounted to 8,400 oz., and of palladium 10,200 oz. Gold was obtained to the extent of 1,260 oz., and silver to the amount of 120,000 oz. Other metals of the platinum group, such at ruthenium, rhodium, and iridium, are also obtained in small quantities in refining. This production was not from the ore mined in 1920, but principally from residues or products resulting from previous refining processes.

Tungsten Mining

By Frank L. Hess*
Geologist, U. S. Geological Survey, Washington, D. C

TUNGSTEN MINING in the United States in 1921 was reduced practically to zero. So far as is known, no ore was mined anywhere in this country except a few tons taken out by the Wolf Tongue Mining Co. in the course of a little development work carried on at its Cold Spring mine, near Nederland, in the Boulder (Colorado) district. Not a wheel was turned in the mills.

The world's tungsten market has been wholly overshadowed by the Chinese production. The placer deposits of Kwangtung and Kiangsi have proved so large and so cheaply worked that there has been no possible competition even from Tavoy, and in the face of a quiescent high-speed steel business, Chinese ore has continued to reach both European and American ports, and weak British holders have sold good ore for 11s., or an equivalent of less than $1.85 per short ton unit, the lowest prices ever known.

The possibility of a tariff has kept ores, ferrotungsten, and metal coming into the United States, and a great stock has been built up. During the first ten months of the year, 1,341 short tons of ore was imported, of which 978 tons came from China.

An equivalent of more than 13,000 short tons of concentrates carrying 60 per cent WO_3 is probably on hand, and considering the normal consumption to be 3,000 tons, it is readily seen that even the highest of tariffs cannot justify tungsten mining again for several years.

Tungsten mining in the United States, to get into full blast, must wait on the steel business; on the depletion of stocks both in the United States and abroad; and in less degree on the depletion of the Chinese placer deposits. For whether or not Chinese deposits supply the United States, they will supply its rivals in the steel trade, and the competition must be met either here or abroad.

Molybdenum

By B. F. Phillipson
President Climax Molybdenum Co., New York

THE PROGRESS in the industrial application of molybdenum during 1921 cannot be measured by the production in this country during that period, because of the general economic situation. No molybdenum ore was mined during the last year. However, greater progress was made in the commercial development of the metal in 1921 than during the entire preceding four years. The reasons for this statement will be apparent if the following technical papers on the subject are read: "A Suggested Method for Determining the Comparative Efficiency of Certain Combinations of Alloys in Steel," by J. D. Cutter; "A Discussion of Molybdenum Steels," by Charles McKnight, Jr.; and "Molybdenum Steel and Its Application," by M. H. Schmid. These three papers appear in the *Transactions* of the American Society for Steel Treating of December, 1920; March, 1921, and June, 1921, respectively. Further interesting information and pertinent data will be found in "Molybdenum Steels," by John A. Mathews, in *Transactions* of the American Institute of Mining and Metallurgical Engineers, February, 1921, "Molybdenum," by Arthur H. Hunter, American Iron and Steel Institute, May, 1921, and "Application of Chrome Molybdenum Steel From the Consumers' Standpoint," by C. N. Dawe, to be presented before the Society of Automotive Engineers in January, 1922

From a purely technical standpoint, the fact that steels containing molybdenum in fractional percentages ranging from 0.15 to 0.75, but never exceeding 1 per cent, have been extensively adopted as standard by some of the foremost manufacturers of automobile and automobile parts, as well as in the manufacture of such other products as die blocks, drop forge piston rods, shovels, pneumatic tools, railway parts, mill rolls, seamless tubing, and similar products indicates the quality of the molybdenum structural steels.

The molybdenum steels can be produced at a cost entirely competitive with other alloy steels of comparable physical properties. There is also the additional fact that molybdenum is the only one of our commercial alloying elements available in sufficient quantities within our borders to take care of all the requirements of the domestic industry.

Molybdenum is no more a panacea for all the ills of steel than any of the other established alloying elements, but, imparting as it does to steel at a commercial cost certain marked advantages not obtainable otherwise, and being available in extraordinary tonnage quantities in this country, its future in the steel industry is assured.

Vanadium Mining

By R. B. Moore*
Chief Chemist, U. S. Bureau of Mines

OWING to the slump in the automobile industry early in 1921, the production of vanadium was seriously curtailed. The Vanadium Corporation of America produces the larger part of the vanadium used in this country at its mines at Minasragra, Peru. The last shipment of concentrates from Peru to the United States was in the early part of the year, and no shipments have been made since that time, although considerable stocks of vanadium ore had accumulated in this country, and are now available.

Business for a short time was better during the summer of 1921 than it had been in the spring, especially during July and August, but in the fall there was another drop in the demand, and this was maintained until the first of 1922.

No ore was mined primarily for its vanadium content during 1921 in the United States. A fair amount of vanadium was, however, produced as usual as a byproduct in the extraction of radium from carnotite ore. Up to the middle of 1920, there was a tendency on the part of a number of operators to be interested in high-vanadium, low-uranium ores in the Paradox and surrounding districts, making vanadium the main product and radium the byproduct. An ore carrying 6 or 7 per cent V_2O_5 and from 0.5 to 1 per cent U_3O_8 was in strong demand. This condition has now entirely changed, and all vanadium from carnotite has been a byproduct, with radium the main objective.

Two plants near Newmire, Col., treating roscoelite ore, were shut down during the whole year, and there has been no production from these plants. The Vanadium Corporation has continued a moderate amount of development work at its properties in Peru. The branch railroad from the lake to the main line has not yet been completed, although the loose rails are down. Work has been temporarily discontinued on this improvement.

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Owing to the fact that a large percentage of the ferro-vanadium produced during 1921 was made from accumulated stocks of vanadium ore, it is not possible to give the actual production for the year.

Prices during the spring ranged from $5 to $5.75 per lb. of contained vanadium in the ferro, f.o.b. works. The variation in price depended upon the amount of impurities present, such as silica and like materials. There was a slight reduction during the summer, the price dropping to from $4.50 to $5 per lb. A number of lots of resale material have been sold recently at a price slightly under that quoted.

Uranium and Radium Mining

By RICHARD B. MOORE*
Chief Chemist, U. S. Bureau of Mines

THE general business depression probably influenced the radium business a little later than that of the other metals. Whereas the industry had slowed up to some extent during the latter part of 1920, production continued on a fair basis during the spring of 1921, and during the summer. It was not until September that the mines of most of the operating companies were shut down, although ore production had decreased to some extent before this period. The plants operated in a fairly consistent manner during 1921, and in practically all of the companies fractionation work continued up to January, 1922. Even after a plant has closed down, it usually takes from two to four months to clean up all of the accumulated radium concentrates. In addition, most of the operating companies always keep a fair store of ore ahead, so that it is not necessary for the extraction plants to close for some time after mining operations have ceased.

Operations have continued with few exceptions in the old districts. The Standard Chemical Co. has been getting a large part of this ore as usual from the Club Ranch and surrounding neighborhood. The company has, however, been producing a considerable amount of its ore from the south side of the Paradox Valley west of the Jodandy claim. This is a district that was temporarily abandoned several years ago, but new beds of ore have been opened up, and production has continued.

The operations of the other companies, the Colorado Radium Co., the U. S. Radium Corporation, and the W. L. Cummings Chemical Co., have necessarily been more limited, as they do not possess as many claims as the Standard Chemical Co. controls.

Little was done around Thompson's during 1921. Operations around Temple Mountain, Utah, were closed down in August. A fair amount of development work has been done in this district, where the ore is usually high in vanadium but rather low in uranium. A new district opened up during the year as an extension to the south of the proven fields is near the Carrizo Mountains, on the border of New Mexico and Colorado. Some fair ore showings have been found in this locality, and though the ore is not as high grade as further north, a fair production may be expected.

Prices of ore in 1921 remained about the same as during 1920. Most of the ore produced is mined by the operating companies themselves, and only a relatively small quantity is purchased in the open market or through agents. For several years it has been the custom to pay for the vanadium as well as for the uranium content. Recently, on account of the slump in the vanadium market, prices on the vanadium content of the ore have been reduced, but prices for the uranium in the ore have been approximately the same as for 1920. There is some small variation in the prices offered, but generally speaking, they are about as follows: 2 to 2½ per cent U_3O_8, $2.25 per lb. U_3O_8; 2½ to 3 per cent U_3O_8, $2.50 per lb. U_3O_8; 3 to 3½ per cent U_3O_8, $2.75 per lb. U_3O_8. Ore has been sold containing as low as 1 per cent U_3O_8. Ore of this grade, however, has usually been high in vanadium. More recently the tendency has been, owing to the lack of demand for vanadium, for the dealers to be less interested in the lower grades of ore.

A deposit of uranium minerals in Katanga, Africa, was announced during 1921. This is near the town of Elisabethville, and is on the property of Union Minère du Haut Katanga. Meager information has yet been given out concerning the possible production, but the owners appear to be optimistic over the possibilities of this deposit for the extraction of radium.

The production of radium in this country during 1920 was 32½ gm. The production during 1921 will undoubtedly be greater, and will exceed 35 gm. This is in face of a depressed market, and shows that the radium producers have been inclined to go ahead with confidence.

Prices of radium have remained steady, and are practically the same as in 1920. For small lots of radium, the price varies from $115 to $120 per mg. of radium element. For larger lots, purchases under competitive bid, the price is less and depends upon the amount of radium involved.

Mesothorium has become well established as a substitute for radium in certain uses, particularly for luminous paint. Both the Welsbach Company and the Lindsay Light Company has been steadily producing mesothorium as a byproduct in the manufacture of thorium nitrate for gas mantles. The mesothorium always contains from 12 to 25 per cent radium, and, in practice, the manufacturers of luminous paint usually add a little more radium so as to bring the percentage of radium up to a slightly higher figure than is natural in the mesothorium. As this product has the life of five or six years after it has "ripened" for about a year, its use tends to conserve radium for therapeutic application, research, and experimentation.

Arsenic Industry

By V. C. HEIKES*
Statistician, U. S. Geological Survey, Salt Lake, Utah

PRODUCERS of arsenic in the United States marketed in 1921 approximately 5,732 short tons of crude and refined white arsenic, compared with 11,502 tons, valued at $2,021,356, in 1920. A considerable amount of arsenic is held at points of production and in consumers' hands, and only a small quantity of the supply was manufactured into fungicides.

Large stocks of calcium arsenate, said to aggregate 5,000 tons, were reported at the close of 1920, so the situation was not encouraging to producers. A part of the supply was sold in 1921, and the remaining portion, about 1,000 tons, which had begun to deteriorate, was in the hands of manufacturers and distributors. These warehouse stocks of insecticides were accumulated by an anticipated demand, so that when the South did not buy, producers had no outlet for their holdings.

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The largest producer of arsenic in 1921 was the U. S. Smelting, Refining & Mining Co., whose output for the most part was made into fungicides at its Midvale plant. Very little of the white arsenic produced at Tacoma, Globe, and Anaconda was put on the market, and most of this was sold to manufacturers of fungicides and refiners making the higher-grade arsenic demanded by plate-glass works.

The price of white arsenic gradually fell from 11c. per lb. in February, 1921, to 6c. per lb. in November, with few offerings. Toward the last of November, there was an improvement in the insecticide business, and agricultural buying for spring trade was a feature of the market, with forward deliveries commanding a premium.

Prices for white arsenic near the close of 1921 were 7½c. per lb. Red arsenic decreased from 16 to 11c. per lb. during the year, and quotations for calcium arsenate were steady, ranging from 16 to 20c. per lb.

An increased demand for the products made from arsenic suggests a better price for the raw material in the near future. It is not likely that the foreign arsenic will interfere with the domestic production, as most of it, except that produced in Mexico, will be consumed locally or shipped to foreign dealers.

The future of arsenic production depends mainly on its use in the cotton regions and on railroad rights of way, but there is a prospect that the alfalfa-growing regions will develop a considerable demand, and the use of arsenical insecticides on intensively grown crops is steadily increasing.

The Petroleum Outlook

BY JOHN D. NORTHROP*
Land Classification Board, U. S. Geological Survey,
Washington, D. C.

THE PREDOMINANT ELEMENT in the petroleum industry at the dawn of 1922 is uncertainty. Has the post-war depression run its course as far as the petroleum industry is concerned, or are still lower levels to be traversed before substantial improvement may be expected or complete recovery assured? The evidence at hand does not yield a categorical answer. Its elements conflict, and are in places, seemingly, if not actually, contradictory.

On the adverse side of the ledger, the pessimist finds occasion to view with unfeigned alarm the financial and economic paralysis of the world in general and of Europe in particular, with its attendant constriction of foreign demand for petroleum products and its demonstrated capacity for preventing able-bodied oil-burning merchant vessels from engaging in active service. He notes also the slow progress of domestic industry toward normal activity and joins lustily in the anvil-chorus of invective against the ruinous costs of railway transport. With regard to the products of the petroleum industry he finds, on the one hand, a keenly competitive market, listless as to demands and bearish as to prices, and on the other hand the usual seasonal decline in the consumption of gasoline superimposed on an accumulation of stocks of the principal refinery products, other than kerosene, that is without precedent in the history of petroleum refining. As to crude petroleum, he observes a ready market for all oil offered at prices that barely cover the cost of production, a persistent increase in stocks, a steady influx of cheaply produced Mexican oil, and a threat of overproduction and market relapse in the daily gain in proved productive capacity of the newly found oil fields near Mexia, Tex.; Haynesville, La.; Eldorado, Ark., and Burbank, Okla.

There are, however, other factors, and other aspects of the same factors, that disclose a state of affairs by no means hopeless. Because they reflect basic rather than transitory conditions their effect is decidedly cheering.

On the favorable side of the general ledger, the optimist points with pride to the staple character of the commodity with which he deals, to the diversity of its applications, and to the indispensable rôle it plays in industry, transportation, agriculture, and everyday life. He notes the spirit that pervades the international conference on armament limitation and the Anglo-Irish compromise, reads its tangible expression in a stiffening of foreign exchange, and interprets the progress made in terms of European rehabilitation that must inure to the ultimate benefit of the American petroleum industry. With regard to industrial conditions at home, he observes the persistence, rather than the deliberation, with which the pathway to normal activities is being sought, found, and relentlessly pursued, and counts each shaft, spindle, pulley, and wheel restored to motion as an embryonic market for his wares.

The optimist enters even the idle tankers and oil-burning merchant vessels in our harbors as assets, listing them as prospective customers, as available delivery vehicles and as guarantees that the domestic petroleum industry will not run short of raw material so long as it is available in near-by countries. In this connection he finds it impossible to overlook the fact that the quantity of bunker oil furnished at American ports to vessels engaged in foreign trade in the first nine months of 1921 aggregated 20,252,215 bbl., and is greater by 11 per cent, 130 per cent, and 323 per cent, respectively, than in the corresponding period in 1920, 1919, and 1918.

With respect to railway tariffs, the optimist derives a modicum of cheer from the facts that all the great industries are equally affected with his own, that substantial industrial prosperity cannot coexist with railway adversity, that the highway to railroad prosperity is largely financial, and that, since the petroleum industry, as the purveyor of about 40,000,000 bbl. of locomotive fuel annually, is in a position to benefit directly by railway prosperity, its contributions to railway betterments are not without interest-paying possibilities.

Turning, then, to the matter of refinery products, the optimist perceives that all is not as dismal as might at first appear. With respect to gasoline, he finds that the domestic and foreign market absorbed 3,817,638,979 gal. in the first nine months of 1921, and that this quantity is greater by 3.4 per cent, 30.4 per cent, and 30.6 per cent, respectively, than the quantity absorbed in the corresponding periods in 1920, 1919, and 1918. He notes that the indicated rate of consumption in 1921 averages around 424,000,000 gal. per month, and with this in mind calculates the stocks on hand at refineries the country over as equivalent to less than a six weeks' reserve. He finds therein no warrant for general dismay, although he concedes that this condition may lead to local unsettlement in localities where competition is particularly keen and storage space is already occupied.

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A glance at the automobile industry suggests that some part of the failure of gasoline consumption to increase in 1921 at the average rate of 40 per cent attained in other recent years may be attributed to anticipation by the public of the deflation that is now in progress and a consequent postponement of motoring "joys" until a later date. In any event, the lowering of automobile prices is certain to stimulate buying and to result in a demand for gasoline next summer.

As to kerosene, the situation is well in hand as judged by statistics for the first nine months of 1921. These show decrease of production, consumption, and stocks as against the same period last year, despite a gain of about 5 per cent in the quantity of crude oil refined. Similar evidence concerning lubricating oils indicates a moderate decrease in production accompanied by proportionately greater decreases in domestic consumption and foreign shipments and by a doubling of refinery stocks compared with a year ago.

The mettle of the optimist is severely tested as he contemplates the situation of gas oil and fuel oil. He finds them a drug on the market, selling below their cost of production and accumulating in refinery storage at the rate of 1,000,000 bbl. a month. The surplus accumulated to the end of September aggregated about 29,300,000 bbl. and was 60 per cent larger than on the same date in 1920. In consideration, however, of an average monthly outgo of nearly 18,000,000 bbl., an accumulated excess of 30,000,000 bbl. more or less would not seem to afford the basis for much apprehension were it not for the close interrelation that exists between the market for fuel oil and the market for the lower-gravity types of crude petroleum. The former cannot substitute for the latter, but, within certain limits, the latter can substitute for the former; hence, the availability, supply, and price of crude largely control the situation as to fuel oil.

With respect to crude petroleum, the evidence at hand, comprising statistics for the first eleven months, indicates for 1921 a production of about 467,000,000 bbl. This constitutes a gain of about 6 per cent over 1920, but reveals a deficiency in production as compared with consumption that aggregates approximately 50,000,000 bbl. Importations from Mexico made good this deficiency and added about 54,000,000 bbl. net to the reserves of crude oil in the United States prior to November 30. At that time the total stocks of crude oil on hand amounted to 176,006,000 bbl., equivalent to a four months' supply at the current rate of consumption.

The collapse of the crude-oil market in the first half of 1921, which reduced "Pennsylvania grade" from \$6.10 to \$2.25 per bbl., and "Oklahoma-Kansas grade" from \$3.50 to \$1 per bbl., followed as a natural consequence of the overproduction developed in response to the high prices established in the spring of 1920 and consistently maintained throughout that year. The extremely low levels reached by prices in midsummer 1921 brought about so vigorous a curtailment of field activity as to threaten a serious shortage of crude within a few months. As a result, prices reacted sharply during the fall months to levels that at least cover the bare cost of production, even though they provide little or no incentive for wildcatting.

With field activity pared to the bone and three months of winter still to run, with production diminishing from the old wells, and with domestic requirements exceeding domestic production by an average of 4,000,000 bbl. per month, and ranging as high as 10,000,000 bbl. per month, the only apparent obstructions to immediate advances in the price of crude oil at the wells are Mexico and the new oil fields discovered in the southwestern states in 1921. Both are uncertainties as yet, and until their measure is taken the market for domestic crude may be expected to pursue its present conservative course.

The growing conviction that the days of Mexico's big and cheap production of refinable oil are numbered, and that the number is astonishingly small, tends to offset any misgivings that might otherwise arise as to the effect of the rather unexpected injection of about 200,000 bbl. per day of new production into the domestic crude-oil situation.

The keenness of the competition displayed by the purchasing agencies for the new production unearthed at Mexia, Haynesville, Eldorado, and Burbank, and the record-breaking bids offered at the December sale of leases on prospective oil land in the Osage Indian Reservation, Oklahoma, point unmistakably to a vital concern for assured supplies of crude oil that cannot long avoid reflection in market quotations, for the better grades of domestic crude at least.

The algebraic sum of the factors briefly set forth in the foregoing discussion permits for the domestic petroleum industry as a whole no other forecast of conditions in 1922 than generally fair with rising temperature, accompanied probably with clearing showers and other evidences of unsettlement, temporary in duration and purely local in extent.

Barytes Mining

By J. B. Pierce, Jr.
Chief chemist, Rollin Chemical Corp., South Charleston, W. Va.

The barytes mining industry underwent a severe decline toward the end of 1920 and throughout the entire year of 1921. Figures for actual production for 1921 are not available, but there is no doubt that a decided shrinkage will be shown in comparison with those for 1920 and 1919.

The tariff question appears to be the critical turning point of the domestic barytes industry. If adequate protection is not accorded, the industry cannot survive. German barytes, because of its vein formation, permitting of lower mining costs (no mechanical preparation being required), together with the lower ocean freights as compared with the cost of rail transportation from the domestic producing areas to the Eastern seaboard consumers, can be laid down in the United States at a cost which domestic producers can not possibly meet.

Barytes could be contracted for at the close of 1921 for \$6.25 per short ton, at the mines. The freight rate is from \$5 to \$8 per long ton on the domestic ore to northern seaboard territory, depending upon its point of origin. The tariff, as proposed in the present bill, of \$4 per ton, will scarcely enable domestic producers to compete with the imported ore in seaboard territory, but should give them the entire internal business of the country.

Bauxite and Aluminum

By JAMES M. HILL*
Geologist, U. S. Geological Survey

THE domestic consumers of bauxite were apparently well supplied during 1921 with both domestic and foreign material. The market quotations for crude have been constant at \$8 to \$10 per ton. Dried pulverized bauxite commands a premium of \$4 to \$5 per ton, and calcined is quoted at \$20 at shipping point.

The total imports of bauxite for the first nine months of 1921 were 21,571 tons, having a declared value of \$7.62 per ton. The imports from British Guiana for the first five months of the year were 10,545 tons, or nearly half of the total imports for the nine-months' period.

The Demerara Bauxite Co. closed its plant in British Guiana early in 1921, presumably owing to the slackened demand for bauxite in the United States and to the fact that the colonial office had made no regulations under which it could operate. It is reported, however, that the "British Bauxite Co.," formed no doubt at the instigation of the British government during 1921, is to develop all the bauxite lands on the Demerara River, not already controlled, upon condition that their output go to British aluminum interests.

In Dutch Guiana, the bauxite deposits at Moengo, 160 km. from the mouth of the Commewyne River, are under development. The Dalmatian and Istrian bauxite mines are on a producing basis, and it is reported that high-grade material from these deposits is now being delivered in the United States.

Large bauxite deposits in the Bakony district, Hungary, have recently been discovered, and a company has been organized to operate them.

France has placed a 20 per cent ad valorem duty on the export of bauxite, as a consequence of which it is said that some of the mines have been closed.

The demand for aluminum in the United States has apparently been less than for some time, reflecting in part the depressed condition of the automobile industry. Quotations for domestic aluminum, which at the first of 1921 were 28.3 to 28.5c. per lb., declined to 24.5 to 25c. in July and in November were cut to 20c. Foreign aluminum was quoted from 3 to 7c. cheaper. Imports of crude aluminum for the first nine months of 1921 were 26,177,852 lb. with a declared value of 22c. per lb., and exports of domestic aluminum in the same period totaled 1,024,346 lb., valued at 27c. per lb.

French aluminum plants are reported to be operating at about normal capacity, but the German plants are having difficulty, as many of them derive their power from coal, and are therefore at a disadvantage.

Japan is still endeavoring to establish an aluminum industry, latest reports being of a semi-governmental investigation of a new (?) process for extracting aluminum from local raw materials.

The Aluminum Company of America has indicated that a raise of 5c. per lb. on the import duty of pig aluminum would be acceptable. Consumers, however, are of the opinion that the present duty of 2c. per lb. on ingot and 3½c. per lb. on sheet aluminum is sufficient protection for the firmly established domestic industry.

The outlook for both producer and consumer of aluminum in the United States is encouraging. The United States has a well-developed, strongly organized company, whose policy of enlargement to meet the increased demand is well known. Also, there exists the possibility that in the near future other interests will be producing aluminum.

Consumers are in good position, for the prices have receded and will probably continue downward, for, with French and Norwegian aluminum now coming in considerable quantities, it is hardly probable that prices for domestic aluminum can be held at unreasonable figures.

The Borax Industry

EDITORIAL STUDY

THE notable event of 1921 in the borax industry was the discovery of another important colemanite deposit. The finding of the mineral in Clark County, Nev., was described in *Engineering and Mining Journal* of Oct. 1, 1921, on p. 524. F. M. Smith secured control of the new deposit for the West End Chemical Co., a subsidiary of the West End Consolidated Mining Co. The West End Chemical Co. thus becomes an active competitor in the borax market, along with the Pacific Coast Borax Co., the American Trona Co., and several other producing companies. During 1921 the Pacific Coast Borax Co.'s plant was shut down most of the year, and the American Trona, at its Searle's Lake property, operated only during the early part of the year, owing to restricted demand.

In common with other industries, the enameled-ware industry, which is the most important business utilizing borax, was depressed throughout 1921. Later in the year inquiries from this industry indicated a loosening of the situation, and it is expected that 1922 will bring a certain degree of prosperity to the borax producers.

The price of borax in the latter part of 1921 [illegible] approximately 5c. per lb. Exports during the first eleven months of the year were 3,658,059 lb., of a value of \$246,658, as against 14,003,239 lb., of a value \$1,171,651, for the corresponding period of 1920.

The Fluorspar Industry

By BENEDICT CROWELL
President, Rosiclare Lead & Fluorspar Mining Co.

THE fluorspar mines in the Illinois-Kentucky district, where about 85 per cent of the domestic output is produced, were practically idle during 1921. Total shipments will probably not exceed 25,000 tons, or less than 10 per cent of the 1918 output and about 20 per cent of the average pre-war production per annum over a period of five years.

The steel industry consumes approximately 85 per cent of the fluorspar produced. Stocks on hand at the close of the war, supplemented by later deliveries of tonnages contracted for on a basis of war-time produc-

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[illegible] together with drastic curtailment of steel operations late in 1920, combined almost to eliminate purchases of fluorspar in 1921.

Fluorspar is essential to the basic open-hearth steel process. Prior to the war about 35 per cent of the furnaces were of that type. The ratio is now 80 per cent, as practically all new furnaces and replacements built during the war period were of the basic type. With reasonable activity in the steel industry and increasing demands from the glass, enamel, and other trades now using the high-grade ground ore, the outlook for 1922 is fairly encouraging.

It is not generally realized that the known fluorspar deposits of this country are very limited in extent. War stimulation failed to develop a single new orebody of consequence that I know of. The increased supply in 1917 and 1918 came from the exhaustion of reserves at the principal mines, depletion of all old and newly located shallow deposits, working over old dumps, and salvaging the low-grade ore left in the old workings of abandoned mines. Prices of $35 to $60 per ton justified extreme activity.

Only four producers in the Illinois-Kentucky district have railroad connection. The rest are compelled to haul the ore and supplies from four to fifteen miles over dirt roads that are almost impassable for five months in the year.

During the war period many new companies were organized to develop and operate fluorspar prospects. Practically all used up their capital and passed into history. Many of them never actually produced a car of ore.

Exhaustion of shallow deposits, the uncertainty and added cost of deeper mining, necessary exploration, and dead work are contributing factors which have tripled the cost of producing fluorspar. It has become a complicated, expensive, and relatively deep mining proposition. If the steel industry and other users in this country are interested in insuring a future supply of this material, the foregoing facts should be given serious consideration, and the ore should be valued accordingly.

The Graphite Industry

By BENJAMIN L. MILLER

Professor of Geology, Lehigh University, Bethlehem, Pa.

DURING 1921 the graphite industry of the world was in the most deplorable condition in its entire history. The present situation can be definitely traced to a few definite causes. The demand for crucible steel for war purposes created an unusual demand for graphite crucibles, and scores, perhaps hundreds, of new graphite mines were developed in Ceylon, Madagascar, the United States, Canada, and other less important graphite countries.

The sudden ending of the war found the steel manufacturers with large supplies of crucibles on hand, the crucible manufacturers with an excessive amount of graphite in stock, and the graphite-producing companies with supplies of refined and crude graphite sufficient to meet even the inflated needs of war time for many months or even for years. There has not yet been time enough to exhaust the surplus, and until that is done stagnation of the entire industry is the natural result. Prices have fallen, and there have been many forced sales at figures far below the cost of production, but even at a sacrifice it has not been possible to dispose of surplus stock.

It is a question as to whether the domestic flake graphite producers can successfully compete with the Ceylon producers, whose product is considered superior for crucible manufacture, or with the graphite producers of Madagascar, where a flake graphite similar to the domestic variety is put upon the market at lower costs than have ever been realized in this country. Congress is therefore being asked to impose an import tax on foreign graphite, to keep the American graphite producers from complete liquidation.

If it should become the policy of our Government to impose a temporary protective tariff on such of our mineral products as we have in great quantity until opportunity had been given to determine the ability to compete with foreign materials, graphite is certainly one of the minerals that should receive especial consideration. In Alabama, New York, Pennsylvania, Texas, and in several other states there is sufficient flake graphite to supply all our needs for centuries.

The alternatives are for the graphite producers to so perfect their refining methods that with decreased transportation rates they could compete in our markets with the foreign materials, or for the producers to engage in the manufacture of graphite articles. The latter is regarded as the only satisfactory solution of the problem by some of those engaged in graphite production, but as yet only one important company has made the attempt, and that organization produces only a small part of the material consumed in its manufacturing business.

Until supplies on hand are consumed, the production of graphite will be at a minimum in all countries, and practically all the mines and mills will be idle; but eventually new supplies must be obtained, and prices will depend upon the cost of production. The present situation is discouraging, but the future offers more promise, and it is hoped that, irrespective of an import tariff, the better-established American producers may be able to continue.

The Magnesite Industry

By R. W. STONE*

Assistant State Geologist of Pennsylvania, Harrisburg, Pa.

THE domestic production of crude magnesite in 1921 was between 35,000 and 40,000 tons, as compared with 300,000 tons in the preceding year. It came from California and mostly from two producers. The California product is employed largely for plastic purposes, and its use decreased in 1921, largely because of general business depression and restraint in the building trade, until in December all California magnesite mines were shut down.

The mines in Washington, which produced 220,000 tons in 1920, have been idle for twelve months, because their output was used exclusively for refractory purposes, and the steel business has been bad. Furthermore, the high price of magnesite has made steel companies search for a substitute, and it is surmised that figures eventually will show that the use of dead-burned dolomite for lining steel furnaces has greatly increased in the last two years.

Imports of magnesite can scarcely be charged with the slump in the domestic industry. The normal consumption of crude magnesite in the United States is about 300,000 tons. In 1920 it was 366,000 tons, of which 63,000 tons, or 17 per cent, was imported. The general imports in the first ten months of 1921 were 51,215 tons, and for the entire year will just about equal those of 1920. It would seem, therefore, that the demand for refractory magnesite in the United States is rapidly decreasing. Of the 51,000 tons imported, 31,000 tons was shipped from Italy, 8,000 tons from Greece, and 6,000 tons from Austria. Most of the magnesite imported was crude. In the first nine months of 1921, imports for consumption were 42,324 tons crude, valued at $9.75 per ton, and only 5,261 tons was calcined, but this was valued at $34 per ton. The low cost of production in Europe can be judged from the fact that the 6,000 tons from Austria in August was valued at port of shipment at $6.75 per ton. Italy shipped 6,000 tons in May, valued at $7 per ton, and 2,900 tons in October, valued at $8.90 per ton.

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The present rate of exchange, the low cost of production in Europe and of water transportation, and the fact that the market for dead-burned magnesite is practically all east of Chicago combine against the producer who wishes to ship Washington magnesite to the Eastern market. The deposits near Chewelah and Valley, Wash., will constitute a reserve unless a new market west of Mississippi River can be found. The large producers in California should scarcely expect to supply all the plastic trade on the Atlantic seaboard, but by using definite heat-controlled methods to prepare a superior quality of caustic calcined magnesite they may be able to hold the trade of most of the country.

The Talc Industry

By Raymond B. Ladoo*
Mineral Technologist, U. S. Bureau of Mines

THE talc industry in 1921 experienced a marked depression, in common with nearly all industries. The generally unfavorable trade conditions were further aggravated by the expansion of mill capacity which occurred in 1919 and 1920. This resulted in drastic price cutting and severe competition among producers for the small amount of available business. In some instances prices were cut below the cost of production. New operators in general found great difficulty in introducing their product, although in one noteworthy instance a new producer was able to run his mill practically to capacity because of the demand due to the superiority of his product. Competition proved too severe for some of the smaller companies.

The generally unsatisfactory condition of the industry was reflected in the imports of talc, which for the first nine months of the year amounted to only 44 per cent by tonnage of those for the corresponding period of 1920 and about 91 per cent of 1919, a year of low production. Toward the close of the year a Canadian producer dumped his surplus stock on our markets at a very low price. Thus the final import statistics will probably show an increase during the last three months.

The demand for talcs of various grades is, of course, dependent upon the prosperity of the consuming industries into which talc enters. The largest markets for Vermont talc are in the paper, rubber, and prepared roofing industries. The poor condition of the paper and rubber industries in 1921 caused a severe drop in demand for Vermont talc. The prepared roofing industry was not as badly effected, but even here demand was far from normal.

Much New York fibrous talc is used in paint, and as the demand for paint was fairly good, New York producers of talc were probably in a somewhat better position. Toilet grade talc is produced in quantity only in California, and California producers find their principal outlet for high-grade talc in the East. Heavy imports of low-priced high-grade talc from Canada, France, and Italy, and high transcontinental freight rates, combined with a lessened demand, made it almost impossible for California producers to compete in eastern markets.

The tariff situation is still unsettled, though the Fordney Bill, which passed the House of Representatives, is regarded as affording ample protection to the talc industry. This bill provided for a tariff of ¼c. per lb. on the crude, ½c. per lb. on the ground and 1c. per lb. on cut or sawed crayons, cubes, or other forms.

Despite the generally unfavorable condition of the industry, there were a few encouraging developments. For the first time the talc industry as a whole, through the Talc and Soapstone Producers' Association, embarked upon an advertising program. Though the publicity so far has been rather limited in extent, it is a very hopeful sign.

Return to normal conditions will probably find the talc production divided between fewer but relatively stronger companies. Few producers expect a rapid return to the unusually high production of 1920. Hence new mill construction will not be justified in the near future unless such mills represent a distinct advance in the art of milling, resulting in lower costs or better grades. Domestic production of talc of toilet grade depends primarily upon the extent of protection afforded by the new tariff bill, but is also influenced materially by freight rates and labor costs.

The Mica Industry

By Rudolph S. Lienau
Mica Specialist, Brooklyn, N. Y.

THE mica industry at present is at its lowest point for many years. Large quantities of imported mica are on hand, which are slowly being disposed of, while hardly any of the domestic mines are producing any mica of consequence. It is my belief that only 10 per cent of the firms producing mica in pre-war times are now operating.

This critical situation in the industry will remain until manufacturers using mica are working on a full-time basis, and depend again upon the production of domestic mica of sufficiently good quality and quantity and at a reasonable price to make it profitable for the consumer to use it.

With a little help from the new Fordney Bill, which places a tariff of 6c. per lb. on the imported mica, and which may become a law about March 1, 1922, the industry can again return to its former satisfactory condition provided the wage scale also returns to a reasonable basis.

The lack of modern machinery in the process of mining and the need of trained men who understand the mining and manufacturing of mica are the greatest handicaps in competition with the imported material.

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Industrial Efficiency

Training Miners for Efficiency

Standards of Work Must First Be Determined—Best Methods Evolved by Conferences — Foremen and Bosses Become Teachers — System of Reward For Accomplishment Essential -- Increase of Earning Power Reduces Costs

BY ARTHUR NOTMAN
Superintendent, Mining Department, Copper Queen Branch,
Phelps Dodge Corporation, Bisbee, Ariz.

THE GREAT WAR brought to the metal-mining industry what it brought to all war industries, the supreme necessity for greater production. The industry has reason to be proud of its response to the need. That it was accomplished at the sacrifice of costs is a matter too well known to require comment. Unparalleled surplus stocks, notably of copper, produced at high costs, and failure of demand since the Armistice, have resulted in the shutdowns involving lay-off for employees and reduction or suspension of dividends to stockholders.

The supreme necessity of peace is lower costs. Can and will the industries make the same splendid response to this even more important need? If so, how can they do it? The following factors control: Better management; better methods; better equipment; better-trained men.

I shall not attempt to evaluate these factors, and I have little to offer upon the first three. Perhaps it would be just to assume that the management which directed the doubling of production under war conditions is capable of directing the halving of costs under peace conditions. Better methods are a function of management and, likewise, better equipment. Having gone this far, one might easily close the argument by admitting that better-trained men are also a function of management, and they are.

SKILLED MINERS CALLED UPON TO DIRECT METHODS

Before the introduction of machine drills, with the tremendous increase of individual productivity in mining and the inevitable expansion in demand for mining labor, the miner was an artisan who had chosen his profession because of the romance in the search for buried treasure which by his skill and effort he might any day uncover for the world's enrichment. What he didn't know about drilling, breaking, mucking, timbering, and ore was not to be learned. The supply of such trained, skilled, interested artisans was adequate to meet the demand. What happened then? With the rapid expansion of the industry these same men were called upon to direct mining operations. They were placed in authority over large groups of practically untrained men attracted to the industry by the prevailing high wages. They were called on to direct methods and use equipment with which they themselves had had no previous experience. To their credit, let it be said that they made the best of a bad situation. With the help of the management, they carried on.

What has been done or can be done to improve this condition? Too many things to enumerate—in fact, so many that some are forgotten until brought to light in the cold gray dawn of returning competition.

Perhaps most of us have decided at some time or other that there was one best way to do a certain piece of work. We have issued an order that hereafter all such work should be performed in that manner. Straightway we have gone forth and forgotten what manner of order we issued. Months or perhaps years later, we were asked how such work was being done in our mine. Glibly we described our one best method, and very likely in the course of conducting our inquisitive visitor through the workings we found that same piece of work carried out in a different manner in every heading. Possibly we had never even regarded the question of how to do that particular job as of sufficient importance to reach the conclusion that there was one best way of doing it. We knew that our general plan of ore extraction was sound, that we had good equipment, that our foremen and shift bosses were well chosen, and that the men were the best that could be obtained. What more could we desire? If mining could be carried on above ground, perhaps nothing more would be required, but, unfortunately, in most mines, not over a half dozen men at the maximum are in sight at any one time while working, and the general average would be nearer two.

How can we overcome the fundamental difficulty in supervision? First, by increasing the number of bosses and improving their quality. Second, by reducing the number of methods. Third, by rewarding good work directly and promptly.

Some operators have reduced the necessity for increased supervision and have obtained excellent results by contracting all or nearly all of their work. I think the best field for such a method lies where uniform conditions maintain over large areas of the mine, as in certain coal and iron deposits. Some, fewer probably in number, have worked successfully on the straight day's pay method, with increased supervision. Others have adopted task and bonus schemes based on standards of performance satisfactory to both company and employees. This last seems the more elastic and consequently the plan best suited for general metal-mining conditions.

In choosing contracting as the lesser evil, one must be sure that standards are based on work done by good methods under good conditions and by good men, or no saving will result. Under the day's pay plan, the same factors control, but with an added difficulty. There is no more incentive for the good miner to extend himself than for the poor one. This strains supervision to the utmost.

Under the task and bonus plan, properly applied, the mining company is assured that only better than standard work will receive better than standard pay. The miners are assured that they will receive nothing less than standard wages and that any work that they can do better than standard will be adequately rewarded. What do we mean by standard work? First, we must make a careful detailed survey of all methods in use and all other possible methods for doing each item of work. Second, we must select the mest method from the joint standpoints of safety and economy. Third, we must introduce that method to all foremen, bosses, and miners. Fourth, we must then instruct them therein. Fifth, we must see that these methods are followed.

After these details have been taken care of, we are then in a position to make records of the average performance by the standard methods under good supervision with standard wages. This is standard work. Only after this has been established can the question of bonus rates be discussed intelligently and the division of the savings, to be made by greater and more intelligent effort, both of management and men, be placed on an equitable basis. Important to the success of any such study are frequent conferences among all those who will be responsible for the instruction of the men, so as to secure the value of their knowledge, criticism, and suggestion.

Trained miners in sufficient numbers are no longer available, and must be developed by foremen and bosses who have ceased to be taskmasters and have become teachers and leaders. In fact, they will furnish most of the knowledge to be transmitted to the miners. A permanent committee on standard methods and permanent records available for distribution in the form of pamphlets describing these methods will be of great assistance in this program. A step further would be a course of study by foremen and bosses in the instruction of miners in standard methods. The plan cannot be too rigid, so that methods may be modified or discarded in the light of experience.

As a concrete example, standard methods for drilling, loading, and shooting development faces might be cited. Such methods have been described in C. A. Mitke's book on standardization, published a few years ago by *Engineering and Mining Journal*. Mr. Mitke's book was based largely on the observations of such a program then in process of development at the Copper Queen Mines of the Phelps Dodge Corporation at Bisbee, Ariz. These observations were made during frequent visits to that property as consulting engineer on ventilation problems.

Nothing has yet been found so generally productive of results in opening the minds of men to new ideas as the hope of reward. Any time that a man can be shown that by using new methods he can increase his earning capacity, you gain his prompt attention. If you attempt to show him this without any other object than advancing your own interests, you fail to get under his skin. If you merely order him to do things your way, the burden of seeing that he does so remains on your own shoulders. Your sole reliance then becomes his fear of losing his job. Though such fear may be wholesome for us all at times, it cannot be upheld as the only or most desirable incentive to human effort. Herein lies the hope for better-trained miners.

In my college days there was much heated debate over the respective strokes in use by our own and our rival university crews. I shall never forget the feeling of utter conviction with which I heard one intelligent student of this question deliver himself of this piece of common sense: "A poor stroke well rowed will beat a good stroke poorly rowed seven days in the week." Though this is no argument for poor methods, it does exemplify the need for good training and sound morale.

How can these be secured except through the efforts of our foremen and bosses and a system of reward based on accomplishment? We must train our foremen and bosses in their obligations as teachers. We must study what we want them to teach. In doing so, we must invite them to furnish their contributions. We must then open the minds of their men by paying for work and not for time. It can be done because it has been done. Metal miners would be well repaid by a survey of the many successful applications of these principles in other industries as well as in their own. There have been failures, and there will be more so long as greed outruns common sense and justice. Individual bargains are good only when they are good for all three parties. Why talk to me about efficiency and loyalty when, if I furnish them, you take all the profits. Show me how to increase my earning power and I will show you how to reduce your costs. This is a good bargain for miner, mine owner, and consumer.

Standardization in Mining

A Plea for Systematic Classification of Underground Conditions—Study of Methods an Essential Preliminary to the Selection of the System Best Adapted to Existing Conditions—Standardization Not Permanent, But Changes When Better Methods Are Developed

BY CHARLES A. MITKE
Consulting Mining Engineer, Bisbee, Ariz.

THE NEED for investigation of mining practices, or mining methods, with a view to improving present conditions in respect to high production costs, has made itself felt throughout the entire mining industry.

Not long ago, the standardization of metal-mining systems was considered impracticable, particularly underground operations, from which natural circumstances have, to a large extent, excluded the light of publicity. The reserves of many of the larger mines were also so rich and extensive that economy did not play as important a part as perhaps it should have done. In addition, the ever-present possibility of "sweetening the ore," or, in other words, bringing the daily output up to expectations by the addition of high grade, kept in reserve for such purpose, has often tided over situations which otherwise might possibly have disclosed unsystematized methods and careless supervision on the part of underground bosses, to whom the necessity of making a showing at the moment, by producing a large tonnage, meant everything, regardless of the disastrous effect their methods might have upon the future of the mine.

Now, however, the situation has changed. The mines are confronted with the possibility of having to operate on a small margin of profit with wages somewhat reduced, and with costs of materials, supplies, and all necessary materials and equipment still considerably above pre-war prices. Moreover, the richer orebodies are being rapidly depleted, leaving the leaner ores, which require more economical methods of mining.

FUTURE OF METAL INDUSTRY DEPENDENT ON COST CUTTING

Many writers have expressed the opinion that the future of the metal industry is largely dependent on cost cutting. This gives rise to the question, "How and where shall costs be cut?" Supplies and materials are still higher than pre-war figures; labor is as high—in some districts higher; freight rates are also high. How, then, are we to meet the situation?

By an analysis of every detail connected with the various operations in mining, followed by a systematization or standardization of operations; by training the men to perform their work in the most efficient and modern manner; by substituting mechanical devices for human labor wherever possible; by the use of improved mining methods; by keeping a careful accounting of every item of expenditure; and by a healthy agitation for better and improved mining equipment, which will stimulate further experimentation on the part of inventors and manufacturers.

As stated in a recent editorial in *Engineering and Mining Journal*, "the economy resulting from consistent study of the details of mining is in the aggregate large. Isolation and excessive conservatism are probably in a measure responsible for the slowness to take advantage of the progress that is being made." The question has frequently been raised as to how far standardization underground can be carried. At present there are so many opportunities for standardization in this field that it is well to test its possibilities before we consider its limitations.

Standardization of Mine Timbers.—The standardization of mine timbers, as far as it has been perfected, has given such encouraging results that investigations are now being conducted for standardizing timber details still further. Chutes, raises, manways, drift sets, and tunnel sets have already been standardized in a majority of operations, so that it may be said that approximately 50 to 90 per cent of all the timbering used underground conforms to certain standards.

Standardization of Drilling Machines—The mining industry is at present burdened with a multiplicity of machine drills of varying types, sizes, and weights, the difference in weight between machines in some instances being not more than 1 to 2 lb. The introduction of new machines is so rapid that in an effort to stock up with the best equipment available on the market, many machines in good condition must be scrapped, and as minor parts are not interchangeable, a considerable expenditure in such supplies must continually be charged off to profit and loss. The development of these machines is, of course, effected by the manufacturer to meet the needs of the industry, but, unfortunately, these needs are often the individual conceptions of various operators rather than the combined views of the majority. What may appeal to one does not meet the need of the other, and consequently, the necessity for purchasing and trying out this variety of types becomes an ever-increasing burden on the operator. Were there any great difference between the types, there would be a considerable advantage in this vast experimentation on the part of the operator, but often, as stated before, the difference is so slight, perhaps an increase or decrease in weight of one pound, that the advantage gained is almost negligible.

ANALYSIS AND CLASSIFICATION OF CONDITIONS

Classification of Underground Conditions—In the standardization of drilling machines, the first requisite is the classification of underground conditions and the recognition of the types by the operators. This might appear to present difficulties, but such is not the fact. The Copper Queen standard rounds were based on a classification of the ground. There were different types of rounds for different kinds of ground, and these rounds are now universally used in the various mines in the Warren district. The same is true of the company bonus system, which is also based on a classification of the ground. After all, the manufacturer himself, in selling his machines, actually bases their value to the operator on their guaranteed performance in certain classes of ground.

Although the argument is being continually advanced that "conditions in every mine are so very different," by which is meant that the types of ground are entirely different, this is often overdrawn. As an example of the extent of this erroneous impression, consider two mines, side by side, mining the same orebody and with the property line going through the center. The mine on one side of the property line adopted a small 45-lb. machine, and had excellent success with it for years, whereas the mine on the other side of the line, in the same orebody and with exactly the same conditions, used a 125-lb. machine with large steel, the operators giving as a reason that "conditions were so very different that the small machine was not applicable in their kind of ground." After some years, they were persuaded to make extensive tests with a small machine, weighing about 45 lb., and small steel, and were surprised to find that it did just as well in their mine as it had done in their neighbor's. Though conditions in mines in general are, of course, not as similar as they are in these two properties, there is not as much variance in rock conditions as men who are familiar with only a few mines would have one believe.

Should a survey be made of a large number of mines, and the different classes of ground be listed (after the duplicates had been omitted), it would probably be found that, with few exceptions, a dozen general headings would cover the different classes of ground found in practically all mines.

Therefore, the first step in the standardization of rock drills is a classification by the operators of their own underground conditions. When this has been done, and the conditions have been designated by certain specific headings, the next step is a comparison of the performances of different weights of machines in the specified kinds of ground. From this comparison the weights and types of drilling machines that will suit each class of ground, or combination of classes of ground, can be determined.

Drilling Machines—An incorrect impression still prevails as to what "standardization of drilling machines" entails. It is not suggested that operators should draw up detailed specifications, covering the most minute points in the manufacture of rock drills, or select one certain rock drill, prohibiting all further improvement; but, rather that, having first classified underground conditions, and unanimously agreed upon the best approximate weights and types of machines to meet those conditions, the operators should then ask the manufacturers to concentrate their efforts on constructing and continuing to improve machines of those weights and types to meet the specified conditions. In this way, the large number of different types, sizes, and weights of machines now on the market would ultimately be reduced to a comparatively small number, and the manufacturers would then be able to devote all their ingenuity, skill, and inventive genius toward improving this small number of machines.

At present, progress in the standardization of rock drills is at a standstill. An obstacle is that competition in the rock-drill business is so keen that the manufacturer is compelled to sell first-class, high-grade, machines almost at cost. The margin of profit on the machines is so small that he is forced to take the larger portion of his profits through the sale of minor parts, the cost of which is excessively high.

By minor parts is meant such accessories as cradle, feed screw, and side rods, but not the major parts, such as the rock-drill engine proper, patents on which are the property of the manufacturers, and which parts should not be included in the standardization program, for the reason that it is to the benefit of the industry to stimulate further experimentation and improvement in the building of such major parts. The interchangeability and standardization of minor parts would, of course, greatly reduce the manufacturers' sales, and naturally his profits, and consequently he does not accord much enthusiasm to propositions promotive of that purpose. On the other hand, minor parts for drilling machines not being interchangeable, and practically every variation of drilling machine requiring a different set, the operator is compelled to spend large sums of money on such parts, which become obsolete as soon as he purchases a different type of machine. This expenditure is so large that, at many properties, old, out-of-date machines are kept in operation much longer than they should be, so as to use up the replacement material on hand, which otherwise would have to be scrapped as useless. Were the minor parts standardized, as suggested, and interchangeable, it would then be possible for the companies to eliminate their old machines as soon as their efficiency dropped, without at the same time entailing a great loss through the scrapping of parts which would fit no other machine.

Standardization of Chucks—The standardization of chucks for machines should keep pace with the rapid standardization of drill steel. Formerly, six or seven different kinds of steel were used at many mines where today it is unusual to find more than three, in some operations only two, and in exceptional instances one kind of steel at a mine.

Drilling and Drill-Sharpening Operations—A great deal of work can be done and is being done in the standardization of the various operations connected with the sharpening and tempering of the drill bit. Many mines have also already done much toward the standardization of operations connected with drilling, such as the working out of standard machine rounds and the establishing of a routine for the driller. This practice will find a still wider application to mines in general when the operators have once got together and have classified their various kinds of ground, and decided on a minimum number of types and weights of drilling machines.

Shoveling and Loading Underground—One of the great needs of the industry is the use of a mechanical device in place of hand shoveling. The perfection of underground mechanical loading machines, followed by the standardizing of operations connected with them, will solve this problem; also, changes in the stoping methods, such as the liberal use of incline raises; the carrying up of much smaller stopes in high-grade orebodies, which will permit the use of slides to the chutes; and the substitution of incline square sets, incline top-slicing, and incline cut-and-fill for the horizontal methods.

Sampling and Estimation of Ore Reserves—When it is desired to compare the ore reserves of one mine with those of another, the first difficulty met is the determination of the methods that were used in sampling and in computing the ore reserves. The personal element frequently enters into the calculations. The working out and adoption of certain standard methods of sampling, and of estimation of ore reserves, would be of great value in computing and comparing the orebodies of one mine with those of another, in respect to the ore in sight and the tonnage extracted.

Mine Accounting Systems—Comparison of underground mining costs of various companies is at present practically out of the question. Every company has a different set of items which go to make up its cost sheets. For instance, one company will charge the preparation of a stope to prospecting and development work, whereas a second company will include it in the stoping cost; another company will charge the tramming of ore to stoping, and still another will include it in its transportation charges, and so on. Few if any organizations use the same system, and therefore their costs are valueless for comparative purposes. The working out by first-class mine accountants in conjunction with competent mining engineers of a standard system of cost accounting for underground mining, which would meet the conditions of a majority of the mines, and include the same items, would be of immeasurable value in stimulating healthy competition, and would give rise to investigation by those companies which, after comparison, found that certain of their costs were high as compared to those at other properties. Unquestionably such comparisons would result in lower costs at many mines.

Miscellaneous Underground Operation and Training of Workers

Other Units of Underground Operation—In addition to the specific instances already mentioned, standardization can also be applied to the routing of sharp steel from the shops to the underground workings, and dull steel from the working places to the surface. The same applies to the routing of mine timbers. The standardization, also, of the materials for underground warehouses; ventilating equipment for drifts and raises; ventilating doors; fire-fighting equipment, to be kept on hand for immediate use; mine cars, locomotives, track, gage, rail, and other materials and routine operations is worthy of consideration and deserving of extended study.

Training of the Workers—After having worked out and introduced standard methods wherever practicable in mining, it is then necessary to train the men so that they may perform their work in accordance with the standard practices.

High Costs in Absence of Standardization—It has been my privilege during the last year to visit, among others, some mines in which no attempt has as yet been made at standardization. Practically every stope was carried up in a different manner. Nearly every raise, drift, tunnel, chute, or manway had some individual feature about it, which the members of the organization characterized as "additions, possessing certain advantages over the previous cases." In summing up the situation, these mines, in which no standardization was attempted, might be characterized as "great mines worked by hand methods." The mining costs told the story, as they were 50 to 200 per cent higher than those in mines of similar character where standardization has been introduced.

There is, I find, considerable misunderstanding regarding the general scheme of standardization in mines. A great many, even in the operating field, still believe that standardization means the selection of a few types of machines and certain methods of operation, which, once adopted, are to be used continuously without change, which procedure, if followed, would naturally limit experimentation and retard progress. But those who advocate standardization in mining contemplate no such outcome. The selection of a piece of standard equipment, or a certain method of performance, implies only the adoption of that which, after careful consideration, appears to be the best machine or practice available at the time. When better equipment or better methods are offered, and careful study proves beyond a doubt their advantage over those in use, the older equipment and methods should be replaced by the newer and better things.

As Tennyson says, "The old order changeth, yielding place to new," and such has been the history of the world from time immemorial. Why, therefore, should any attempt be made to stop the hands of the clock of progress in respect to standardization of mining?

The Reduction of Costs

Average Prices and Costs Expected To Decline Gradually — High Wages and Short Working Week Destroy Efficiency — Stabilized Figures, Based on Supply and Demand, Better Than High Prices

By J. R. Finlay
Mining Engineer, New York

THOUGH ONE MAY EXPECT rather confidently that the average price and cost of commodities, measured in gold dollars, will decline for the next fifteen years or so, it is probably not reasonable to anticipate that they will decline uniformly. In many directions the fall in prices has been overdone; in others it has hardly begun. Thus, though the tendency is certainly downward, we shall undoubtedly have many instances of increases of prices of commodities that have slumped unduly, if only to regain some balance with commodities that have remained at war levels. It is hardly too much to say that from the viewpoint of many producers we have not yet obtained a readjustment of prices but rather a maladjustment. For example, before the war, and even during the war, a pound of copper in New Mexico would buy over 200 lb. of run-of-mine coal; now it will buy only 60 lb. So many examples of this kind have been cited that it seems useless to repeat them.

Preference for Urban Living Conditions Creates Difficult Problem

So far as one may judge from the comments one reads and hears, it seems that the public has discovered the chief obstacles in the way of a more equitable scale both of prices and of costs in fuel, transportation, and city house rents. Of the last probably it is enough to say that the high rents result from an under-production of living accommodations. I have said "city house rents" —in the small towns and in the country there is no apparent shortage of room. Back of the shortage of house room in the cities one must explain why so many people wish to live in the cities. This I shall not attempt, but merely mention it as one of the prime causes of the economic maladjustment.

The abnormal price of fuel and transportation certainly finds no support in under-production. On the contrary, those commodities can be oversupplied by 40 or 50 per cent. The true explanation lies in preferring artifice to nature, building up an economic scheme which nature does not approve of and will certainly destroy. The Government boards, in deference to labor unions and according to their lights, always with the attitude and solemnity of devotion to equity, have built up such inequalities that it is not hyperbole to call them grotesque.

Coal Mines in New Mexico on Two-Day Schedule

On a recent trip through the coal fields of New Mexico I found that the mines were working about two days a week. There was labor enough and development enough at hand to produce two or three times as much coal as could be sold; or, conversely, from one-half to one-third either of labor or of mines could supply the market. But at the same time the cost of production was the highest on record. The operators were having the greatest difficulty to make both ends meet, although run-of-mine coal sold at nearly $4 a ton and lump coal at $6.75 at the mines. It cost one of the principal operators $17.16 per man per day to run his mine for the month of September. Mexican laborers all over the state get $2 a day—sometimes $1.50. In the copper mines of the south they get $2.10; but in the coal mines the same Mexicans get a minimum of $7.90 per shift. The average of the diggers is a great deal more.

Shaft miners in Arizona get $4.50 a day; in these coal mines $8.40 plus a bonus. In the only two shafts being sunk, the work is done by miners from the copper country on these terms, in this kind of competition with the copper industry and the agricultural industry, both of which need cheap fuel more than at any time in their history. If these prices resulted from scarcity with an overpowering demand to force production, no one could, within reason, oppose objection. They would be temporary. The proper forces would be at work to restore equilibrium. But they respond to nothing except the pure inertia of price fixing. These wages were fixed by the award of one of Uncle Sam's boards for price fixing, I forget the name of it, and the wages are supposed to stand until April 1, 1922.

HIGH WAGES AND SHORT WORKING WEEK DESTRUCTIVE OF EFFICIENCY

To show how well rooted these prices are in economic necessity, I found at a wagon mine a hundred miles from the railroad excellent lump coal selling for $2 per ton. It was hauled fifteen miles and delivered at the house in Farmington at $5.50 per ton. The coal was dug by a miner from West Virginia, and the farmers of the neighborhood took little stock in labor unions.

I thought this exhibit was particularly instructive in the patent fact that though these artificial prices did everybody harm, they did nobody any good. The number of beneficiaries was infinitesimal. The highly paid miners get $15 to $25 per week, if they are lucky; but, in the excessive prices caused by their excessive wages, they do well to keep body and soul together. Their surroundings are ash heaps and tin cans, a sure proof that their days of idleness are an exercise in shiftlessness. Their children have the outlook of tin cans and ashes, with loafing on the street corner as a luxury in prospect for a real man.

COMPETITION ACTUALLY PROFITABLE

Through all this the people seem to be learning that competition is actually profitable; that to protect any class of people from it results in making them poor—an artificial scale of wages in excess of that warranted by production is either charity to mendicants or a tribute to robbers.

I have always believed that to pay higher wages than your competitor is good business, because thereby you generally get better men, with increased production, even more than in proportion. A man's plant costs money. It requires more capital to provide equipment for a thousand poor men than for five hundred good ones. But the most casual glance at the record of coal production in New Mexico is enough to prove that every cent that has gone to raising wages has gone to increased cost. There has not been the slightest increase in production; rather a decrease per man. The country therefore is burdened with an immense increase in the cost of fuel, for which there is no compensation whatever —except experience.

The break-up of the economic absurdity which I have described has, however, already begun. Wages have been cut in Colorado, and prices of coal have been cut already in New Mexico. The reduction all round will no doubt sweep the country, and before the end of 1922 fuel will probably be had on a normal scale of prices.

I have dwelt on the coal situation particularly because that, with railroad transportation, is an example of Government interference with production. It is nothing less than that. It is truckling to the bugaboo of trade-unionism; but of course it masquerades in the pretense of fair play to the poor laboring man. In other industries that are free from this pious scheme of lifting oneself with one's boot straps there is a marked difference. Readjustment has gone on apace. In contrast to the stagnation of production in the Government-protected coal mines, I can name instances where the output per man has been raised during the past year more than 50 per cent. The lead mines of southeast Missouri are an example. In these mines, despite the fact that the high cost of freight, fuel, and supplies still keeps the cost of lead above the pre-war level, the efficiency of labor has returned to a marked degree, production per man is much higher than before the war, and the business is on a firm basis. The men are earning far more, though at a rate of wages nominally lower, than the coal miners.

Except for the cost of power and transportation, the metal mines of southern New Mexico and Arizona can operate as cheaply now as they ever could. The gold and silver mines of this region are rather far apart, but as the matter of transportation with them is of less consequence than with other kinds of mines, they are operating successfully. Their costs, in some instances at least, have got down to pre-war levels.

In general, I think we may say confidently that except where labor is suffering (that is the word for it) from the false economics of unionism and Government control, it is as efficient and productive as before the war, which so greatly disturbed the normal progress of events.

HIGH PRICES DO NOT INDICATE HIGH PROFITS

One very interesting fact is disclosing itself. High prices are not a sign of high profits. From 1917 onward, the profits of metal mines declined with the same rapidity with which they had previously risen until for the years 1919 and 1920 those of New Mexico all showed a loss. In the coal mines the profits show an increase if measured in dollars but a decrease if measured in any other way. The proportion of profit to gross value of product has been uniformly less during the era of high prices than it was before the war, and the purchasing power of those profits has been less, with the same uniformity.

It seems to me that this fact brings home an exceedingly important economic lesson. It is an old story that there is no merit in inflation. Somebody always gets hurt, but even sensible men have generally preferred high prices. The fact seems to be that abnormal prices, either high or low, indicate an economic disparity from which a large section of the population must be suffering. People are wasting their efforts; working in vain; either producing what is not required or failing to produce what is required.

To keep exchange flowing freely, with everybody producing, so that each person may supply his needs with the greatest ease—that is prosperity. Stabilized, or fair, prices—prices made stable by the solid facts of supply and demand; by demand justified by ability to exchange goods for goods, and supply justified by competitive production—are far better than high prices, which either represent the exploitation of other peoples' necessities, or are fanciful and illusory, measured in dollars that are degenerating into scraps of paper.

Promoting Efficiency in Drilling Ore and Rock

Present Conditions in Mining Require Adoption of Preferred Methods in All Operations—Drill Carriages—New Drill Column Mountings—Standard Rounds—Better Rock Drills—Co-operative Research Necessary for Improvement

By B. F. Tillson
Assistant Superintendent, New Jersey Zinc Co.

MORE THAN EVER before the mining industries are feeling the urge for a greater productivity per unit of labor because of higher prevailing wage scales. As it is improbable that these will return to the pre-war base, and as it is likely that competition will be keener in the future, all operators are, therefore, strongly prompted to consider all means of increasing efficiency.

The mining industry is peculiarly in need of such help, because of the restricted market and low prices now current for its products and the insistent demand for still lower prices. It is obvious that a reduction in costs purely on a wage-scale basis will not produce the results which are sought, for such a step could not be taken in the mining industry unless it were correlative with a similar movement in other industries. It therefore appears that an increased efficiency must be sought, even though wage scales drop toward the pre-war rates. Mining work must be carefully analyzed into its component operations and into the fundamental ways in which efficiency may be increased.

The art of mining may be divided into such elements as drilling, blasting, timbering, mucking, loading, tramming, mechanical haulage, hoisting, pumping, power, and concentrating (and these groups may be further subdivided). This paper will consider only the first element, which is an important item in all cost sheets.

The productivity of labor units may be increased by the development of methods of working which minimize wasted energy or useless motions; the installation of machines of a high rate of productivity; and the establishment of contract, piece rate, or premium systems to give the laborer a greater incentive.

METHODS OF WORKING

In drifting operations, it is preferable to provide two headings for each group of drill runners and muckers, so that the operations of drilling and mucking may occur on alternate shifts in each heading and the work of neither group of men will impede the progress of the other. The runners will then not be required to muck out a place in which to set up their drill columns (this being a useless handling of muck and additional time), and the muckers will not be called upon to pack drill steel or otherwise wait upon the runners and will not have to handle muck beneath the feet of the former. Where the time of progress of a heading is the item of importance, this desirable arrangement is not possible, and it then is necessary to seek other methods to reduce the interference of the two groups.

To avoid useless mucking on the part of the runners and to get the rock drills working as promptly as possible after the beginning of the shift, it is advisable to discard the vertical drill column in favor of the horizontal drill bar. The set-up of the latter may be greatly facilitated by the use of a tunnel carriage such as that shown by Fig. 1. Such a device may be constructed at any mine. The cantilever arm is made of a length sufficient to reach over the muck heap to a point where the bar can be jacked into position. If the drift is not a narrow one, the carriage need not be taken away from the heading after jacking the crossbar, but may be left attached to it, as the muckers will have room to work around and beneath the arm. As the arm, cross-bar, and drills are counterweighted by a sheet-iron box filled with heavy ore or iron castings, it is possible for one man to control the elevation of the equipment by means of a hand wheel working on a discarded feed screw. A swivel socket for the bar at the front end of the arm may be made from a drill column arm, and its clamping cap will permit the cross-bar to be adjusted laterally to the cantilever arm.

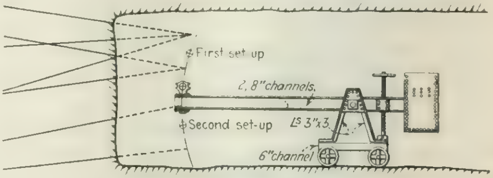

FIG. 1. DRILL CARRIAGE USED IN ADIT CONSTRUCTION

CORRECT MOUNTING OF DRILLS

The rock drills may be mounted directly on the cross-bar or may be mounted sideways on column arms which are mounted vertically on the cross-bar, thus giving a greater latitude for placing holes from any position of the cross-bar. Years ago, four 3½-in. reciprocating rock drills were operated successfully with such a mounting in a tunnel 11 to 12 ft. wide and 9 ft. high. In that operation, the drills were all connected by short lengths of 1-in. hose to a 2-in. pipe which ran through the counterbalance box, and a 2-in. hose was used to connect to the air line, so that only one air connection was necessary to make the drills ready to operate. The drills and cross-bar were always in position on the tunnel carriage, and when the heading was drilled up the jackscrews were loosened, the cross-bar was swung around parallel to the cantilever arm, the 2-in. hose disconnected, and the carriage run back along the track to a place of safety—a great economy of time and labor over the usual routine of disassembling and carrying a number of heavy pieces by hand.

In drifting, the rock-drill saddle and clamp is usually mounted on an arm, especially where a vertical column is used, and this arm is almost universally a casting of a fixed length which is clamped upon the column so that its axis will intersect the axis of the column. It is usually desirable that this arm should be of such length as to permit the column to be mounted in the center of the heading and yet allow the drill to be placed against the side walls when swung to either side. But as there is often a variation in the width of drifts, the result is that an arm is used which is too short, and either the side holes are drilled with too much spread (thus necessitating extra holes, "easers," using extra explosives and breaking unnecessary muck), or an extra set-up of the drill column is required. This type of mounting should be abandoned, in my opinion, in favor of a special cross-clamp (see Fig. 2) in which a pipe arm is fastened approximately tangent and at right angles to the drill column. This pipe arm should be of a length more than half the width of the usual heading, as its effective length may be readily adjusted by sliding it through the cross-clamp. It is also feasible to make this arm almost as long as the width of the heading, so that two drills may be mounted on it and the holes can then be planned in such a sequence that one machine would finish its side holes before the "easers." The arm could be shifted laterally through the cross-clamp, so as to permit the other machine being positioned for its side holes. Such a cross-clamp permits a mine to be equipped for drifts of various widths without carrying a reserve supply of the heavy cast arms of various lengths, providing it carries pipe suitable for making the pipe arms.

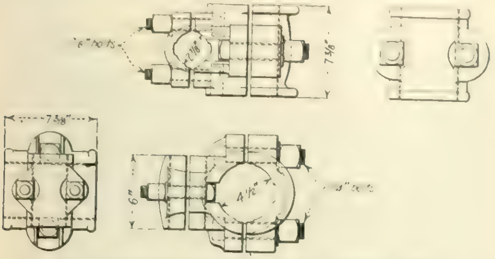

FIG. 2. COLUMN ARM CLAMP FOR ROCK DRILLS

For the heavy hammer-drill type of drifting machines, it is advisable to use 4½-in. outside diameter columns made from 4-in. extra heavy pipe, as smaller and lighter columns permit too much axial and torsional spring; but the arms can often be 2⅞-in. outside diameter made of 2½-in. extra heavy pipe. This decreases the weight of the arm and saddle clamp, which must be lifted by the runner with his machine when changing its elevation on the drill column.

STANDARD TYPES OF ROUNDS

At each mine experiments should be conducted to determine what standard types of drifting rounds should be developed to meet best the various conditions of ore, or rock, and of mounting. The problem is to insure that the standards are properly applied. Different operators have developed specially graduated cones or column fittings to indicate the angular direction of the drills horizontally and vertically, or have applied clinometers, protractors, or templates for the same purpose. However, have not these devices been largely of educational value in training the drill runners to realize the proper positions of their drills, and, once they have learned, is it not possible for them to measure the relative location and direction of one hole with another with no other instrument than a folding rule, by which they can estimate closely the proper spacing, convergence or divergence of the holes? It has been the experience of some that such accessory devices were only of temporary necessity and use, although of value in instituting the "blueprint" drill rounds.

It is of fundamental importance that in planning a round there should be no attempt to make it of greater depth than will permit of its being drilled and blasted by a crew of men working one shift, with possible overtime. This places the work on a unit task basis and obviates the tendency to "soldier." If the round is planned so that it requires work on a shift following its start, it is only reasonable to expect that the drill runners will run into enough difficulties to require virtually the entire second shift to complete it, or the remainder of the time available on the second shift will not be profitably spent because of the presence of powder smoke in the heading during regular working hours or because of the time lost in transferring the men to other work. Again, it is preferable not to divide the responsibility for the breaking of any round as would be necessary if another crew of men had to finish drilling and blasting it on the following shift. Where the task is a little too great to be completed in one shift when the runners must set up their columns and machines, it may be possible to overcome this difficulty by training the muckers on the opposite shift (where alternate headings are drilled and mucked) to set up the columns and machines, so that the runners then find it possible to drill up the round and blast in one shift.

EXTENSION POINTERS ON STOPERS

In raises and stopes where the air-feed stoping drills are used, it is possible to have a type of mounting not generally appreciated. This additional device is an extra extension pointer which slides within the direct air-feed cylinder and is locked by a gib and key wedge, cam, or various other devices. The only objection to this attachment is its weight of 7 or 12 lb. On the other hand, it permits an additional extension of the drill of 24 to 28 in., which permits the final drill steels to be run into the rock their full length without the use of a pile of blocking beneath the feed point (and oftentimes the use of such blocking is a hazardous and time-wasting practice). Also, if the extra extension pointer is partly extended when a hole is started, it is possible to use drill steels whose lengths vary considerably from the usual tolerances in a set, and the saving in steel which would otherwise be cut off in the blacksmith shop to change it to the next shorter standard length, when it has worn too short for its original length, may be great.

An economy in labor also results in the omission of a length of drill steel from the set, if it be broken or battered. It is therefore unnecessary to delay the work while a search is made for a steel of suitable length. This is possible if the extra extension pointer is retracted into the feed cylinder so as to permit this insertion of a longer drill steel. In raises, in addition to the foregoing advantages, the extra extension pointer permits the staging to be mounted on timbers wedged into the old bottoms of drill holes, regardless of the fact that they are slightly further from the face than would normally be desirable. This saves the time and labor which would be required to cut hitches or avoids the decided hazard of mounting a stoping drill on a pile of blocking on the staging. The extra extension pointer is strongly recommended for investigation by mine operators who are desirous of increasing the efficiency of their pneumatic-feed stopers.

The remarks already made about arranging a task in drifting which will be completed in a shift apply as forcefully to raising, but if two raises are available for a crew to work in, it is sometimes possible to get the same men to break a round in each raise within an eight-hour shift, especially if one of the two men does some work in the second raise when his pardner does not need help.

Better Rock Drills

The buyer must be discriminating, so as to encourage the manufacturer in the development of superior tools. Therefore, the mine operator should become familiar with the design, operation, and maintenance of the various rock drills and the requirements of a tool to do his work more efficiently. He should be willing to spend considerable time, money, and thought on this matter and should be free with his suggestions to the manufacturer, untainted by any motive other than the desire to obtain a superior tool. He is in a position that, because of his intimate contact with the work done by the drills, can bring material assistance toward the advance of the art; and he should be slow in concluding that the ultimate of excellence has been reached in design.

The manufacturer is surrounded by many commercial conditions which inhibit his desire to develop new and more efficient designs if he has a reasonably satisfactory market for his products. He has a considerable investment in the jigs, fixtures and stock of spare parts for the tools he is selling, and these will be wiped out by obsolescence if either he or his competitors market a superior design, and his financial loss may be great. His tendency is unknowingly to magnify the virtues of his products. Competition and the alertness of discriminating customers are therefore chiefly responsible for advances in the art.

Rock-Drill Manufacturers Challenged

With the hope that a free discussion may be provoked and a healthy outgrowth may result, operators may well challenge the manufacturers as to whether they have researched with sufficient pains into the fundamentals of mechanics upon which their rock-drill designs should properly be based. If so, the mining fraternity at large is not conversant with that fact, but has gained the impression that the development of drills has been largely by the "cut-and-try" method, combined with the application of ingenuity in the rearrangement of mechanisms. However, the tendency of keeping a watchful eye upon the mechanisms of a competitor, whose designs must therefore consciously or unconsciously tend to influence a new creation, is frequently present, and the resulting mechanism accordingly fails to be a distinct novelty in principle. As vigorous a refutation was made fifteen years ago as will now be made to this indictment, and yet at that time, some of the ablest and most experienced men in the manufacture of rock drills could not too strongly deride the possibility of the hammer-drill type of tool ever replacing in general work the old reciprocating type of rock drill. Nevertheless, it has done so, and with unthought-of benefit to mankind.

To be specific in setting forth inquiries, do the rock drill designers know:

1. What force and type of blows are best suited for drilling certain well-defined rocks and ores? This might involve knowledge of the modulus of elasticity and elastic limits of these rocks as well as their molecular inertia (or resistance to sudden deformation); also, the nature of the propagation of stresses through them and the limiting size of chips which could be cut by bits of a certain angularity without wasting energy in the needless crushing of material.

2. Do they know the amount of rotation of the cutting edges which should take place between successive blows, and have they provided for this?

3. Should the bit be against the rock when it receives energy from the drill, and, if so, what influence have various pressures against the rock upon the effectiveness of the drilling operation?

4. Have steps been taken to insure that the bit is away from the rock while it is being rotated?

5. Are the maximum number of blows per minute, effective upon a certain rock, limited by the resiliency of it, and what are they?

6. Can they define the energy which can be expended usefully upon the rock in terms of foot-pounds per inch of cutting edge; of course, different for various materials?

7. Have they studied the transmission of the vibratory compressional waves through the drill steel and the frequency at which these waves should be produced in order that the resultant initial and reflected waves should perform the greatest amount of useful work and so minimize the wasteful destructive energy evidenced by the heating and breakage of the drill steels?

8. Do they know the influence of the drill tappet on this sonic transmission of energy?

9. How can the amount of compression in the front end of the drill cylinder effect not only the nature of the piston blow but also the lingering of the piston against the drill steel so as to influence the nature of the reflected vibratory waves within it?

10. Can the nature of the vibratory waves be altered by a device on the drill steel or integral with the chuck bushing which will produce results analogous to a condensor or a choke coil as applied to the transmission of electrical energy?

11. Is it advisable to strike the drill steel with an accelerated blow or a decelerated one, and is it known as to which type of blow is present in various drills?

12. Have the instantaneous pressures in front and behind the piston been accurately measured, and how?

13. Are the instantaneous velocities of the piston known at various points in its stroke?

14. Have the sizes and lay-outs of the inlet and exhaust ports been determined by such studies of pressures?

15. Have similar studies been made of the action of valve mechanisms?

16. Has proper consideration been given in regard to the synchronization of the rebound of the air feed with the blows of the piston?

17. Has there been any fundamental research of the possibility of developing a method for drilling which would prove a radical departure from present practices? For instance, is it not practicable to combine some of the features of the Brandt hydraulic rotary drill with those of the diamond drill and the hammer drill and reduce the amount of chipping of rock by taking out a core at a higher speed than can be obtained by a diamond drill, because of the rapid hammer blows impressed upon the steel tube?

The art of drill designing invites scientific research, and it is decidedly advisable that such be initiated as soon as possible if this country is to remain in a position of supremacy in the rock-drill manufacturing and the mining industries. The task is not a small one, and so it should be planned as a joint co-operative effort of the manufacturers and the mines. It is fitting to place the sponsorship for such an investigation with a technical and disinterested body such as the U. S. Bureau of Mines. As the outcome of such research would be of general and national importance, its financing should be by the Government. It is hoped that sufficient interest will be awakened in the subject to bring sufficient pressure to bear upon the U. S. Bureau of Mines and Congress to insure the undertaking of such proposed research.

The advent of successful motor-rotated block-holding, sinking, and stoping drills may be looked forward to as a development of the near future which will greatly increase drilling efficiency. An advance has been made in the production of such a type of drifting drills, and in one mine the use of this type resulted in so great an increase in drilling speed as to permit two men with one machine to accomplish more drifting than was formerly possible with three men and two machines. This achievement refuted the thoughtless contention sometimes advanced by certain representatives of rock-drill manufacturers—that the machines had reached such a perfection that it was futile and unreasonable to expect more from them, and that the mine operator should devote his attention to obtaining a higher productivity from labor rather than ask the manufacturer for higher drilling speeds. It is true that the drills are actually running a small proportion of any shift and that an effort should be made to increase their running time, but such a condition does not lessen the desirability of obtaining tools of superlative drilling capacity. The manufacturer who puts into practice his contention to the contrary will find business drifting toward competitors with more liberal views.

The contention is often advanced that drill design has so far exceeded the quality of the drill steel that it is futile to expect greater capacity from the drills until the steel has been improved. Although much may be hoped for in the improvement in quality of drill steel, this fact should not supply an excuse for lack of interest on the part of the drill designer, for it is probable that with sufficient study he will find is possible to apply energy to the cutting of rock so efficiently as to perform more useful work and reduce the stresses in the drill steels and drills below their values at present, and to permit higher drilling speeds with no heavier tools than those now employed. The mining industry may hope for the future to bring forth motor-rotated stoping, sinking, and drifting drills of double the drilling speed possessed by those at present available, and with no greater weight or destructive effect on the drill steels.

The motor type of rotation is cited as the coming advance in accepted design, as it avoids the inherent disadvantage in the rifled type of rotation of the interdependence of the rotation and the hammer blows upon the steel. The difficulties of mechanical rotation applied to air-feed drills do not seem insurmountable, although the unfortunate experiences of some operators and manufacturers with such drills, as so far developed, may serve to delay their production and general adoption.

Another inhibitory influence is the tendency for some workers, and especially organized labor, to revolt against an increased productivity, regardless of the fact that more work could be performed with no more or with less physical effort. However, it is hoped that this tendency will soon be dissipated, as there is a growing realization that the extension of the use of efficient and economical mechanical devices does not adversely affect the interests of the worker but makes a greater income possible for him through his increase in productivity.

The problem of the improvement of drill steel is now in hand through the activities of a committee representative of the steel manufacturers, the drill manufacturers, the mine operators, and the oil interests—all under the auspices of the metallurgists of the U. S. Bureau of Mines and the U. S. Bureau of Standards. A general research board will be organized from representatives of the various engineering societies and commercial organizations whose interests are involved, so that this work may be concluded in the most thorough manner. It therefore behooves the drill designer to make haste in perfecting his knowledge of his tools so that he may co-operate in the advance of the art of drilling.

The Trend in Milling Practice

Improved Methods and Increased Efficiency Will Rule — Proper Utilization of High-Priced Stores—Intelligent Stepping-up of Initial Operations —Standardization Of Parts and Methods — Comparison of Recoveries — Comprehensive Reports

BY GUY R. RUGGLES
Mill Superintendent, Inspiration Consolidated Copper Co., Inspiration, Ariz.

DURING THE SUSPENSION of mining operations which occupied either all or a greater part of the year 1921 and in some instances part of the year 1920 as well, every mill superintendent has had a chance to meditate on his failings in the past and to make many resolutions as to better methods of conducting his business in the future. Though not attempting to prophesy on the events of the year 1922, it would seem that the following conditions should govern:

The mill superintendent of a large concentrator will undoubtedly have a skeleton of his former organization when operations are resumed. If he is in charge of a small concentrator, his organization will probably have been disbanded. In either event he will find that skilled concentrator labor will not be immediately available. Many of his former employees will have been forced by necessity to seek their livelihood in other industries. Little by little, however, new forces will be gathered together. Recoveries and costs will be adversely affected somewhat in the interim, but as much of the unrest caused by the war and its after effects will have passed away, it will not be long before operations resume their former smoothness, and results will return to the best performances of former years. Lower wages will prevail, but this will be offset by a decreased cost of living.

USE OF MATERIALS IN STOCK

It will be found that the warehouse shelves are crowded with the materials purchased under the stress and strain of the war and the resulting confusion following it. Large stocks will have accumulated. Much or all of this material will be higher in price than material which it will be possible to purchase currently. Many contracts made in 1920 will still be binding. In any event, this material should be used before new is purchased. Fortunate indeed will be the mill superintendent who finds his stocks low at this time. New purchases will carry much lower prices than those which have prevailed in the past few years, but, owing to excessive freight rates, prices will still be high when compared with the year 1913 and earlier.

Power conditions for 1922 will depend more or less on the source of the power. If it is derived from fuel oil, little relief in cost can be anticipated. Freight rates on oil may decrease, but present indications are that the price of oil at the wells will advance. Coal-fired plants should furnish cheaper power than formerly, owing to decreased freight rates and higher labor efficiency. Hydro-electric power from present installations should approach pre-war prices.

Although handicapped by reorganization, the mill superintendent will find this handicap a means toward economy. Operations will probably be resumed slowly and will be on a rising scale rather than on a fluctuating or decreasing scale, as in the years 1919 and 1920. Sub-foremen who were a necessity in a large organization and whose services were retained even during a partial curtailment will not be needed until operations have reached a point more extensive than they were when the shutdown of 1921 occurred. New combinations of work, which are always awkward and difficult to initiate while operating, will be made without difficulty. If possible, scattered offices, laboratories and sampling rooms should be gathered together, thus promoting efficient interdepartmental work and supervision.

In 1922, the time will surely be opportune for the installation of many automatic devices for the economy of labor, and, further than this, for the development of new ones. There are many different signal systems for summoning men. Bells, horns, lights, or whistles are all satisfactory if applied under the right conditions. For all-around satisfaction, however, the telephone is probably the best.

Pumping machinery will run with little attention, requiring oiling and inspection only at long intervals. Centrifugal pumps, used for raising solutions or water, are especially adaptable to automatic control. This can be accomplished electrically, by float valves, by admission of air to the suction or by a combination of these means. In pumping water it will often be found more economical to abandon, or to use as little as possible, many outlying, isolated stations and do all the pumping from a central station, assuming that the central station is better designed and equipped with more efficient machinery. Such a procedure will often be economical even under the condition of a higher lift from the central station.

INTELLIGENT HANDLING OF REPAIR WORK

The rapid handling of repair work is something that is always to be desired. Most large mills are equipped with cranes, either motor driven or hand operated, at least over the floors where the heaviest work is done. If the crane has but one hook for heavy loads, it will often be advisable to add a smaller hook, for fast work. It may be possible to install a crane here and there in a small mill. Of course these would not be power driven, or have a power hoist, but they would serve to move quickly the various parts of a machine to one side and to bring them back to place when the desired changes had been made. If the mill superintendent is not able to install a bridge crane, a jib crane may suffice or at least a crawl with a trolley. This is especially of value where it is necessary to reline ball mills in place.

Where mill supplies are handled in large quantity it will be advantageous to move them mechanically, or, if this is not possible, at a minimum of labor. In the absence of a mechanical or magnetic scheme for handling balls, it will be found that they can be transported long distances by rolling, in the concave side of a channel iron. This can be done with a small amount of slope, provided, of course, that the balls are not too heavily burdened with knobs and accretions. Flotation oils, wherever it is possible, should be carried from the supply tanks to the point of use by pipes. The transportation of oil in cans or barrels always results in waste.

To the mill operator, central control is probably of the greatest assistance in his work. It will be a help to him if the water valves which he constantly uses are conveniently placed, if he does not have to go too great a distance to regulate an air valve, and if a clutch or starting compensator which he is likely to use frequently is near to the scene of operations. These minor operations can often be accomplished by small changes in existing conditions. Such changes will help to keep the operator on the job where he can give the machinery under his care the best of attention.

CONSERVATION OF EFFORT IN SUPERVISION

Close supervision of operations at all times is important. The mill foreman is of limited endurance, and two complete rounds of the mill is often as many as it is possible for him to make in an eight-hour shift. Why could not escalators, which are so efficient in large department stores, be installed for the benefit of the mill foremen and others whose duties demand of them much stair climbing? If the shift foreman could thereby double his number of rounds, such a device would surely be worth installation. To a small mill such a scheme would not be practical, but it will often be possible to put in a new flight of stairs or rearrange the old ones in such a way that going from one part of the mill to another will be much easier.

Before ordering supplies extensively in the year 1922 every mill superintendent should look over the discarded material. All plants have scrap heaps, and during the years 1916, 1917, and 1918 these scrap heaps received large additions. This was probably from two causes; first, that a possible delay was assumed not to be worth the cost of the material involved; second, a shortage of labor which made it unwise to take chances on the use of old material.

In connection with the use of old material a second-hand warehouse will be of great value to many concentrators. Here should be collected the various odds and ends that are to be found scattered about every metallurgical plant. Gather up all the bolts, nuts, pipe fittings, and countless other small parts, which unless picked up are eventually lost. Possibly on some of these it will be necessary to do some work. Pile this material neatly and systematically so that it can be delivered at short notice. Assemble all the old pipe, and if encumbered with fittings, remove them, so that the pipe can be delivered as pipe. Structural shapes of all kinds should be salvaged and put in condition for future use. Discarded transmission machinery should be disassembled. Then, when a pulley of a certain size is desired it will not be necessary to spend two or three hours to find it and as many more to remove it from a rusty shaft.

In this sorting, much cast iron, brass, and copper will be reclaimed which can be recast into new shapes. In addition to general supplies many special parts will be uncovered which in many instances it will pay to reuse. In a large plant the ratio of the cost of a ball-mill lining to the labor involved in a lining change is large. A fair estimate would be about sixteen to one. Hence, if a set of liners can be salvaged and operated for a sixteenth of the ordinary length of life, the work done has been paid for. Very often pinions and gears are discarded with only one side of the teeth worn. If these are placed in the second-hand warehouse, and used whenever a call for a new one is made, the results will often be surprising.

SYSTEMATIZING AND CLASSIFYING SCRAP MATERIAL

After looking over the scrap heap, the mill superintendent should see if the storekeeper can be assisted in using some of the slow-moving and surplus stocks. Perhaps some of the mill superintendent's predecessors have had pet ideas with reference to hose, belting, flotation oils, balls, and the like. All of this material cannot be used at once, but little by little it can be turned to good account. Possibly the material in question may not meet the approval of the present superintendent, but if it is in the warehouse it has been purchased by the company, and much thought should be expended before new material is ordered when there is something on hand that will give satisfaction.

In a large concentrator, supplies are a bigger item than labor. The ratio will probably be about two for supplies to one for labor. Hence, though labor should not be wasted, the big economies will be made in material. During 1922 (and as far as that goes thereafter), it will behoove the mill superintendent to economize on supplies. The year 1922 should be a period of economical operation, and no item will be too small to merit consideration.

In the attempt to increase the life of material, an intelligent study of conditions should be made, followed by tests that have been carefully planned. Records should be kept of such tests. If the problem is the search for a grinding medium, be sure that ore tonnages are right and that the weights made from time to time are correct. Close co-operation with the manufacturers will probably lead to the development of steels fully as cheap as those used in the past and which will give far better results in pounds per ton. Studies of wear on the worn liners from ball and tube mills should be made, and from these studies new liners developed. Only in this way can metal be removed, or added to the liners, intelligently.

PROPER USE OF FLOTATION REAGENTS

If the problem is that of flotation oils or reagents, perhaps there are other combinations of oils that will do better than those in use. On the other hand, perhaps different percentages of the same oils will do better, not necessarily as to recovery but in devising a more economical mixture. In this work, one should make haste slowly, changing only one variable at a time and giving the new mixture a reasonable test in which to make its effect known. If quantities of oil are being investigated, conclusions should not be based on small daily measurements, but rather on the measurements of the main supply tanks over long periods. In some mills, belting will be the big problem. The majority of concentrators are probably over-belted. The belting should be studied as to widths and plies as well as for quality. Careful records should certainly be kept here. In a large concentrator it will pay to have one man devote either a part or all of his time to this study of the life of materials.

The standardization of material and machines is one of the most efficient aids to economical operation. This quickly results in fewer parts to handle, smaller stocks, and fewer kinds of machines with which operators must make themselves familiar. In general, the first thing to do is to get rid of as many "lefts and rights" as possible. Many times a bolt hole added, or some minor feature removed, will accomplish this. If there are a number of grinding mills on the job, see if the same size of bolt cannot be used, then make the scoops the same, then perhaps the liners can be duplicated.

Elevators, with their multiplicity of parts, are easy of standardization as to parts. If there are a number of different pumps, clutches, tables, filters, or flotation machines in the mill, ascertain which is the best, and gradually work toward one machine, eliminating the others. The conveyor, drive, and elevator belting should be studied and a small number of sizes determined as being necessary to carry. Much could be written on the subject of standardization, not only of material, but, if a company is operating more than one concentrator, of methods.

ECONOMY IN POWER

Economy of power in 1922 will have to be accomplished by economy in its use. First of all, keep every machine at capacity. The larger proportion of power in a concentrator is used in moving the machines. Under either heavy or light tonnage conditions, the power load approaches a constant. Therefore the largest tonnage on each unit in operation, consistent with the best recovery, will result in the lowest cost of power per ton and also per pound of metal recovered. Roller and ball bearings will probably become more of a factor in power transmission, and their use at places where much power is consumed is well worth investigating.

Attention should be given to lubrication. Avoid the use of belt dressing where possible. It not only damages the belts but it increases the power consumed. Wattmeters are invaluable. Every small concentrator using electrical power should have its total incoming power metered. For a large concentrator, more meters would be practical.

Assaying and sampling are of extreme importance. It is by these that the extraction of the desired metals is determined. One assaying method should be checked against another, as well as checking the technique and application of each method by check samples. The sampling should be done carefully and intelligently.

KEEPING OF RECORDS IMPORTANT

The keeping of records has been previously mentioned. This should be given the best of attention. The foremen should be encouraged to keep accurate data. Give them note books in which to jot down happenings, records of breakages, and their own personal observations. The official records, however, should be kept in the superintendent's office. Cards should be maintained on all the most costly items, such as conveyor and elevator belts, roll shells, and ball- and rod-mill parts, and this can be continued down to the smaller items, always remembering, however, that it is better to have a few records that are correct and used than many that are doubtful and neglected.

Whenever tests are under way, the foremen should be given an intelligent explanation of what it is hoped to accomplish. They will be able to offer many helpful suggestions to further the object of the test. Every mill superintendent should keep before him in his office plots of the principal daily results. In this way he can watch the fluctuations of the different factors far better than by scanning the daily reports. These curves should always be kept up to date.

Undoubtedly there will be many changes during 1922 for the installation of new machines. Improvements are constantly being made in grinding machines. The rod or roller mill is attracting attention. Interesting comparisons of air lifts with elevators are beginning to appear. Sand pumps are being improved in design. Screening devices have been making rapid strides. Coarse crushing machinery is being developed. From all this progress in the art, the mill superintendent will undoubtedly be able to pick some devices to lower his costs.

RECOVERIES SHOULD BE COMPARED

In the effort to reduce costs, the factor of recovery should not be overlooked. By this time the flotation process has been introduced into nearly every concentrator, but it is possible that it is not always applied correctly. Intelligent experimentation with the oils at hand or with new oils may reveal new possibilities. Are the water conditions for flotation correct? Will the use of additional reagents help or hinder the process?

The calculated recovery as determined from the assays of the feed, concentrates and tailings should be constantly compared with the actual recovery as determined from the assays and weights of feed and the concentrates. Such a comparison will often reveal discrepancies that seem unbelievable and which should be minutely investigated.

In the treatment of very low-grade material, much information can be derived from microscopic examination. A small amount of money expended in this manner may give a clue as to the condition of the mineral present and what process would be best suited for its treatment. In many operations such an examination might prevent the expenditure of larger sums where the chances of success are remote.

All portions of the plant engaged in recovering mineral should be closely analyzed to determine if each department is operating at a profit. If this investigation brings to light a money loser, see if the offending member cannot be brought into line.

Safety and cleanliness go hand in hand. The men should be educated in safety-first work and in hygiene. By the establishment of safety committees, the encouragement of safety suggestions, and the awarding of safety prizes, the former will be attained. By personal appeal to the men, it will be possible to attain the latter.

Last but not least, there should be the closest co-operation among all departments. The mine superintendent may not understand the effect that the presence of grease and sewage in the ore exerts on the flotation process. Then there is the effect of a varying head assay and the effect of ore from different stopes, levels or drifts on the recovery or grade of concentrates. The mine superintendent will have his problems too, but if the superintendents get together each will have a better understanding of the others' work and the general operations will be benefited.

Copper-Smelting Industry

Reduced Costs Simultaneous With Curtailed Production Are Impossible—Increasing Demand for Copper Imperative—Improvements in Receiving, Crushing, Roasters, Sintering, Reverberatories, Blast Furnaces, and Converters

BY A. G. MCGREGOR
Engineer, Warren, Ariz.

IN GENERAL, in the mining and smelting industry, low costs go with high production. It is impossible for the industry as a whole to meet the present situation by reduced costs and reduced production at the same time. The solution of the problem lies in increasing the demand for the metal.

The war had its effects upon the smelting industry, some of which will be permanent. It is well known that practically no other established pre-war industry has suffered as keenly in the transition from high-record production as has the copper mining and smelting industry. Then the profit was certain, and the problem was how to get the greatest possible production. Now the problem is not as simple, and apparently it will not be for some time.

The present situation has brought home forcibly the defects in the organization of the industry. It is now fully realized that copper has never been exploited to the extent that the best interests of its possible consumers deserved. Also, it is realized that in no other important industry has there been such a wide gap between the producer and the ultimate consumer.

At present the copper producers are in the same situation that the iron and steel producers would have been in if they had disregarded all responsibility for their products beyond the stage of producing pig iron and steel billets. Some of the copper producers are preparing to market finished products, just as the steel people do. Only by this policy, which is entitled to the full co-operation of all copper producers, can the industry be stabilized and fully exploited to the greatest benefit of all.

The war has undoubtedly caused a permanent change in the fuel-oil situation, with which the smelting industry in the Southwest especially is concerned. The smelting interests are confronted now with a permanently higher relative price for fuel oil than before the war, unless there is a marked change in the available supply.

This situation may make commercially impracticable the use of fuel oil in reverberatory smelting, which has been general in the Southwest for many years.

Though most of the copper-smelting plants were shut down nearly two-thirds of 1921, some plans for improvements have been made, and certain smelting-plant construction work has been carried on, notably the work on the Cerro de Pasco Copper Corporation's new plant in Peru.

Several copper-leaching plants are under consideration. So far, the use of furnace smelting methods has not been impeded by the introduction of leaching processes, but, instead, each has its own field of operation. How long this will hold true no one knows. It is safe to say, however, that important improvements will be made in both methods from time to time, for many years.

RECEIVING—SAMPLING—CRUSHING—BEDDING

In the receiving of coarse ores no particular development has taken place in recent years. A special machine has been constructed at the Garfield Smelting Works for excavating flotation concentrates from the flat-bottom gondola cars. This machine also automatically samples the concentrates in the unloading operation. A detailed description of this installation appeared in the Jan. 1, 1921, issue of *Mining and Scientific Press*.

The auger sampling, used for both flotation and gravity concentrates received at the International Smelting Co.'s plant at Miami, has been developed to a highly satisfactory stage for all concerned. The system of unloading and sampling used there operates at a cost of about 2½c. per ton of concentrates received. This system is being installed or planned for at several other plants.

For ore mined underground, gyratory crushers continue to be more popular than the Blake type as primary crushers. As primary crushers for ore from steam-shovel operations, large Blake type crushers seem to have the preference. For intermediate crushing and crushing to ½ in., opinion seems to be divided between Symons crushers and rolls. The Symons machine has advantages in floor space and head room occupied, which are sometimes a determining factor.

At the new Cerro de Pasco plant, horizontal Symons crushers will be used for the intermediate crushing, and rolls for the finer crushing. This practice will also be used in the crushing plant now being planned for at the United Verde Copper Co.'s plant at Clarkdale, Ariz., except that the vertical Symons is to be employed instead of the horizontal for the intermediate crushing. For screening, the flat inclined vibrating screens are taking the place of revolving trommels.

ROASTER FURNACES

There is a tendency to increase the number of hearths on roaster furnaces, which permits a lower limit of sulphur content of the charge before extraneous fuel is required. In the larger roaster furnaces, common red brick for hearths and linings has given way to the use of firebrick. On the hearths having drop holes in their outer circumference, there is a tendency to make these holes as large as possible, consistent with the strength of the hearth required at the drop holes. The center drop holes have the same effective area as the total area of the outer drop holes. Some of the special high-temperature bonding cements are being used with good effect in roaster furnace brick work. By the use of these cements, the furnace lining and hearths are practically converted into a firebrick monolith.

The heat in the calcine is being conserved by insulating the containing hoppers, and the hoppers and the transfer car bodies are being arranged to offer less cooling surface per unit of cubical contents. The practice of conserving heat in roaster furnaces by using a special insulating brick next to the outer shell is continuing.

Cottrell electrostatic treaters are gaining in popularity as a means for recovering the fine dust in roaster furnace gases. The Cerro de Pasco's new roaster plant is being equipped with tube-type treaters. Each roaster furnace has its individual treater overhead. The treaters are connected by a header, however, so that an treater may be cut out for cleaning or for repairs. The United Verde Copper Co.'s plant is being equipped with Cottrell treaters for all the furnace gases. In this installation three types of treaters will be used, the tube type, the Tooele type, and a modification of the Hayden type.

Progress is being made in reducing the dust losses incident to the transfer of calcine from the roaster furnaces and the flue dust to the reverberatory furnaces. This is being brought about by more efficient connections between car and the calcine or dust hopper from which the car receives its charge, and by more efficient means of venting the car.

SINTERING FURNACES

The Cerro de Pasco Copper Corporation expects to treat in its new plant a considerable tonnage of ore which will carry 2 per cent copper, 12 per cent zinc and 25 oz. of silver per ton. The ore will be smelted with other ores in the copper blast furnaces. The fines in this zinc ore will be sintered in Dwight-Lloyd sintering machines before being smelted in the blast furnaces. Ten sintering machines are being installed.

The arrangement of the sintering plant is much the same as found in lead plants. The fuel used will be powdered coal, which will be distributed to the various furnaces by the Holbeck system, furnished by the Bonnot company.

An effort has been made in the design of the building to get better ventilation and abate the fume nuisance usually incidental to the operation of sintering plants. The gases, after leaving the furnaces, pass through uptakes into cyclone dust collectors and then into downtakes to the fans. By this arrangement, dust will be removed and the gases will be cooled before entering the fans. Cooling the gases by increasing the length of pipe between a machine and its fan was found to be advantageous in overcoming trouble with the fan due to the condensation of sulphur on the runner, at one of the company's other plants operating on this ore.

REVERBERATORY FURNACES

Size.—In reverberatory furnaces, where large tonnages are smelted, the practice is to use furnaces 24 ft. wide, or wider, and 90 ft. long at least. From experiments which he conducted at the Copper Queen smelter in Douglas, Col. H. H. Stout advocates materially shortening reverberatory furnaces. The furnace of greatest width is at El Paso, the inside dimensions of the furnace there being 28 ft. wide by 129 ft. 6 in. long.

Skimming.—The practice of allowing the slag to run off continuously through a seal at the skimming door, instead of skimming intermittently as in former practice, seems to be quite thoroughly established in many plants. This system of skimming has effected a material reduction in slag losses at a number of plants. In certain properties using powdered coal having a particularly high infusible ash content, the exclusive practice of continuous skimming does not seem feasible. Also, in certain plants the slag track arrangement is such that continuous skimming is impracticable.

Waste-Heat Boiler Settings.—The arrangement of waste-heat boilers and the passages for the heated gases between furnaces and boilers, commonly used in the Southwest for oil-fired furnaces, has not been found well adapted to the use of powdered coal, especially when the coal ash is fusible. The header flue and the somewhat long and complicated connections tend to become clogged, requiring extra labor to keep them cleaned. Also, a lower heat recovery in the waste-heat boilers results, on account of the cold air admitted through the openings through which the work of cleaning out must be performed.

The United Verde Extension Mining Co.'s reverberatory furnaces were constructed to use oil fuel. Later it was decided that powdered coal would be the fuel used. A furnace with its waste-heat boilers, flues, and other appurtenances, as originally planned, was operated six months with powdered coal, and much trouble resulted from the clogging of the flues and connections between the furnace and boilers by fused ash and dust. Later, the boilers were raised and moved close to the furnaces so that the connection between furnace and boilers was short and direct. This overcame the former trouble completely. The slope on the bottoms of the connections is such that any sticky material dropping down between the furnace and boilers drains back into the furnace. The sticky particles passing into the boilers are cooled by the tubes and drop down as a dust into the hoppers below, from which the material is easily removed through doors provided for that purpose.

The furnace and boiler records show that with the original boiler setting the evaporation in the waste-heat boilers was 3.8 lb. of steam per pound of total coal burned in the furnace and the dryer at the pulverizing plant, whereas with the new setting the evaporation is 4.56 lb. of steam per pound of total coal burned, an increase of 20 per cent. Stirling type boilers continue as the favorite waste-heat boiler in copper-smelting plants.

Draft Control.—At Anaconda, C. R. Wraith and L. E. Jones have devised a sensitive regulator for operating the dampers situated at the rear of the waste-heat boilers. By the use of their system, a minimum draft is maintained in the furnace, which furnishes just the right amount of air for the best results in the combustion of the powdered coal fed to the furnace. The advantage of only a slight negative pressure in the furnace, together with the proper combustion mixture, is apparent, and this system of draft control has effected an important saving in fuel required for reverberatory smelting at the Anaconda plant.

Charging.—In connection with the charging from overhead hoppers at Anaconda, cast-iron water-cooled collars, set in the arch brickwork, are being used for the charge holes, with good success. A new method of charging reverberatory furnaces is being tried out on one of the furnaces of the Arizona Copper Co.'s plant at Clifton. This is described by J. O. Ambler, the plant superintendent, in *Engineering and Mining Journal* of Jan. 29, 1921. The charge is fed slowly but continuously through holes in the side wall, near its top, by means of screw feeders. This results in the accumulation of charge along the side walls, which slopes down and protects the wall. The new charge trickles down slowly over the slope and partly melts before it reaches the molten bath at the toe of the slope.

At the International Smelting Co.'s plant at Miami, work is under way to try out another side-charging method on a furnace there. On this furnace, the charge will be positively forced through charge holes in the side wall, down near the slag line, by means of a plunger. By this method, the charge will be bulged out in front of and above the charge holes, affording a protection to the side wall. The charging will be intermittent. Each charge will be forced underneath and back of the previous charge. In this way, each charge will gradually advance, step by step, toward the interior of the furnace. The oldest and hottest unmelted charge material in the furnace will be the fusing surface, directly exposed to the interior heat of the furnace, and the newest material in the furnace will be the coldest and will be directly against the side walls.

The present methods of charging appear crude indeed when it is realized that a comparatively cool, dusty charge is dropped through the furnace arch into the rapidly moving, highly heated gases of the interior. A cloud of dust rises in the furnace, the brickwork of the arch is fluxed away by this dust, and valuable dust is swept along through the furnace into the flues and boilers, where it is reclaimed with difficulty. Also, valuable dust is carried out the chimney, and the furnace is alternately cooled and heated, resulting in inefficiency. There is certainly room for improvement in charging reverberatory furnaces.

BLAST FURNACES

Charging.—The blast furnaces at the new Cerro de Pasco plant will be charged in the same manner as the furnaces at the Calumet & Arizona and United Verde Extension plants are charged.

Powdered Coal Substitute for Coke.—Encouraging results have been obtained in the Cerro de Pasco old plant with powdered coal as a substitute for coke. If the results obtained on ten-day runs can be maintained continuously, an important saving in the cost of fuel will result. The main sources of delay and interruption in this application of powdered coal have been in the lack of a dependable mechanical method of delivering the fuel to the furnace. For the best results, it is desirable that the fuel be always available at the many points of application, in whatever quantity required. At present a modification of the Holbeck air powdered-coal circulating system, which has been successful in plants having large numbers of comparatively small furnaces, is being installed and will be in operation soon.

Jacket Cooling.—A thermo-syphon cooling-water system for blast-furnace jackets has been worked out by Norman B. Roper, formerly with the Cerro de Pasco Copper Corporation, at one of that concern's older plants, and will be used on the blast furnaces in the new plant. The thermo-syphon cooling system will operate with a minimum of new make-up water, and in operation has been found thoroughly dependable, relieving the furnace men of worry about the possible failure of the jacket-cooling-water supply.

Hot Blast.—At the United Verde plant at Clarkdale, Ariz., the blast air for the blast furnaces has been heated to about 200 deg. F., for several years, by passing it through a system of pipes in the furnace tops before entering the furnace tuyères. Plans are now being made for an improved heating system in the furnace tops, whereby it is expected that it will become practicable to extract more heat from the furnace waste gases and materially to increase the temperature of the blast air entering the tuyères.

Sulphuric Acid as a Byproduct.—At Copperhill, Tenn., the smelting plant delivers about 90 per cent of all the sulphur contained in the ore to the acid plant in the form of SO_2 in blast-furnace and converter gases. The acid plants recover in acid about 92 per cent of the sulphur in the gases delivered to them.

REVERBERATORY VS. BLAST-FURNACE SMELTING

In the Southwest, the relative costs of fuel oil or powdered coal for reverberatory furnaces and of coke for blast furnaces are such that the reverberatory furnace has a decided advantage over the blast furnace. Under the conditions, and with the value of the waste-heat steam obtained in reverberatory-furnace operations, the advantage more than compensates for the extra cost of crushing and roasting required in reverberatory smelting.

CONVERTERS

Type.—Though at present more matte is converted in the so-called Great Falls type, or upright converter, it is my opinion that the majority of smelting-plant superintendents favor the barrel type, or so-called Peirce-Smith, type of converter. The American Smelting & Refining Co., in several of its plants, is using the large 13-ft. by 30-ft. Peirce-Smith converter. This is a rather large size for many plants, and where only one or two are operating, the demand for converter air varies through wide limits, causing a fluctuating demand for steam. Also, with high-grade matte, the use of the large converters results in large quantities of copper being finished from time to time, which practically necessitates the use of a tilting storage furnace or a refining furnace between the converting and casting operations.

The steam for compressing converter air is generally furnished by reverberatory waste-heat boilers, and there is often an advantage in keeping the demand for steam as uniform as possible. To accomplish this in the new Cerro de Pasco plant, and to avoid the use of a tilting copper furnace, the expedient of using more units of smaller converters is being adopted. A 12-ft. by 20-ft. Peirce-Smith converter has been developed, five stand of which are being installed.

Garr Gun.—The Garr Gun is widely used for feeding the siliceous ores into the Peirce-Smith converters. The operation of feeding the siliceous ores into the converters is usually attended with considerable hand manipulation and attention by the operator. In the new Cerro de Pasco plant, roller type feeders are used for feeding the ore from the overhead bins down through pipes into small, narrow, tapering hoppers, which at their lower ends curve into the ends of the converters, so that the ore will almost discharge into the converter without the aid of the air jet of the Garr Gun. In the operation of feeding in the siliceous ore charge, the attendant merely opens the gate in the hopper on the converter, admits air to the Garr Gun, and through a remote control starts the small motor which drives the feeder. The amount of the charge is measured by the length of time the feeder is run.

Converter Blowing Equipment. — Turbo-compressors have been used to some extent for furnishing converter air, but where they are steam driven, and where the value of steam is important, they have not been able thus far successfully to compete with the reciprocating type of steam-driven blowing engines in copper smelting plants. It seldom happens that fuel is found near copper ore deposits, and about the highest prices are often paid for fuel at the copper smelting centers of the United States. This, together with the fact that in copper converter plants the demand for air is quite variable, places the turbo-compressor at a disadvantage. At best the turbo uses more steam than a reciprocating engine at its rated capacity, and at partial loads the economy of the turbo falls off quite rapidly, whereas the economy of the reciprocating blowing engine remains nearly constant through a wide range in the amount of air delivered.

Converter Slag.—Converter slag is successfully granulated at the Tooele plant of the International Smelting Co. Where there is a shortage of base in the reverberatory charge, the full benefit of all the iron in the converter slag can be realized by mixing it in the granulated form with the charge. Only a part of the fluxing value of the converter slag is realized when it is poured into the furnace in its molten state. A converter-slag granulating equipment is being installed at the new Cerro de Pasco plant.

Copper Casting.—The practice of pouring blister copper from a tilting furnace into the casting machine has been common in recent years. However, the operation of the tilting furnace entails considerable expense, and where anodes are not required it will likely be displaced to some extent by improved casting machines permitting faster pouring from the copper ladle and giving bullion bars with fewer fins and need for chipping, all of which will contribute to reduced costs.

COPPER PRODUCERS WILL MANUFACTURE THEIR OWN COPPER SPECIALTIES

At present, interest in the process of producing copper, to most men connected with the mining and smelting industry, ends with the operations at the converter plant. Undoubtedly, in a few years, as intimated in a preceding paragraph, they will be concerned in the other processes through which it passes before reaching the consumer, and it is probable that a number of the larger copper producers will eventually manufacture their own finished copper specialties.

The reputation of copper has suffered in the past through the sale of defective metal. There is need for more exact processes in refining and for more uniformity in all the properties of the finished material. If it is not feasible to make a uniform finished product, the finished metal must be more uniformly graded and the various grades must be standardized. There is yet much to be learned of the possible alloys and their properties. For the best interests of the producers, close co-operation is required in working out these problems, to the end that the most suitable metal may be furnished for each of the various present uses and the added uses of the future.

The co-operation of the men of the smelting industry in its development and in its many problems of production has been proverbial. The logical continuation of this helpful policy will greatly hasten the solution of the industry's now apparent more vital problems, including the creation of a logical demand for their valuable product through a wider knowledge by the public of its true worth, and in providing facilities whereby those desiring it may be more efficiently served, both in respect to quality of metal and utility of manufactured article.

Current Problems

Licensing the Mining Engineer

Burden of Proof of Desirability of the System Rests on License Proponents Relation Between Mining Engineer and His Clients Not Analogous to That Governing the Individual in Public Service

By H. G. Moulton
Mining Engineer, New York.

THE MOVEMENT to abridge the individual liberties of the engineer through registration or licensing is a part of the general restrictive tendency of recent years. The trend being present, and accelerated by conditions prevailing during the war, only the stimulus of some specific demand was required to bring about the movement to limit and confine the engineer's liberty of action and technical status. This demand came in the beginning from engineers who felt that their compensation was not proportionate to their worth, particularly when compared with the compensation of skilled or unskilled laborers during the war. In casting around for some remedial measure, the trade union idea was seized upon, and it was thought that through restriction in numbers the law of supply and demand would operate to increase the engineer's compensation. The idea found ready support in legislative bodies because of the fact that state expenses were increasing faster than state revenues and the fees to be charged for registration or licenses would form a welcome addition to income.

LICENSING IS SPREADING

An excellent survey of the extent to which the licensing movement has progressed may be found in an article by B. B. Gottsberger in the November, 1921, issue of *Mining and Metallurgy*. Mr. Gottsberger's article is so thorough and so interesting that it should be read by all mining engineers, and no attempt will be made to summarize it here. Nineteen states now have laws regulating the practicing of engineering, and as the mining engineer commonly practices his profession in many states besides the one in which his office may be situated, he is affected by, and must be conversant with, the licensing laws of his own state and also those of other states in which such laws are in effect. He is, therefore, vitally interested in the existing situation, and should be even more concerned in the outlook for an extension of the movement into other states. The mining profession as a whole has given little thought to the spread of restrictive measures, and before the movement is extended to other states or becomes nationwide through the passage of a Federal law, it is necessary to determine our policy as a special class in the engineering profession and also to determine what, if anything, may be done about it.

In order that individual freedom, which is our most precious heritage and because of which our country has progressed so greatly, may be safeguarded and protected in every possible way, it is necessary to scrutinize every restrictive measure, principally from the standpoint of absolute necessity. The burden of proof should be on the proponents of every restrictive measure, and not on the opponents. Therefore, as mining engineers, in opposing licensing, are not on the defensive, both as mining engineers and as part of the citizenry of the country, we must be convinced that the value to the many is greater than the harm to the few before supporting such measures, or even before voluntarily consenting to their consideration.

The problems of other classes of the engineering profession may be somewhat different. It may well be that in theory surveyors or engineers who may be hired by the general public to determine land lines, boundaries of mineral claims or town lots, or even to plan or construct highways, bridges, or other engineering works for the use of the public, should be limited in their practice by state authority. With the mining profession, however, the conditions are entirely different, for the reason that mining engineers as a whole do not have the general public as clients, and the problem of the relation between the individual and the state, or the individual and the public as a whole, is not present, as with doctors, lawyers, dentists, or perhaps even certain classes of civil engineers. The latter professions also commonly serve people of comparatively small means and not in a position to judge for themselves as to professional qualifications. The mining engineer as a rule deals with a company, a financial institution, or an individual of means and standing, and the relation is one between competent individuals—in no way a proper matter for state concern or state control. In attempting to enter this field of determining the qualifications of an individual who will be employed by another individual competent to determine such qualifications, the state is therefore going outside of its proper function and the action is to be condemned on grounds of unnecessary interference with individual freedom.

MINING ENGINEER AND CLIENT COMPETENT INDIVIDUALS

It may be argued that the public as a purchaser of mining securities is directly concerned with the qualifications of the engineer. The answer to this is that the general public does not buy mining securities on the basis of engineers' reports; its opinions are formed rather on brokers' circulars, tips from friends, newspaper articles, and similar publicity, to the extent that they are formed at all. Interests desirous of selling unsound mining securities to the public need in no way be handicapped by requirements for licensing which are intended to prevent unqualified engineers from reporting on mining projects. Even if such licensing requirements should bar from professional practice the dishonest or incompetent engineer (which is not necessarily a sound assumption), the public may be supplied with what are only the opinions of some superintendent, manager, business advisor, circular writer, or anybody else who can be made to speak with a glib tongue on mining matters.

Aside from the large group to which we refer in vague terms as the general public, there is a class of small investors, few in number, who buy securities of sound mining companies issued or sponsored by reputable banking houses, and such investors undoubtedly give weight to the standing of the engineers reporting on the properties. However, they necessarily give as much or even more consideration to the standing of the banking house and to the management of the companies involved. The investor's protection in such transactions is that the banker who sponsors the security issues and recommends its purchase to his clients, and is the one who must judge of the qualifications of the engineer. The engineering report, being only one phase of the whole business problem, the investor who trusts the banker will trust the banker's judgment as to the engineer. Can anyone seriously believe that the type of banking firm which would place the securities of an Inspiration, a Utah, a Miami, a Braden, or a Chile would need the protection of a state license in its relations with the engineers reporting on the properties? To the banker, the licensing laws would be only additional nuisances, in that at times it might be necessary to determine whether or not some aspects of the licensing laws would prevent the use of extracts from engineering reports in circulars sent to certain states. Activity is not so pronounced in the field of new mining finance, or unemployment so rare among engineers, that our representatives in the state legislatures can afford to place even slight unnecessary handicaps on the business of placing securities.

MINING ENGINEER RECEIVES NOTHING FOR LICENSE FEES

Having established the point that the relation between the mining engineer and the client is normally one between competent individuals, and not one between an individual and the public, and therefore not a proper function for state control, it is unnecessary to argue as to the extent to which the state may find it possible to protect individuals by attempts to determine the qualifications of mining engineers. The state need not and should not do so; therefore there is no reason to argue as to the methods by which it might do so.

What will the mining engineer receive in return for the fees which he must pay to the state or states in which he may practice? Nothing. Mining engineers are chosen by their clients because of particular skill as executives, as consultants, or as technologists. More than in any other profession, the mining engineer must possess judgment, and this may or may not be acquired by education and experience. The investor seeking the services of a mining engineer, or the mining company seeking an executive, must judge the man's abilities by his record, and seek the advice of others familiar with his judgment. I am of the opinion that the investor will give just about as much weight to the framed license hanging in the engineer's office as he will give to his certificate of membership in the National Geographic Society.

The license or registration fee is therefore somewhat on the order of an occupation tax. It is on the order of an occupation tax, rather than an occupation tax, for the reason that it is, after all, only a tax on the use of the term engineer in connection with an occupation, and not a tax on the occupation.

To develop this thought further, consider on the one hand the general superintendent of a contracting firm engaged in the construction of a great public work. The superintendent directs labor employed in excavation, steel erection, concrete construction, and like activities. He is able to estimate costs, to handle men, to design and erect temporary structures, and even to lay out work and to establish points by the use of the chalk line, the level, the carpenter's square, the plumb line, and the steel tape. The difference between him and the engineer in charge of the work often is that the superintendent can do many things without engineering training or surveying instruments which the engineer does with such training and with the aid of certain special instruments. The further difference is that the superintendent usually has larger responsibilities and also gets much more pay. Is the engineer not already sufficiently penalized by lower remuneration without a further penalty in the form of title tax for the use of the term engineer?

DEFINING PROFESSIONAL ENGINEERING

The New York law defines a person who practices professional engineering as one who holds himself out as able to do or who does the work that an engineer does in planning, designing, and constructing, or in making investigations for proposed engineering projects. Note, therefore, that the definition revolves about the idea of doing or holding oneself out as able to do the work of an engineer. Many of the things that an engineer does are also done by the construction superintendent, the business man, the industrial executive, the financier and the credit man. They, however, do not assume the title of engineer, and therefore do not have to pay the title tax. Similarly a legislature might pass a law providing for an occupational tax on hardware stores, and if the definition of hardware store were similar to the foregoing definition of an engineer, only the title hardware store would govern. A department store might be engaged primarily in selling hardware, but if it avoided the term it would avoid the title tax.

VARIATION IN STATE STATUTES

The Michigan law appears to rest entirely on the question of title, stating that any person who represents himself to be an engineer shall be registered. The New Jersey law also uses a definition dependent upon title in that it defines professional engineering as the practice of the professional engineer who investigates or directs the application of the resources of nature to the use and convenience of man and who represents himself to be such an engineer through the use of the term engineer or the use of some other title implying that he is such an engineer. The Pennsylvania definition is practically identical with the one used in the New Jersey act. The Oregon law states that the practice of the profession of engineering embraces the design and supervision of the construction of public and private utilities specified in considerable detail, the design and supervision of mining operations and of municipal works, irrigation works, and similar projects. The execution of such works as a contractor, or their supervision by a foreman or superintendent for a contractor, is excluded, and as the superintendent of a large contracting operation is, after all, truly an engineer of the very highest grade, in that he directs labor, utilizes the resources of nature, and actually puts into effect the plans which the engineer initiates, the Oregon law, to this extent, discriminates against the use of the term engineer. The definition in the Florida law is very similar to that of the Oregon law, and makes the same discrimination as to a foreman or superintendent for a contractor.

WHAT MAY BE DONE ABOUT LICENSING THE ENGINEER

The conclusions stated suggest an interesting possibility in connection with the question of what may be done about licensing. If the engineer is to be taxed for the use of the name, is it not possible that under certain conditions he may operate freely without a license simply by avoiding the use of the term engineer? Let him call himself an industrial executive or a business advisor, and while operating as such executive or advisor why cannot he do the same things in connection with mining or smelting as others may do in connection with construction or operating factories; for what is mining but excavation, and what, after all, are metallurgical plants but factories? Why should the men who run a factory which extracts copper from ore be called engineers and licensed, and the men who mix the copper with zinc to form brass and later make the brass into various shapes be called by other names and not licensed?

For different classes of mining engineers the problem is, of course, somewhat different, but for the consulting engineer retained by a client to report on a proposed mining investment, the answer to the question of what shall be done about licensing may lie in the thought that one need not make the examination as an engineer but as a business advisor.

TEST CASE MAY BE NECESSARY TO DETERMINE EXACT STATUS

As an illustration let it be assumed that an investor asks a consulting engineer with offices in New York to go to some other state and examine a mine offered for sale. The consulting engineer is not licensed in the other state, and its laws forbid his practising engineering therein without a license. Therefore, he should go, not in the guise of a consulting mining engineer, but as a business advisor retained by the inventor for the purpose of judging a purely business and financial matter; that is, the advisability of purchasing and operating a mine. If the same investor were considering the advisability of investing in, say, a cattle ranch in Colorado, he could hire some man with expert knowledge in the commercial side of cattle raising and send him to that state to examine and report on the proposition. The investigator would not be called a cattle engineer and licensed accordingly. It would seem a proper function of the American Engineering Council to finance a test case by retaining a lawyer to handle the case for the first consulting engineer who would frankly ignore the licensing requirements of some state in which he was making an examination on the grounds that he was functioning as a business advisor rather than as an engineer. If this test case were successful, a later trial might be made by some operating mining company on behalf of one of its executives, on the ground that the law made an unfair discrimination between factory managers in metallurgy as compared with factory managers in other lines, or as between men in charge of excavation operations called mining on the one hand and superintendents or managers of contracting companies excavating for railroad cuts or doing other construction work.

Banks send credit men to investigate businesses in which they have or are asked to have a financial stake. Various types of financial institutions from time to time send experts to examine and appraise the operations of companies in which they are interested. Individual investors often send trained business investigators or advisors either to represent their interests or to advise them in connection with all sorts of transactions in which the investor has interests at stake. Why, then, should we, or why need we, assume that the position of the trained business advisor who investigates or appraises a business involving the operations called mining or metallurgy be put in a different class under the law and penalized for using the title of consulting mining engineer?

THE MINING ENGINEER BECOMES BUSINESS ADVISOR

If the foregoing logic will stand the test of the courts —and it should be relatively inexpensive to determine this if some consulting engineer will offer himself on the altar for a test case—the answer is clear enough as far as the consulting mining engineer is concerned. He need only leave his title of consulting engineer at home in the office, and then he may operate freely as a business advisor in all states regardless of license laws, provisions for reciprocity, or other regulations or requirements. For he is calling himself a business advisor, and doing the work of a business advisor, and is not bound by restrictions placed on the one who calls himself an engineer and necessarily does the work of an engineer.

THE ENGINEER IN COURT PROCEEDINGS

It would, of course, be necessary to give consideration to the possible effect of such action on the position of an engineer in court proceedings. If he is making an examination in connection with a matter which may involve litigation, and consequently faces the possibility of being placed on the stand as an expert witness, it would not be advisable for him to jeopardize his position by ignoring licensing requirements and abandoning his title of consulting engineer, as the voluntary abolition of the title might jeopardize his qualifications in the minds of the jury.

After all, it would be difficult for any individual engineer to take effective action in opposition to present or contemplated restrictions on his engineering activities. Each, however, can and should register dissatisfaction as strongly as possible through every available channel, in the hope that organized effort to render ineffective existing license laws so far as they affect the mining engineer and to prevent the passage of similar measures in other states and territories or in Congress may be developed later in the interests of the public in general and of the engineer, whether he be engaged in mining or other professional engineering, in particular.

Mining Prosperity and the Railroad Problem

Successful Operation and Development of Mines Essential to Roads' Well-being—Increase in Freight Rates Serious Contributory Cause of Inactivity—Railroad Transportation a Controlling Factor in Mining Operations

BY F. R. RAIFF
Traffic Manager, American Smelting & Refining Co., New York

ASSUMING that there can be no question that there is a close relation between the railroad problem and mining prosperity, let me illustrate by the recital of a recent occurrence: An important mining camp in a certain Western state faced serious difficulties from the reduction in metal prices, lower grades of ores, and increased mining costs, due to higher labor, fuel, supplies, and freight charges. Having reduced all these items, except freight rates, as far as possible, the mine owners approached the chief traffic officer of the railroad serving the community with a request for reduction in freight rates on their ores to the smelter, saying that with the reduction asked for they could continue operations. The railroad company, also facing increased expenses for labor, fuel, and materials, decided after full consideration that no reduction could be made. The mines closed down. The population of the community scattered to the four winds, and what had previously been a considerable city became a fair representation of the "Deserted Village."

RAILROAD OPERATION AT COST PREFERABLE TO DESERTED CAMPS

The traffic officer of that railroad stated afterward that he had figured the loss to the carrier in freight charges on the material and supplies for the mines and for the community, such as clothing and groceries, also the coal, coke and fluxes for the smelter in the treatment of the ores, and on the outgoing bullion, and had determined that it would have been better to have hauled the ores for nothing than to have suffered the closing of the mines. He added: "Never again will we allow a mine to close if any steps within reason which we can take will prevent it."

The railroads have had, and are having, their troubles, but some of their traffic officers did not realize soon enough the difficulties facing the mining industry. At the signing of the Armistice the prices of copper and lead were practically fixed by the Government (in the case of copper actually so at 26c. per lb. maximum). Production in this country was on a scale never before approached, with the Government taking nearly all of the production; hence, the suspension of hostilities in November, 1918, found large accumulations of copper, lead, and zinc in process at high costs, and a sudden and almost complete cessation of buying. The amount in process was much larger than normal, owing to the delays incident to the war work. Furthermore, at the earnest solicitation of the Government, production of copper was not immediately curtailed, this to avoid unemployment and as an aid to the general economic situation. Prices then dropped to less than half those obtaining in November, 1918, and today the price of copper is approximately 50 per cent of the maximum fixed by the Government, with lead and zinc at about the same ratio, whereas the freight rates are approximately 165 per cent of those of June 24, 1918.

After the operation of the railroads was taken over by the Federal Government, all freight rates were subjected to a general advance by the Railroad Administration. In June, 1918, came the so-called "general advance" of 25 per cent, some commodities receiving greater or lesser increases. Rates on smelter products advanced from 55 to 115 per cent and on these excessively increased rates were superimposed the general freight rate advances of August, 1920, amounting, on shipments from the Western mining states, to 33⅓ per cent. In some instances the rates of August 26, 1920, were more than 250 per cent of the rates effective before the advance of June, 1918. Among other commodities singled out for excessive advances was lime rock, used by the smelters for fluxing, the advances in some instances approximating 200 per cent or more.

As a result of these excessive advances, the industry sought new and cheaper routes for its products, and the equivalent of many thousands of tons of bullion on which the Eastern railroads had received satisfactory earnings before the increases was lost to them, a large part of the product moving from Montana, Utah, and Nevada to the Pacific Coast and thence via the Panama Canal to the refineries and the markets of the East at reductions of several dollars per ton as compared with the all rail rates. The revenues of the railroads were depleted by hundreds of thousands of dollars at a time when they were hungry for business, which was lost to them not so much through any action of their own as by the short-sighted policy of the Railroad Administration.

EFFECTING READJUSTMENTS DIFFICULT

After the railroads were relinquished from Federal control, their traffic officials immediately sought to correct the conditions thus brought about, but though the Government, by the issuance of a simple order, could advance the rates excessively and disrupt differentials that had existed for years, the process of undoing all this was not so simple a task. After several months of effort, the railroads are beginning to get their tariffs lined up so that there is some semblance of justice in the advances the mining industry will pay on its products as compared with those of other industries.

A review of the results of the readjustment process contains much of instructive interest. The rate on lead from Utah, Montana, and Idaho to Chicago is $15.30 per net ton, and has been since Aug. 26, 1920. At present, the water rate on lead from Spain to New York is approximately $4 per ton. (The rate from New York to Hamburg, Rotterdam, Havre, and British ports is $4 per ton.) The rate from New York to Chicago is $7.70 per net ton. The lead from Spain can move more cheaply into Chicago than that from our own intermountain country, and over 20,000 tons was imported during 1921. Also, a large tonnage was moved in 1920, much of it into Chicago territory and paying the import duty. Copper or lead from refineries on the Pacific Coast, including

Puget Sound on the north and South America, move to the Atlantic Seaboard via the Panama Canal at $6 per net ton, and then by rail or canal to Rome, Buffalo, and other cities, at freight costs less than from the intermountain territory, all rail, to the same destinations, or to Chicago.

During the recent period when rail transportation was undergoing so-called "standardization" at the almost total disregard of the effect on industry, there crept into the hastily organized central control many rules and regulations that were not competent for general application. Many of these rules are still being applied and are hampering the mining industry.

The standard industrial track contract is troublesome to the ore shippers, and when encountered is doing much to create distrust and a feeling that proper co-operation is not being accorded in an effort to develop new properties. For example, it is difficult to criticize the impatience of one mine operator for whom a carrier offered to construct a loading track. He was asked to deposit the cost of construction. The deposit was to be refunded according to the standard contract, at a rate of $2 for each carload shipped from the proposed track. The track cost was $1,270. The refund would have been accomplished when 635 carloads were shipped. The carrier's revenue from the 635 cars would have been $254,000, based on the published rates to the smelter to which the ore would have been consigned. That shipper cannot be made to see that the carrier really wanted to help him.

Though transportation service plays a vital part in the industrial life of the country as a whole, probably no industry is more dependent upon it than the mining industry. Generally the mines are far removed from manufacturing districts of the Eastern states, where practically all of the products of the mines are marketed, used, or exported. Most of the mining machinery, materials, and supplies originates in the manufacturing districts of the East and must be transported distances ranging from 1,500 to 2,500 miles to the mines, or substantially the same distance that smelter products are transported to refineries and consuming points in the East. There is no industry in the country that requires as much long-distance transportation as the mining industry, and for that reason transportation service and costs are controlling factors in the development and successful operation of mining projects.

ADVERSE CONDITIONS OF SMALL MINES

The prospector and small miner are operating today under adverse circumstances. Their properties may have favorable surface conditions, but it remains to be seen whether the orebody is of sufficient size and quality to make a successful project. The small miners are obliged to team their ore to the nearest railroad for movement to the most available custom smelter. Possibly the first ore is of sufficient value to cover the actual cost of mining and transporting it, but there are many instances when the early returns do not meet the outlay. On the other hand, the initial operations of some properties yield a slight profit, due to higher ore values, and in such operations development follows natural lines. However, it is the former, or low-grade surface properties, that are more numerous, and, for that reason, more important. In all such prospective developments rail transportation is the controlling factor.

This is especially true of low-grade properties. Any fractional increase in freight rates on low-grade ore curtails production, and if the increase is substantial it will completely stop the production of such ores. For illustration, if a certain district is mining 2½ per cent ore, which requires from 45 to 50 tons (depending upon the metal recovery) to make one ton of bullion, and there is an increase of 25 per cent per ton in the rate on ore, with no corresponding increase in the price of the refined metal, controlling factors of profitable production are equivalent to an increase of $11.25 to $12.50 per ton in the cost of bullion, or over ½c. per lb., which might in turn wipe out all profit and result in an actual operating loss. As a rule, transportation and the development of mines are so closely related that the railroads could well afford, as a business proposition, in prospective cases, to co-operate to the extent of hauling the ore at cost, at least until the early and unprofitable development work is completed and the mine is established on a sound basis.

MINING OPERATIONS PRODUCE BACK-HAUL FREIGHT

Following the early stages of development, and even after the property has reached the stage of large production, the element of transportation costs continues to exert a marked influence on mining operations. The importance of this fact is emphasized when one considers that each ton of base metal produced represents an inbound movement of tonnage far in excess of that weight. In other words, it often requires from three to eight tons of inbound materials and supplies, exclusive of ore and concentrates, to make one ton of smelter products.

As a striking illustration of the extent to which the production of base bullion involves heavy movement of collateral tonnage, one of the prominent copper companies uses eight pounds of materials and supplies inbound, exclusive of ore and concentrates, for each pound of copper produced, and even the companies with the lowest operating costs and most favorable grades of ore use as high as 3½ tons inbound, exclusive of ore and concentrates, for each ton of copper. The movement of this enormous tonnage and the cost of transporting it are vital factors, not only in the prosperity of the mining industry, but to the prosperity of the carriers as well.

Without reasonable and fair freight rates and adequate service the mining industry cannot hope to thrive. The bare cost of transportation alone on the materials inbound and copper bullion outbound from Western smelters to refineries in the eastern part of the country represents from 25 to 35 per cent of the existing market price of copper. To state it another way, it costs from 3½c. to 5c. per lb. for transportation alone to deliver one pound of copper from the Rocky Mountain territory to the consuming territory adjacent to the Atlantic seaboard.

The railroads are really partners in any successful mining enterprise, and are the chief benefactors, without incurring financial risk. The mining industry of the country creates an enormous amount of traffic for the railroads, which ranks with the most desirable and profitable tonnage that they handle, due chiefly to heavy loading, minimum transportation risk and claim hazard, and ordinary dead-freight service. If transportation costs are excessive, production is necessarily curtailed, because these costs are reflected in the price of the metal and consequently in the use of it. On the other hand, if transportation costs are maintained on a workable basis, the conditions thus created are likewise reflected in the price, which is made more attractive and creates increased uses for the metals.

The general industrial activity during the years of the war brought such a demand for metals that all the efforts of the industry were bent toward production. Mine development, usually carried on concurrently with production, was greatly curtailed. In all districts mines were depleted. When the demand suddenly ceased and prices were depressed, continued production was possible only under lower costs. Many mines could not afford the continued high labor and other costs, particularly when expensive development work was necessary, and were forced to close. Practically all of these mines are still inoperative. Their resumption of operation is dependent not only on metal prices but on lower production costs. When their problem is solved that of the ore-carrying railroads will, in a measure, be solved.

Resumption of work by the mines means greatly increased tonnages and revenue for the railroads serving them. Ore rates are principally based on the value of the ore—"the smelter returns to the mine or owner before deducting freight charges." These rates have, with few exceptions, been increased 62½ per cent since June 24, 1918. The lower grades, those under $15 per ton, have in many instances been readjusted to a basis 125 per cent of the rates in effect June 24, 1918, but the miner cannot increase the value of his product nor the metal content of his ores, and increased costs for fuel, labor, freight rates, and supplies make unprofitable the mining of even the higher grades of ores that formerly yielded a fair profit. An increased ore production would mean to the railroads increased revenues on ores, coal, coke, fluxes, fuel oil, bullion, and all those supplies required by a prosperous community.

Copper, lead, and zinc ores and their associated metals occur in deposits distributed throughout the world, and many countries produce the refined metal in large or small quantities. There are probably no basic commodities produced in the United States which meet with greater competition in foreign markets than these metals. The surplus production of the United States goes to Europe and to Asia in competition with this world production, which is produced principally contiguous to the seacoast and has the advantage of low-cost water transportation.

At present the rate on copper, lead, and zinc from Montana or Utah to the Pittsburgh district is $15.90 per ton, though the same product can be delivered at a lower charge via the Pacific Coast to Japan, Germany, France, or England. The South American producer ships his copper product direct to Europe or to New York at the present time for $5 to $7 per ton, while our own Western producers pay $16.50 to New York refineries.

The consumer in Antwerp or Rotterdam gets this copper from the refineries at New York today at a freight cost of $3.50 per gross ton, which is 30c. per ton less than the rail rate from the same refineries to Philadelphia or Trenton. Copper shipped from the refineries at New York or Baltimore to Rome, N. Y., a large consuming point, pays from 60 to 130 per cent greater freight cost than is paid from the same points to Liverpool, London, Antwerp, or Rotterdam.

In Interstate Commerce Commission "64 I. C. C. re Grain, Grain Products and Hay," Commissioner Potter, in his concurring opinion, said:

> "The fundamental trouble with the industrial and commercial affairs of the country is that there is insufficient production and costs are too high. The latter is the cause of the former. Production in this country at the present time is far below normal needs. If normal conditions could be brought about, the industries of the country could operate normally for a long period to take care of the markets of this country, to say nothing of the markets in other countries. Normal operation of the country's industries would furnish employment to labor generally, revive markets, and increase the general buying power which the country needs. A reduction of production costs is essential to this result.
>
> "Freight rates are an important element of manufacturing and production costs. Railways are the carriers and conveyors which bind together the different departments of the great national industry in which the finished product of one individual industry becomes the raw material of another. In a large country like ours, with its long hauls and wide distribution of producing industries, it is obvious that the freight burden in its relation to other cost factors must be stable. A disturbance of the proper relation of the cost factors is bound to affect industry and may force changes and relocations which impair the general public and private interest. Until within the last few years the tendency of the factor of transportation cost in relation to other factors has been downward. Recently it has been upward, and it is now out of proper relation to other factors. Rates must be gotten back to the proper relation to other things. They must come down, and whatever is necessary to bring them down must be done."

How Should a Mining Engineer Be Trained?

Mining Engineering Covers the Broadest Field—Technical Mining Curricula in Throes of Experimentation—Selection of the Student Material Difficult—Cultural Subjects Desirable—Metallurgy Should Be Included

BY ALLEN H. ROGERS
Mining Engineer, New York

THE TRAINING of the mining engineer is the subject of much discussion at present, not only among educators but by the practicing members of the profession. Among the educators, the motive is mainly what to teach in the time available; among engineers the discussion is based on the feeling that technical school graduates are not properly equipped for entrance into the practice of the profession. It is generally felt that most of the graduates cannot successfully apply, in practice, the knowledge they have acquired in school, and that they have not enough of the culture and general information which the dignity of the profession requires. The schools do not graduate finished mining engineers; they turn out what may be called engineers in embryo, who require a period of apprenticeship before they become full-fledged engineers.

The field of mining engineering is the broadest of all of those comprised in the divisions of engineering. Mining engineering is the application of science to the extraction of mineral substances, and in its practice the mining engineer is called upon to apply at one time or another the principles of all the specialized branches of engineering. When it is considered that the mining engineer, as manager of large operations, must also specify equipment, build railroads, plants, and towns, and operate them, it is easily comprehended that there is no branch of science which, as applied, is known as engineering, that the mining engineer cannot, with advantage, master.

Naturally, within a field so broad, there is much specialization in the practice of the profession. The economic geologist devotes himself to untangling the complicated processes of ore deposition or to tracing the structure of a petroleum pool. The metallurgist interests himself in smelting, leaching, or milling. Among mining engineers, in the popular acceptation of that term, there are specialists in placer mining, coal mining, and what not. Some of these specialists, particularly geologists, train from the beginning as specialists. Many, however, become specialists through practise in some one branch of the profession.

The mining engineer should possess a knowledge of geology and of general engineering combined with business and executive ability. Geology and engineering are based on the fundamental sciences of mathematics, physics, and chemistry. Business and executive ability are likely to be in proportion to the knowledge possessed of economics, sociology, and facility of expression. As a professional man, the mining engineer should also possess that culture which comes only with a knowledge of literature, history, and art. It is therefore apparent that the problem of educating the mining engineer is an important one. It must be more difficult than that of teaching any other branch of engineering, because it includes the fields of nearly all of them. Any problem existing in the teaching of other branches of engineering must exist for mining also.

Some years ago, certain national societies joined in forming a committee for the study of engineering education. This committee found the task beyond its capacities, at least for the study the subject merited. At their solicitation, therefore, the Carnegie Foundation appointed Prof. Charles R. Mann to study the subject, and his report is issued as "Bulletin 11" of the Carnegie Foundation. This report has been generally commended by engineers as a masterful discussion of present methods and conditions and as offering a wealth of constructive criticisms and suggestions for improvement. For some reason, hard to determine, its acceptance by teachers of engineering has not been so cordial. To one who desires to pursue this subject extensively, no better introduction is available.

Comparison of Mining Curricula

More recently a study of mining engineering education has been made by a committee of the Mining and Metallurgical Society of America. Its report embodied a comparison of the time devoted to the various branches by different schools. The comparison was made on a percentage basis, and was confined to those schools devoting four years to the course, so that the figures might be approximately comparable on the basis of time.

The comparison was made under fourteen different headings. It disclosed a most extraordinary diversity of conditions, as a study of the accompanying table, summarized from Mining and Metallurgical Society "Bulletin 150," will prove:

DISTRIBUTION OF TIME ON PERCENTAGE BASIS IN TWENTY-FOUR AMERICAN MINING SCHOOLS (CURRICULA GENERALLY OF 1919–20)

	Average of All Schools	Average of Those Specifying Subject	High	Low
Mathematics	10.5	10.5	16.8	6.1
Physics and mechanics	9.2	9.2	13.2	4.0
Mechanical drawing	4.6	4.6	8.6	2.8
Chemistry	11.0	11.0	15.7	7.3
Geology and mineralogy	12.5	12.5	17.7	4.3
Engineering economics and history	7.2	7.9	18.8	2.0
Foreign language	2.6	5.8	7.9	3.8
Surveying	2.7	3.3	7.4	1.0
Civil, mechanical and electrical engineering	11.3	11.3	17.9	7.1
Mining engineering	11.1	11.1	19.1	4.4
Metallurgy and ore dressing	10.9	10.9	18.4	4.4
Thesis	1.0	2.4	4.3	1.0
Physical training, military drilling	3.1	5.0	10.5	2.3
Electives	2.3	6.1	20.4	1.3

Of these schools, two required no English; thirteen, no foreign language; fifteen, no thesis; nine, no physical training, and fifteen allowed no electives. There are also three which include no instruction in surveying, but require it at a summer school. The table, therefore, shows averages for all, as well as averages for such schools as specify the subject. It should also be stated that the "low" figure takes no account of the schools which do not include the subject in the curriculum.

As the amount of time devoted to a subject reflects the view of the faculty as to the emphasis placed on that subject in the education of the mining engineer, it is rather astonishing to note the wide variation between the high and low figures. A comparison of the figures of nineteen courses in metallurgy indicated similar conditions. Incidentally, no great difference between the courses in metallurgy and those in mining engineering was apparent.

It must be concluded from such a study that mining engineering education is still in the experimental stage, and it would appear that, generally speaking, the experiment is not being conducted in accordance with the principles taught by the very schools that are experimenting. In research, we are taught that we should know the materials with which we start, observe the conditions under which the experiment is conducted, varying one at a time, and make careful observation and record of the result. Engineering schools have not, in the past, observed these requirements in their experiment on education.

Admission of Engineering Students

The only measure of the candidate's ability in the institutions covered by the investigation was the entrance examination, which, it is now admitted, indicates only a part of the student's ability and gives little clew to his real bent. As to methods of instruction, they change little. The course in mathematics made mathematicians. The course in chemistry made chemists. But none gave clearly the clew of their relation to engineering. Even in many engineering subjects prescribed, the mining engineering student found no reference to mining structures. Such methods have resulted in an overwhelming proportion of failures. Professor Mann states that of students entering engineering schools, over 60 per cent fail to graduate. No corresponding figure is available for mining engineering students, but it is certainly as large. The result clearly indicates a serious defect in the methods of determining admission or in the methods of instruction or both.

Furthermore, I know of no systematic record of the attainments of the graduates. The men of outstanding prominence in the profession naturally reflect much credit upon the schools which educated them, but all schools can count such eminent engineers among their graduates. If we had a way of determining, after some years, an average grade for the graduates of the schools, there might be some clew to the best curriculum or the best school among the variety summarized in the foregoing table. Such is, however, apparently impossible. At any rate, it has probably never been attempted, and so, at present, out of all the experiments there is no measure of which is giving the best result.

Clearly, the problem is difficult, not only of solution, but difficult in devising means of solution. In its present state, it is one to which, apparently, only cut-and-try methods are applicable. There is no law known which can be applied to boys to determine whether they will make good engineers or not, nor can one say, off hand, that this method of instruction will give better results than that. But many are at work on both phases of the problem. In the endeavor to discover the particular bent of a boy, most colleges are now using tests which have been devised as a result of increasing knowledge of psychology. They are admittedly experimental, and, as yet, in no way supersede nor even, it is believed, supplement the regular admission examination. It will take a long time to evaluate these tests—whether they really mean anything or not—but by the limited standards of comparison so far available it is thought that their result will be to save many from spending several years in the study of a profession in the practice of which they are bound to fail. It is sincerely to be hoped that such may prove to be the result. Engineering schools, although many, are overcrowded, and every ill-adapted candidate who can be eliminated assures improved conditions for the student who is a born engineer.

ADVANTAGE OF PRACTICAL INSTRUCTION METHODS

Regarding instruction methods, there is even less of theory on which to base an investigation of results. It is self-evident, however, that, for example, in the study of mathematics the student will be more interested if he learns the processes while working out a practical problem. Every one remembers with greater ease that which interests him than that which does not, so what is needed in instruction is to incite the student's interest. If the student really desires to become an engineer, he will take more interest in a subject if he applies his knowledge of that subject to an engineering problem, thus seeing its application, than if he does not. It should not be difficult to devise means of doing this in instruction in the sciences, and, indeed, it is being done to an increasing degree. In the study of English and other cultural subjects, it is more difficult, but even these are being successfully brought into line.

The underlying problem of the schools is, then, to select from the candidates offering themselves for admission boys who have a natural interest in engineering and to teach what is taught in a manner that will make the student realize that he is making progress in fitting himself to become an engineer. Apparently, this is now thoroughly appreciated by school authorities generally.

Most of the schools give a four-year course. Engineering schools were founded by colleges or college-trained men, so it was natural that four years should be selected for the course. Economic considerations will probably influence the determination of time also. The average boy is ready to enter college when eighteen or nineteen years old. Adding four years to this brings him to an age when he should become self-supporting. Of course, many boys do not have to consider this factor, and then, too, many support themselves in whole or in part during their college course.

THE FIVE- AND SIX-YEAR COURSES

There are some institutions where the time varies. The usual engineering school year is from thirty to thirty-four weeks (not counting required summer work), making 120 to 136 weeks for the course. The Michigan College of Mines divides a similar number of weeks into three years. On the other hand, at Columbia University six years are required. The first three years covers studies, not only of subjects "considered fundamental in the study of engineering, such as mathematics, physics, chemistry, and the first courses in drafting and mechanics, but also such subjects as English, modern languages, history and economics," to quote from the publication of the school. On the completion of the three-year program and the first year's work in the Engineering School, the bachelor degree is awarded. With the completion of the further two years of work, the degree of Engineer of Mines is awarded. Thus, the school is distinctly a graduate school on the same plane as schools of law and medicine. A somewhat similar plan has been adopted at Stanford University, and Harvard has a five-year course, with, however, the difference that the work of the fifth year is in extension of the usual four-year course. Another course in what is known as mining engineering and business administration requires five years for completion. Encouragement for the success of such plans may be found in the increasing number of students who, after a classical course in college, either completed or in part, enter engineering schools. At the Massachusetts Institute of Technology, this year 38 per cent of the students are from other colleges, chiefly of the academic type. It would also appear desirable that a boy who finishes high school at or under the average age of about eighteen and a half, and who has not yet "found" himself (few boys at that age have), should continue his education along the purely cultural lines offered by the usual academic course. This gives him an opportunity to crystallize his ideas as to the vocation he wishes to follow, and, if engineering, he will be much more likely to undertake the necessary studies with the requisite earnestness and understanding. For the type of student noted, for the slow plodding boy who, though not brilliant, remembers what he learns and so finishes high school late but satisfactorily, and for boys to whom the financial burden of any absolutely unessential years would be impossible, the four-year school will always have a place. A great many colleges have the advantage of Government support, and it is doubtful if public sentiment, so long accustomed to consider the period of higher education as four years, could be influenced to favor six or even five years. It would appear, therefore, that the standard course in mining engineering will continue to be four years. There is room for the six-year course where the school is part of a great university, but there will be many students from other colleges who will choose the school of engineering giving the four-year course.

Other things being equal, the location of a mining school in the heart of a large mining district should be an advantage that requires no argument. The ability

To keep the student of other branches of engineering in constant contact with the kind of industrial operations he is learning to conduct is regarded as a great advantage by some and has resulted in such systems as that of the University of Cincinnati, in which the students work in neighboring industrial plants as part of their course. A somewhat similar course in electrical engineering is offered at the Massachusetts Institute of Technology. There may be some question, however, as to the length to which such a policy should be carried, for the object of engineering instruction is not to turn out skilled artisans and too much valuable time could be devoted to the bench and the lathe or, in the education of mining engineers, to running a drill or framing timber. On the other hand, there is no gainsaying the advantage to the mining student of being able to observe mining operations and taking part in them to some extent. Even those institutions far from mining operations require that time shall be spent at mines either at summer schools or as an employee. This, of course, follows the laboratory system of instruction, which has always been a feature of American technical schools.

In view of the broad field covered by mining engineering, there is probably no situation that would not lack some essential feature. Furthermore, as the field covers elements of all other branches of engineering, the general engineering school with liberal facilities for instruction in all branches of engineering offers advantages which offset those of situation possessed by the small mining school in a mining district. At any rate, that is the condition now. Whether the time will come when a great mining school with all the facilities will grow up in some mining district cannot be foretold. Mines are worked out in time, whereas the mining school will go on forever, so that even such a school might lose its advantage.

As to methods of teaching and what to teach, the first part of this question involves problems in pedagogy which I will not attempt to discuss. The endeavor, however, should constantly be made to make instruction more objective. What to teach within the limited time available in four years is another serious question. As indicated at the beginning, there is no item of engineering knowledge which a mining engineer cannot with advantage possess. Those of us of many years' experience can recall an almost limitless variety of problems which have come before us for solution. Some we solved easily; others with much labor. None would have stumped us if we could have looked up the necessary data and had the fundamental knowledge requisite to understand them when found. There is the gist of the whole subject—the fundamental knowledge requisite to understand a reference. It is hopeless for any but a few among us mining engineers to be finished railroad engineers, power engineers, mechanical, electrical or chemical engineers. But we should have the groundwork on which we can erect ourselves into temporary railroad, power, or any other kind of engineer, as the occasion arises.

THOROUGH INSTRUCTION IN FUNDAMENTALS

Instruction, then, in the fundamental sciences, mathematics, physics, and chemistry, should be thorough, and, as previously argued, as "practical" as possible. For mining engineering students almost any kind of engineering example will be useful, but it is important to make the use of the fundamental knowledge clear. The examples need not be many. A list of type examples, carefully selected throughout the fields of civil, mechanical, electrical, and chemical engineering, will give the student the knowledge of how to approach the solution of any problem. The principal thing is to teach him how to apply the fundamental laws—in other words, how to think.

For the mining engineering student, the important subjects in geology are the process of ore deposition and the structure of ore deposits. There is no need that he be made an expert in mineralogy, petrology, or historical geology. These are important in their field, but in consideration of the time schedule, only such stress should be laid on these subjects as will contribute to understanding ore deposits, their form, and the processes of deposition of the ore minerals. Contributory to this is, as with general engineering subjects, a knowledge of physics and chemistry, with the ability to work problems in descriptive geometry.

Another consideration will influence the choice of subjects to be taught, and that is the practical one of giving the graduate an equipment that will make him worth a salary immediately after graduation. It goes without saying that some description of mining and metallurgical operations must be given, although the need for this decreases where the opportunities of the student for observation of actual operations are many. He must have a picture of what mining engineering aims to accomplish, the special problems it faces, and the way in which some of them have been solved. He cannot be fitted to attempt solution of any such problems on graduation. He cannot at once plan or take charge of operations, but must fill some subordinate position such as assayer, surveyor, sampler, or other minor job. It is, therefore, desirable that instruction of the student include practice in commercial assay and chemical methods, surveying and mapping, and mechanical drawing. Furthermore, with few exceptions, graduates in mining engineering must generally accept whatever job may offer within the field.

INSUFFICIENT CULTURAL SUBJECTS

Finally, everybody is agreed that engineering students do not get sufficient instruction in such subjects as English, history, foreign language, economics, sociology, and law. It is generally recognized that the attempt to teach these subjects entirely detached from the technical courses accomplishes nothing. There are two reasons for this, the principal reason being the lack of interest on the part of the student, and the subordinate one the lack of time to do justice to courses in any of the subjects. But here again, as with general science, methods are being worked out to teach these subjects co-operatively with engineering subjects. Instruction in English, for example, may be continued throughout the course by requiring the submission of reports and exercises to the English department for review and discussion.

Engineering may be termed commercialized science. An engineering project is not warranted unless the product is worth more than its cost. Thus, the principles of economics are fundamental to engineering. History, sociology, and law are subjects a knowledge of which is of the utmost importance to the manager of a mining enterprise. Opinions as to the desirability of instruction in foreign language differ widely. The possession of the ability to speak and write a foreign language, particularly Spanish, is unquestionably an advantage to the mining engineer. It is questionable, however, whether the limited time in the four-year course permits of elementary instruction in foreign language. Such is properly a part of the preparatory school curriculum. That the student may keep up the knowledge so acquired, however, the engineering school can properly devote some time to the reading of scientific articles in a foreign language.

It seems to me that the keynote in outlining a four-year mining engineering curriculum should be less specialization and more fundamentals. Furthermore, the curriculum should be designed to form the foundation for the practice of both mining and metallurgy. It is only with extension of the course to five or six years that specialization should be permitted. Practice of mining engineering in its fullest sense is inconceivable without such knowledge of metallurgy as will determine the disposition of the ore. In other words, metallurgy is a specialty in the field of mining engineering, and there should be but one curriculum for the four-year course in mining engineering.

When the mining engineering student is graduated, he fancies himself a mining engineer, although he is not. He is encouraged in this belief by the fact that the degree has very likely conferred this title on him. This is unfortunate, and schools conferring the degree of Mining Engineer should change their practice, even in the cases where the degree is the result of six years' work. Bachelor, Master or Doctor of Science in Mining Engineering would seem to be the proper designation.

THE MINING ENGINEER'S CAREER AFTER GRADUATION

The job offered to the mining engineer on graduation, if any, is likely to be as assayer or surveyor at a mine or smelting works. Possibly the only opening available may be as a laborer. Many believe that some experience at shoveling or at pushing a car underground is a desirable feature of the young mining engineer's apprenticeship. In my belief, the most desirable positions are those of assayer or surveyor. The position of assayer gives the apprentice engineer, as we may now designate him, the opportunity to learn the characteristics of the ore, its sampling in the mine, its metallurgy, and its realization. As this comes to him naturally in carrying on his work, the knowledge and experience are never forgotten. In the position of surveyor, the novitiate has the opportunity of observing and discussing the development layout, the stoping method and progress of the work in all its phases. He will, at the same time, be using his geological knowledge and he will gain a good deal of information as to methods of handling men through observation of results attained under the conditions of the particular organization. A man who simply works as a laborer underground has an extremely limited horizon. He is likely to get so physically tired that his mental processes are dormant, and his close association with men mentally and morally his inferiors can only result in lowering his standards.

The first years of the young mining engineer's experience are likely to be trying, under any circumstances. Here is the young college graduate, with, perhaps, his character hardly formed, thrown into rough and uncouth surroundings, with few influences for refinement and culture—perhaps none. Maybe now the conditions are not quite as bad as they used to be. Looking back at the old-time mining camp, it is marvelous that the boys who went to the dogs were so few. Anyway, the older engineers should encourage their young subordinates to keep up their moral standards and to stimulate their interest, not only in the technique of the work, but in good literature, economics, and the political happenings of the day.

Means for physical exercise are an excellent influence. A tennis court costs little, compared with the benefit it confers in affording means of venting some of the physical exuberance of young men who are otherwise prone to give it expression in dissipation. The larger mining companies are realizing the benefits resulting to them by provision for such activities, and so provide club houses and libraries, tennis courts, and golf courses. For smaller operations also such a policy should be carried out, even though on a smaller scale.

Department of Mines and Its Effect on Taxation

Excessive National Debt and Consequent Taxes Best Met by Development of Latent Resources—Population Increase Requires the Pushing Back of Frontiers of Public Domain—Department of Mines With Cabinet Representation Essential to National Progress and Development

By SAMUEL D. NICHOLSON
Senator, State of Colorado, Washington, D. C.

ALL WARS ARE COSTLY and leave in their trail huge debts and interest charges to be paid by the generations that follow. The need for immediately increasing national revenue to meet these pressing obligations, leads first to the formulation of tax laws which impose the burden entirely upon the incomes of the people and on going industry. Little thought is given to the development of national assets, such as the natural resources of the public domain from which revenues may be derived to lessen materially the tax burden. Yet in times past the expansion of development upon the public domain has proved of vital assistance not only in reducing taxes and liquidating war debts but also in bringing about our phenomenal industrial growth and a condition of general prosperity.

The people of this country have at no time been confronted by such a heavy burden of debt and interest as that which now exists. The interest-bearing debt increased, in round numbers, from $1,000,000,000 in 1913 to $24,000,000,000 in 1920, and the annual interest charge from $23,000,000 to $1,000,000,000. The per-capita debt increased from $10.66 in 1913 to $288.63 in 1920, and the per-capita annual interest charge from $0.24 to $9.55. The revenues to meet these interest charges, sinking-fund accounts, and current expenses for government maintenance and operation are now practically all derived from taxation, a crushing load for our people and industry to carry under present conditions.

EXPEDITING DEVELOPMENT OF LATENT RESOURCES ESSENTIAL

Attention may well be directed to the public lands with a view to expediting their development and thereby increasing the direct revenue to the Government. Exclusive of public domain set aside for national parks, national monuments, Indian reservations, Carey Act withdrawals, and the Territory of Alaska, there are 200,300,000 acres of unappropriated land and 154,142,000 acres of forest reserve still owned by the Government. This total of 354,442,000 acres represents about one-fifth the area of the United States, and is more than eight times as great as the area of the New England States and nearly double the area of the thirteen original states of the Union.

Alaska, practically all public domain, is in area about one-fifth that of the United States. There is in public lands, therefore, an area equal to 40 per cent of that of all of the states in the Union, rich in agricultural, stock raising, timber and hydro-electrical power resources, coal, oil, copper, lead, zinc, gold, silver, potash, phosphate, and many other minerals, to be developed. These unappropriated public lands and forest reserves are situated in thirty-three states and in the Territory of Alaska, which indicates how broadly they are distributed. Any program to assist the discovery, exploration, and development of these resources will benefit not only the Government but also the many states in which the lands are situated.

President Harding, in his address to the Congress of Dec. 6, 1921, made the following reference to the public domain, indicating how seriously he considers the necessity for expediting the development of these natural resources:

> "Under what is known as the coal and gas lease law, applicable also to deposits of phosphates and other minerals on the public domain, leases are now being made on the royalty basis, and are producing large revenues to the Government. Under this legislation, 10 per cent of all royalties are to be paid directly to the Federal Treasury, and, of the remainder, 50 per cent are to be used for reclamation of arid lands by irrigation and 40 per cent are to be paid to the states in which operations are located, to be used by them for school and road purposes.
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> "These resources are so vast, and the development is affording so reliable a basis of estimate, that the Interior Department expresses the belief that ultimately the present law will add in royalties and payments to the treasuries of the Federal Government and the states containing these public lands a total of $12,000,000,000. This means, of course, an added wealth of many times that sum. These prospects seem to afford every justification of Government advances in reclamation and irrigation."

A general conception of the value of the resources of our "national estate" may be gained from the estimate, presented in the recent report of the Secretary of the Interior, of a minimum ultimate value of $150,000,000,000. Based upon the mineral and oil leasing laws, the eventual revenue derived from royalties in the development of the mineral resources is estimated at $12,000,000,000. In this estimate, the realizable value of the timber, agricultural, and hydro-electrical resources of the public domain is not included. The estimated value here presented must be conservative, because it does not take into account the value of mineral discoveries yet to be made in an area which so far has only been superficially prospected. And no one can estimate the additional revenue yield that will result as general industrial activity expands, as it must, with the creation of new wealth.

During the last thirty years, the population of the United States proper increased about 43,000,000. One of the best assurances that any proposal to expedite the exploration and development of the resources of our public lands will be successful is the future increase in our population. Not only will man power be available to perform this work, but the increased demand for the products of the soil and mines, occasioned by this increased population, will create a home market to absorb the increased production. In fact, how will it be possible to satisfy the demands of the increased population unless the frontier of our public domain is pushed back by expansive development, making available these natural resources?

The problem, therefore, is not only a matter of lessening the tax burden by otherwise increasing governmental revenue, but also of meeting the requirements of a growing and progressive nation. The wealth of our public domain is chiefly mineral. As the total anticipated income to be derived from the sale of desert and semi-arid lands, grazing lands, and grazing and forage lands included in the public domain outside of the national forests, and grazing lands, timber, and other resources included in the national forests, is estimated at $1,310,000,000, while the income from royalties to be derived from the development of coal, oil, oil shale, phosphate, and potash, is estimated at $12,387,000,000, it is apparent that the problem of realizing upon these resources is almost exclusively one of mineral development.

I have previously shown the need at this time for a Department of Mines to insure the progress of our going industry by developing operating improvements as world competition becomes more keen, to study the subject of marketing as specifically applied to the products of our mines, to study the problems of the coal industry to avert public suffering when the machinery of production and distribution for any reason breaks down, by better co-ordinating the present governmental activities in the mining industry to render a more extensive and constructive service, and, finally, in providing a Secretary of Mines as a member of the President's Cabinet, who could devote his time exclusively to the solution of the many complex problems confronting the mining industry, and who could assume, on behalf of the administration, the responsibility of all matters pertaining to mining. I wish now to urge the importance of creating a Department of Mines, that the development of our "national estate" may be expedited as an effective means of lessening the tax burden, in addition to other advantages. It is well known that the present tax burden is exerting, and will continue to exert regardless of the system employed for its levy, a repressive influence upon industry and initiative. The development of revenue from these sources of new production, converting as it does a dormant resource into an active, national asset, is a constructive enterprise.

The bill which I have introduced, S. 1957, which provides for the creation of a Department of Mines with Cabinet representation, is designed to accomplish the best results in the development of the mineral resources of our country.

Legislation and the Mining Industry

What National and State Law-Making Agencies Have Done and Can Do To Benefit or Hamper Development and Prosperity of Mines Need of Protection for the Gold Producer — Creation of Department of Mines Warranted by Importance of Industry

By M. C. Rhodes
Chairman Committee on Mines and Mining,
House of Representatives,
Washington, D. C.

WHEN PRESIDENT HARDING, in his inaugural address, declared for more business in government and less government in business, he struck a high chord in the minds of the American people. The President evidently meant to warn Congress against the passage of such laws as impose hardships upon the individual citizen and the business world, and did not say that legislation necessary to encourage the basic industries of the country was not justified.

The development of the national resources of the country is one thing, and their conservation is quite another. We often hear the expression that our resources are unlimited, but, as a matter of fact, they are limited. Therefore, it is the plain duty of Congress to safeguard the welfare of the nation by aiding the economic development of our mining resources and their conservation, because the supply at hand must serve both present and future generations. Our country has grown from a mere handful of people, in the thirteen original colonies, to a population of 105,000,000 whose present needs far exceed those of the past; and with an ever-increasing population, the wants of the future will correspondingly multiply.

What legislation can do for the mining industry in the future can best be judged by what it has been doing in the past. By act of Congress, the Bureau of Mines was established in 1910 for the purpose of scientific research and experimental work in mining and metallurgy and to reduce the number of mine accidents by aiding, in an advisory capacity, the mine operators of the country in working out their safety problems. Coincident with this every state in the Union interested in either coal or metal mining, and not then having a department of mining, promptly enacted a code of mining laws. Through the operation of our state and Federal mining laws, the number of mine accidents in recent years has greatly diminished, the death rate among working men has been reduced, working conditions have been made more easy, and their health has been improved.

By a well-directed system of instruction and education carried on by the Bureau of Mines, workmen and operators have been taught how to avoid accidents, and have been brought into a closer relationship, the result of which has had a large influence in creating the nation-wide movement in all industries with respect to greater human safety. There were fewer fatalities in mine accidents in the United States in 1920 than in any previous year.

The United States Bureau of Mines during the Great War assisted the development of the radium industry in the United States. Prior to 1914 no radium had been produced in this country, and up to that time we had been dependent upon Europe for our supply. In 1914, the National Radium Institute was founded by Dr. Howard A. Kelly, of Baltimore, and Dr. James Douglas, of New York City. The Bureau of Mines entered into a co-operative agreement with the National Radium Institute for the purpose of making a scientific and technologic study of the recovery of radium from carnotite ores. Dr. R. B. Moore, of the Bureau of Mines, took charge of the work. Up to that time, large quantities of radium had gone to waste in the production of metallic vanadium and uranium salts.

A plant was established at Denver, leases were obtained upon lands in Colorado, containing radium ores, and by 1916, when the books of the National Radium Institute were closed and operations discontinued, 8½ gm. of radium had been produced, worth today over one million dollars. The Government's share of the amount recovered was 2 gm. Of this amount, the Bureau of Standards has about one-half a gram, and the Bureau of Mines has one-half a gram, now in the laboratory of the Mining Experiment Station at Reno, Nev., where further experimental work is being carried on upon radium and other complex ores. Of the remaining amount, the Bureau of Mines loaned about one-half a gram to Dr. Howard A. Kelly, of Johns Hopkins University, and one-half a gram to the Memorial Hospital, of New York City.

Up to Jan. 1, 1921, 115 gm. of radium was the total amount produced in this country. As a result of the impetus given the radium industry through the new discoveries made by the Bureau of Mines, and the dissemination of the information thus obtained by the publication of certain bulletins on the subject, private enterprise became interested in the matter, and today American manufacturers are producing ample radium to meet our requirements. In fact, the United States is producing more radium than all the rest of the world.

OIL-SHALE INVESTIGATIONS

Another example of what legislation can do for the mining industry is shown in the experimental work now being carried on for the recovery of oil from shale and the elimination of waste in the handling of petroleum and its products by the use of scientific methods. Oil experts are of the opinion that our reserves of petroleum will be exhausted within the next twenty-five years. If this becomes true, we will be forced to look to other sources for our supply. It has been determined that shale oil can be successfully recovered from the Colorado and Utah shale at an approximate cost of $3.50 per bbl. Geologists are agreed that large deposits of oil shale are situated in Colorado and Utah. Oil experts hold that the potential supply of shale oil exceeds the supply of petroleum. If this is a correct view, the only remaining question to be considered is how to bring the price of production down to a reasonable figure.

It is true, from a practical standpoint, that no market can be found in this country for shale oil at $3.50 per bbl. so long as petroleum can be obtained at $1.50 per bbl., or at any other price below the cost of producing oil from shale. However, Scotland has produced shale oil for seventy years, and is producing it today, at a cost of about $4 per bbl. None is produced for export, the entire amount being used for domestic purposes.

Experiments are now being made for the recovery of oil from sand, tar, and asphalt in the hope that, as the supply of petroleum is depleted, a process may be worked out by which oil may be recovered not only from shale but from these other sources. It is thought that the possibilities for the recovery of oil from oil sands are equal to the possibilities of recovering oil from oil shale.

Under the operation of the recently enacted oil-leasing law, the Government has provided a force of expert oil men to take charge of the oil-leasing stations in Colorado, Wyoming, California, Oklahoma, Texas, and Louisiana. These men go into the field and assist, in an advisory capacity, the more inexperienced operators in the bringing in of oil wells, so as to avoid as much waste as possible. The oil operators, like the coal and metal-mine operators, welcome the assistance the Government is rendering in this respect.

Another instance of what legislation has done for the mining industry is in the operation of the Pittman Act, which became effective April 23, 1918. Under this act, the Secretary of the Treasury is authorized, through the Director of the Mint, to purchase silver produced by the silver mines in the United States at the fixed price of $1 per oz. delivered at the mint, either in New York, Philadelphia, or San Francisco. Though the American silver miner has not received less than $1 per oz. for his silver since the passage of this law, foreign silver since April 23, 1918, has sold for less than 50c. per oz. Had it not been for the existence of this legislation, American silver would possibly have gone as low as 50c. per oz., and this would have resulted in closing practically all the silver mines in the United States in 1919. The effect of closing the silver mines would not only have thrown thousands of men out of employment, but would have also reduced the gold supply, as there is a recoverable amount of gold in many silver ores.

Briefly stated, legislation is conserving our forests, reclaiming arid lands, propagating rare seeds and plants, stimulating industry, and making life worth while.

So much for what legislation has done. Now, let us turn to what legislation can do for the mining industry. On account of the alarming reduction in our annual output of gold since 1915, there has arisen a demand in some quarters for legislation to increase the price of gold. The total gold production in the United States in 1920 was 50 per cent less than the 1915 production. Our 1920 production was 2,395,000 oz., being a reduction of $10,000,000 over the preceding year, and if it had not been for the abnormal importation of gold into the United States during the last three years, our gold reserve would have been reduced to the danger point.

During the recent period of high prices gold was the only commodity that did not advance in value, though the price of labor and material increased from two- to four-fold. In fact, every factor entering into the cost of producing gold increased, the price of gold remaining fixed at $20.67 per oz. Many Western gold-mining operators assert that on account of this fact they have been compelled to close their mines permanently. This situation gave rise to the introduction of the McFadden Bill, proposing an excise tax of 50c. per dwt. for a period of five years upon all gold going into the fine arts.

The Treasury Department does not look with favor upon the proposed legislation, upon the ground that the effect would be to disturb the gold standard by raising the price of gold from $20.67 to $30.67 per oz. Friends of the bill contend that the legislation is justified as a temporary measure, at least, to revive the languishing condition of the gold-mining industry. Recent reports from California, Alaska, Colorado, South Dakota, Montana, and Arizona indicate the industry urgently needs rehabilitation. Unless there is a decline in the cost of producing gold, it will be necessary in the near future to enact legislation of some kind in behalf of the gold-mining industry.

Gold mining is not a casual industry, and cannot be intermittently suspended and resumed without serious interference with production. It is a well-known fact that the high-grade gold-ore reserves are being rapidly exhausted, and unless science can open the way by which the gold content of low-grade ores can be successfully recovered, the time is near at hand when legislation must be enacted to relieve the unfavorable condition of the industry.

Those who oppose change in the existing law should be reminded that the downfall of empires and republics in the past has been brought about by failure to meet new conditions. The virility of this Republic lies in its ability to meet by legislation the new and ever-changing industrial and economic conditions. The decrees of ancient Venice were considered irreversible. One writer in speaking of the laws of the Medes and Persians in their day said, "They altereth not, neither do they change." That condition does not exist in our Republic. Our growth and development have been brought about by the law of evolution. Growth, development, and expansion are made possible by the law of healthy change.

Another question related to the proposed gold bonus legislation should also be mentioned. Under existing law, there is nothing to prevent the destruction of gold coin for use in the arts. In 1919, $80,337,600 worth of gold coin and bullion were sold by the United States mint for use in the arts, of which $3,500,000 consisted of gold coins of various denominations. In other words, five-, ten-, and twenty-dollar gold pieces were actually melted up and destroyed. It is estimated that at least $8,000,000 in gold coins were thus destroyed in 1920.

Another important fact in connection with the use of gold in the arts is that the gold production in this country in 1919 was $21,848,000 less than the amount consumed in the arts and manufactures in that year. Congress has no right to prevent by law the use of commercial gold in jewelry and industry, but Congress should prevent the destruction of gold coins for such purposes, and legislation to accomplish this is before that body.

Last but not least, in the consideration of legislation necessary to stimulate the mining industry, is the creation of a new executive department to be known as the Department of Mines. It is entirely inconsistent with the importance of the mining industry, in the light of its contribution to our whole economic structure, to relegate the indispensable function of government (as is true today with the Bureau of Mines) to a small department in a secondary Cabinet office. Our total output of mineral wealth in 1920 was $6,707,000,000. With one-half of the world's output of coal, iron, and steel, and of many other mineral and metal products, are we not entitled to a Department of Mines in the President's Cabinet?

Editorial

A Quiet Circumspection

WE LOOK BACK over the most lethargic year in mining which we have seen in our generation. The reaction from the stimulus of the World War has rested heavy upon us; and the convalesence of the world has been as slow as the devastating fever was sudden and fierce. We recall what Hoover said recently in Washington, that Europe was doing about as well as a wounded man could be expected to do; and that he believed that legislation and governments should apply disinfectants, and leave the patient alone; that it was no time to apply poultices. What Hoover said of Europe applies pretty well to the United States; and we need to be treated gently and left alone as to legislation, rather than that a stimulation should be attempted, to set up an artificial strength which the patient is not yet able to maintain. Many of our troubles have been legislative troubles; but one of them, the excess-profits tax, has happily been recently abolished.

Undoubtedly we are one year nearer the resumption of mining activity than we were at the time of our last New Year's number, yet the rise of the curve, though unmistakable, has not yet been striking. Copper, lead and foreign silver stand at about the same prices as a year ago, and zinc is decidedly lower. The lesser mining industries are sleeping as soundly now as they were then. Only the gold industry has worked into a decidedly improved position, on account of the constant lowering in cost of supplies and labor. For the moment, gold mining should absorb all our surplus mining activity. Gold properties should be purchasable at reasonable terms, and operation should show a steadily increasing profit. Though this is true of the gold mines of the United States, which suffered most during the war, the rise in dollar value of the pound sterling, from 3.53 to 4.20, has wiped out a considerable part of the "premium" enjoyed by the South African mines, whose prosperity has dwindled accordingly. Also, the rise in Canadian exchange, from a discount of Canadian currency over United States currency of 17 per cent discount to 4 per cent discount, nearly wiped out whatever advantage Canadian gold mines possessed a year ago, in selling their gold in the United States.

In the copper situation, it is probable that much of the scrap which came from the wreckage of war, and which so paralyzed the market for new copper, has been absorbed. Yet, despite the shutdown of a large portion of the producing mines, the copper stocks have been by no means used up; and some of the operating mines, like Chile Copper, have been keeping on at a loss. The fact is that the consumption of all sorts of metals and minerals is moving back very slowly indeed toward healthy conditions. For example, the stocks of tungsten now in the country, accumulated during the later days of the war, will last the country at the present rate of consumption for three years, without further domestic production or import. Of little use, then, to worry about legislation regarding tungsten mining. And this is typical of general conditions.

Resumption in building activity is very slow; the housing shortage has not been remedied. The railroads are still doing a very slack business. Times are hard with the farmers, for the prices of food supplies have fallen; hence there is altogether little buying power. Industries which are an index of prosperity, like the automotive industries, are having fairly hard periods of adjustment.

Yet the general symptoms are those of progressive recovery. Not only have the exchanges of Great Britain and Canada moved in the direction of parity, but the French franc, whch was worth only 5.8 cents a year ago, has advanced to 8 cents; and Italian lire have risen from 3.40 to 4.20. Thus the solvent European nations are recovering. On the other hand, the mark has dropped from 1.30 cents to 0.53 cents, emphasizing the progress of the bankrupt European nations toward the inevitable reorganization. The forthcoming European economic conference should help this. Despite her further depreciated currency, German trade has increased, and in 1921 she bought three times as much copper from us as she did in 1920.

The Limitation of Arms Conference has accomplished a good deal toward the securing of that future peace which is the prime requisite toward prosperity; and we may look forward to a period of peace both with Asia and Europe. The solidarity of the United States and Great Britain evidenced by the Conference was one of the most satisfactory signs. At the same time, political turmoil is not yet at an end, especially for Great Britain, as evidenced by Ireland, India and Egypt.

The buying power of the world has been paralyzed by taxes which have been imposed to meet the cost of war. One cannot spend a dollar for taxes and also spend it for commodities. And a large part of these taxes go to meet the interest on debts incurred in the war; and the repudiation or failure to meet national debts, such as those of Russia and Mexico, has more or less permanently engulfed large portions of the world's productive capital. The Limitation of Arms Conference promises us the first step in the direction of a cessation of tax increase; we even have in our new tax law some marked decreases. In the end, we must ascribe taxation as the main malady of the country and the world. Reduction of taxes will bring us prosperity; not the imposition of tariffs, which in the endeavor to stimulate one industry will impose on all the rest that added taxation which paralyzes all industry and shrinks buying power.

The tax on incomes has been slightly abated, yet not enough to let loose capital in normal amounts from business enterprises; and the colossal blunder of tax-exempt securities forces that capital disaster, the growth of a class who live on their interest, but do not risk their capital in productive enterprises—a class the development of which is not normal to the

American spirit. Piecemeal legislation, such as the exemption from income tax of money invested in mortgages, as in Massachusetts, has feebly endeavored to fight against this condition. The new Federal tax law removes the excess-profits tax; but there were no longer excess profits of importance to collect.

There is only one gospel for the world, one formula for prosperity: Peace, good will, work, production, thrift, simplicity. All this will make business, consumption, the opening of mines, and good prices for metals and minerals. And the maintenance of navies and armies, the general striving to escape effective and productive work, the congestion of population into the cities, extravagance, the lack of thrifty habit, greed, class strife, will make toward poor business, little general consumption, the paralysis of the demands for metals, and low prices for all produced commodities.

The Moment Position of the Mining Industry

Resumption at Butte Promising—Wages and Supply Costs Dropping Labor Sufficient and Quiet—Freight Rates High —Gold and Silver Camps Active—Lead-Zinc Districts Busier

BY A. H. HUBBELL

News Editor, *Engineering and Mining Journal*

THE OUTLOOK for the metal mining industry is certainly more cheering than it was a year ago. Optimism expressed then had a hollow sound, more often than otherwise the wish being father to the thought. It was prophesied that fall would see a decided improvement in copper operations. This not materializing, the date was set ahead to spring, and now apparently the revised prophesies are in a way of being fulfilled. The resumption of work, even on a limited scale, at Butte, and that just announced to take place April 1 in northern Michigan, indicates that the operating corner has been definitely turned, just as the corner in price was turned in August. Hence present optimism appears well founded, though a recovery to normal will probably be a much slower process than many anticipate.

Fortunately for those whose well-being depends largely on the mining industry, the long period of depression in the copper camps has not been paralleled by as marked a depression at the same time in localities where some of the other metals are produced, particularly gold and silver. Those engaged in iron mining have been hard hit, and still are, particularly on the northern ranges, though even they have been more fortunate than those who ordinarily live by mining copper.

At the present time, there is considerable activity in most of the important districts of the country, except the copper camps and the Lake Superior iron country. Likewise in northern Ontario. Costs are still high, though they are improving, as wages decline with prices of supplies. High freight rates are in general a cause of complaint, and are acting as a decided deterrent to production, though with base metals this is not an unmixed evil. Inadequate smelting facilities are another source of discontent, particularly in Colorado.

From the operator's point of view the labor situation is good. That is to say, in most localities at least enough workmen are available for the operations, and the men appear to be of docile temperament. The agitator has practically disappeared, though it is too much to expect that he is gone for good. The year just ended has been notably free from disturbances such as those of 1919, in which year no less than twenty strikes occurred in as many different mining communities. The strike at Tonopah which began in April, and that at the Premier were the only ones of any moment, and at present every camp is quiet.

Unemployment, a bogey reared a few months ago, has proved devoid of sensational features, so much so that it is easy at a distance to deny its existence. There have been however, and are, many men out of work or receiving only a fraction of their ordinary income, particularly in the Lake Superior district and in Montana, though community pride as well as personal pride does not like to advertise the fact. In some camps, especially in the Southwest, many have left with their families for other districts, often at a distance, a fact that must needs be considered when time permits resumption. In sections adjacent to farming communities, a labor surplus is not readily noticeable even in winter.

Wage scales in districts where curtailment is marked are largely nominal and tell nothing as to the income of the miner, owing to part-time or split-shift operation. In general, even in districts that are fairly active, wages are lower than a year ago. Utah operators followed a 25c. decrease on April 1 by another of 50c. on Jan. 1. In the Coeur d'Alenes, a cut of $1.25 to $1 was made last January. New Mexico mines announced a new and lower scale. Likewise in Colorado a general cut from $4.50 to $4 was made, and it was the decrease from $6 to $5.25 at Tonopah and Divide last April that was the principal cause of the strike there. The scale was lowered at Grass Valley early in the summer and many other like reductions can be cited. To some extent this situation has been eased by a decrease in the cost of living, though this has lagged behind wages in falling, as might have been expected.

Supplies cost less on the average, Dun's index number of commodity prices being $164.444 on Jan. 1, as against $247.394 on Jan. 1, 1919; $198.609 on Jan. 1, 1921, and $159.833 on July 1 last, which was the low point of the past year, since when prices have advanced slightly. The cost of powder still seems unduly high to some operators.

Although freight rates are still regarded as hampering operations, the situation is easier in some localities than it was a year ago. The Utah Public Utilities Commission has exempted shippers within the state from paying the 25 per cent increase that became effective throughout the country on Aug. 26, 1920. Lower rates have been allowed on ore shipped to the Bunker Hill, East Helena and Northport smelters and between the Plumas County copper districts, in California, and the Thompson smelter in Nevada, which has not yet resumed. The El Paso & Southwestern R.R. has made reductions on ores shipped to El Paso and Douglas. Likewise, rates have been lowered on bullion between Western points and the Atlantic seaboard, this probably as a result of shipments having been made via Panama. Other reductions have been made and still others are asked for or anticipated. Numerous shutdowns resulted directly from the advances in rates. In some cases whole districts were paralyzed; so much so that the railroads themselves suffered more than they gained. Likewise the smelters were affected. As rates improve, therefore, it is expected that this process will reverse itself. But much remains to be done.

Thus the general situation of the mining industry is promising. Business may be bad in spots, but sentiment is good. A survey of conditions in the various major districts tends to strengthen this belief. We make an exception in respect to the copper camps outside of the Butte district, to which reference has already been made; for truly there is little activity here to point out.

The so-called "porphyries," meaning the Ray Consolidated, Chino, Utah, and Nevada Consolidated companies, are doing little except keeping their mills in running order. An official of the Utah company recently said rather vaguely that his company might resume April 1. In the Southwest, the copper camps are shut down save for the New Cornelia and Miami companies, which are producing at the approximate rate of 2,200,000 and 4,500,000 lb. per month respectively, and the Superior & Boston, which recently resumed. The International smelter is running a furnace on Miami concentrates. The other important companies now shut down are ready to resume when market conditions warrant, though it will take time to build up forces.

In California, the Shasta copper belt is dead. The Plumas County district is active, the Engels company, which is the most important operation, producing steadily. Granby, in British Columbia, is making an excellent showing. In the two important copper-producing sections of the East, namely northern Michigan and the Ducktown district of Tennessee, the former is producing refined copper to about a third of its normal output. Copper stocks awaiting shipment there are dwindling, and Calumet & Hecla, Ahmeek, Allouez and Isle Royale will resume production at about half normal on April 1. The two producers of the Ducktown district are both operating, one of them, the Ducktown Sulphur Copper & Iron Co., at full capacity, the other curtailed.

It sounds like working a worn-out pleasantry overtime to say that silver remains the bright spot in the metal-mining field. Had it not been for the Pittman Act, conditions in the last two years would surely have been much worse. This, of course, applies to the camps within our borders. Canada has been less fortunate, though the improvement in the price of foreign silver has made producers in Cobalt and in the districts of British Columbia more optimistic. At present production is about normal at Cobalt. Conditions have been bad in British Columbia, but are looking better, now that the Trail smelter will settle promptly for custom shipments.

Utah remains the leading silver producer of the country. Park City and the Tintic district, centering at Eureka, are maintaining a steady production that is approximately normal, sometimes above and sometimes below. Bingham is producing lead ore of milling grade and iron sulphide ore for fluxing purposes, the output last month having been about 15,000 or 16,000 tons. The Tooele smelter is down, but the other three in the Salt Lake Valley are running, Midvale and Murray on lead, and the one at Garfield, normally a copper plant, principally on siliceous silver ores.

Conditions in Nevada are considered satisfactory. Tonopah, a silver-gold camp, as well as Divide, is producing normally. Developments at the "boom" camps of Royston and Silver Horn are promising. The Pioche district has suffered severely from high freight rates, but is looking forward to some relief, reductions to be effective soon having recently been granted by the Union Pacific, following a hearing at Carson City. Development and construction work of importance is under way at Virginia City and American Flat. The Randsburg silver district in California has been active.

When one discusses silver camps he soon finds himself talking about lead, lead naturally leading to zinc, because of the frequent association of these metals. In the Cœur d'Alenes, in northern Idaho, normally producing all three metals, but three producers are active, the Hecla, the Morning (Federal), and the Bunker Hill & Sullivan, their output being about normal. In all about 2,500 are employed in the district, with few idle. The last-named company is making an increased production of lead. The entrance of this new smelter into the northwestern field, as a competitor, will benefit the small producer. Early resumption by the Tamarack & Custer and the Hercules is anticipated.

The Consolidated smelter at Trail is handling a normal tonnage, mainly from the company's mines. In districts in the Pacific Northwest, other than those noted, the situation is quiet, though the outlook is promising. Magnesite mining in Washington is dormant. The Tacoma smelter is running at reduced capacity and that at Northport is shut down.

In the Joplin-Miami lead-zinc district, about sixty mines are operating, against half that number a few months ago. Production is about 7,500 tons per week. In the Wisconsin zinc-lead district, there is said to be no curtailment. Five producers are active; also a roaster, an acid plant and an oxide plant. In the southeast Missouri lead district, operations are at about two-thirds of capacity, with production tending to increase.

The gold camps of Porcupine and Kirkland Lake, in Ontario, are scenes of great activity. The Hollinger, at Porcupine, has been breaking its production records and would doubtless do better could it get more power. In the Black Hills of South Dakota, the Homestake and Trojan are producing at capacity. In Colorado, much exploration and development work is under way, especially in Cripple Creek and in districts where gold and silver predominate. Winter conditions have hampered this to some extent. In general, conditions are better. In California, gold mining is improving at lode, drift, placer, and dredger properties. Grass Valley, Plymouth, Sutter Creek, Jackson and Melones are approaching normal, and there is some activity further south.

Nickel production in the Sudbury district, Ontario, is limited to the curtailed output of the Mond company.

The past season has been the worst in many years in the Lake Superior iron country. Winter conditions, when operations normally slacken, now prevail.

The Birmingham district, in Alabama, appears to be getting under way with iron-making conditions steadily bettering. The largest producer there is running at two-thirds capacity. Thirteen stacks in the district are in blast, compared with five six months ago. All things considered, the present situation warrants optimism.

Market Comment

The Outlook for Copper

By JOSEPH CLENDENIN
Sales Manager, Guggenheim Brothers, New York

THE OUTLOOK for copper in 1922 and for years to come is distinctly good, in so far as consumption is concerned, for consumption is bound to increase. The outcome to the mining companies, for stockholders and employees alike, depends largely and primarily, however, on the rate of production that will be maintained, for that will affect not only the cost of the output but also the price that will be obtained for it. Table I gives the production of the mines of the United States in the three years immediately preceding the war, under normal conditions:

TABLE I—MINE PRODUCTION OF COPPER IN THE UNITED STATES, 1911, 1912, 1913

	Pounds	
1911	1,083,856,371	Average, 1,183,787,571 lb.
1912	1,241,770,508	
1913 ...	1,225,735,834	

During the war, worked to the utmost of capacity, the production was as follows:

1915	1,423,698,160	Average, 1,806,732,815 lb.
1916	1,942,776,309	
1917	1,922,555,903	
1918	1,937,900,887	

Subsequent to the war, the output was as follows, but in 1921, for the last nine months of the year, the production was discontinued by all but a few mines:

1919	1,209,614,818	Average, 985,152,163 lb.
1920	1,270,841,670	
1921 (approximately)	475,000,000	

Imports of copper, mainly in ore, matte, and crude metal, averaged about 400,000,000 lb. per annum prior to the war. Since the war the importation has been as follows: 1919, 429,387,594 lb.; 1920, 485,670,691 lb.; 1921 (approximately), 347,500,000 lb.

The production of our mines, plus our imports, gives substantially our total supply. The disposition of this is shown by our deliveries of copper, foreign and domestic, which during the four years previous to 1915 and the three years subsequent to 1918 is shown in Table II:

TABLE II—DELIVERIES OF FOREIGN AND DOMESTIC COPPER

Year	Foreign, Pounds	Domestic, Pounds	Total, Pounds
1911	778,902,233	726,700,981	1,505,603,214
1912	766,396,452	825,064,841	1,591,461,293
1913	887,598,373	793,394,449	1,680,992,822
1914	767,682,491	722,761,784	1,490,444,275
Totals	3,200,579,549	3,067,922,055	6,268,501,604
Average			1,567,125,401
1919	366,331,137	1,224,503,758	1,590,834,895
1920	466,341,570	1,399,653,122	1,225,000,000
1921	560,000,000	665,000,000	1,225,000
Totals	1,392,672,707	3,289,156,880	4,681,829,587
Average			1,560,609,863

The range of prices, monthly averages, and the averages for the years are given in Table III:

TABLE III—PRICE RANGE AND AVERAGE COPPER PRICE

	High, Cents	Low, Cents	Average, Cents
1911	13.552	11 989	12 376
1912	17.508	14.084	16 341
1913	16.488	14.192	15,269
1914	14.491	11.739	13.602
1919	22.319	14.856	18.691
1920	18.918	13.188	17.456
1921	13.555	11.634	12.502

W. R. Ingalls has computed that the average price of 14.95c. per lb. received for copper during the three years 1911-1913 yielded an average gross return of about 3.85c. per lb. of copper. This would result in an aggregate of about $45,500,000 on the average annual production of those years. According to the last census about $850,000,000 of capital was invested in the copper mines of the United States, and the industry employed about 50,000 persons in the production of copper. The annual gross return of $45,500,000, estimated by Mr. Ingalls, is small in comparison with the investment of capital reported by the census. But, be things as they may, the pre-war range of prices, yielding only a moderate return to the industry as a whole, succeeded in maintaining it on an even keel. The output of the mines kept fairly in line with the market, and on the basis of supply and demand there existed a general stability, making the conditions for doing business comfortable for both producers and consumers and affording steady employment to all the workmen attached to the industry.

During the war conditions were abnormal, for reasons that I need not explain, and since the war conditions have been continuously abnormal. In the first place, producers who had been urged to strain themselves to the utmost were suddenly deprived of all governmental buying, but were not able immediately to check the extraordinary production to which they had been stimulated. In the next place, it was found that all of the Allied governments had enormous surplus stocks of copper of their own. And in the third place, scrap copper was salvaged in great quantity. The economic and financial conditions of Europe, which were reflected in the grossly depreciated rates of exchange, became so disturbed as to curtail greatly the demand for copper along with that for other raw materials. Before the war we used to export a little more than 50 per cent of the product of our copper refineries, whereas since the war we have shipped abroad only about 30 per cent. Finally, we began to experience in the latter part of 1920 the inevitable readjustment in our own economic affairs, which continued throughout 1921 and early in the latter year compelled the closing of most of our mines. Notwithstanding these adversities, which have seriously affected every industry, the markets of the world have not only absorbed all the war stocks of copper held by the several governments of Europe, but also they have taken deliveries of copper from the United States at the average rate of 1,560,609,863 lb. during the three years 1919-1921, compared with an average of 1,567,125,401 lb. during the four years 1911-1914.

This record shows the basic soundness of the copper industry. Now that it is apparent that we are again approaching the normal conditions of former times, with the accumulation of stocks being rapidly absorbed as a consequence of the curtailment, the reopening of the mines will soon be in order, and there will be excellent prospects for selling their output.

Our American copper industry, with its vast investment of capital, providing normally 56 per cent of the world's supply, and in normal times selling about 50 per cent of its production abroad, is of course entitled to a fair margin of profit, and obviously will get it. Economic principles decree that the price must be such as will induce an adequate and continuous production. Although the price improved during 1914 and at the end of the year stood at about 14c. per lb., even that price, prevailing as it does under economic conditions that are still distorted, is materially below the pre-war average that was established by the law of supply and demand.

The demand for copper is destined to increase, perhaps to an extent beyond our present rosiest conceptions, for reasons that are quite conclusive. The great consumption for copper is in the electrical industry, in which it is the key material. In pre-war years about 54 per cent of our domestic shipments of refined copper was in the form of wire bars, which affords a rough index of electrical consumption; but not the total, for electrical work uses a good deal of copper in brass and other forms. In 1921, the percentage of domestic wire bar shipments was 67½.

Now, although the United States is the most electrified country of the world, we are still a long way from our limit of electrification. Of the 24,000,000 homes of the country, only about one-third have been wired so far. Yet electric lighting is a relatively old branch of the electrical industry. New branches are developing all the time and are growing swiftly. For example, the value of laundry-machine motors manufactured in 1912 was only $7,000,000; in 1920 it was $50,000,000. But such things, important though they be, relate only to the direct increase of comfort in living. Even more important is the use of electricity toward increasing efficiency in production and transportation. The output of the central generating stations of the country increased from 16,782,000,000 kw-hr. in 1914 to 45,678,000,000 kw.-hr. in 1920, or 173 per cent. During the same period the annual gross revenue increased from $336,980,000 to $882,750,000, or 162 per cent. The installed rating of the central generating plants increased from 7,000,000 kw. in 1914 to 13,750,000 kw. on Jan. 1, 1921, and during the same period the capital invested in the light and power industry increased from $2,706,000,000 to $4,050,000,000.

Our railways are now deficient in capacity. They have not been kept up with the increase in population. We must have more carrying capacity. But instead of providing this in the form of rails, locomotives and cars, it is going to be furnished to a large extent in the form of dynamos, with their heavy fields and armatures of copper wire, and of transmission lines of copper, which will carry not coal but its energy, and will do that at a saving of 75 per cent, according to the U. S. Geological Survey.

Exactly the same things, and for the same reasons, are going to be done in Europe, which at present is far less electrified than America, but yet has more need for it, owing to its relative poverty in coal supplies. Fortunately, there are abundant water powers in Italy, France, Switzerland, and Scandinavia, which are the countries that are poorest in coal. While I have been writing this article the International Electrical Conference, sitting in Paris, has had the subject under discussion. This meeting brought together delegates from twelve countries, including the United States and Canada. Electricity as a means of moving railway trains and turning the wheels of industry is about to come into its own according to these delegates. The Americans surprised the European experts when they outlined the extent to which electricity is made to work for the American people. The introduction into the American home of such labor-saving devices as electrical stoves, dish-washers, laundry machines, carpet sweepers and other household conveniences amazed many of the delegates who represented countries where as yet electricity has not been utilized in the home except for supplying light, and that only to a trifling extent.

In Great Britain the Northeastern Railway has completed plans for the electrification of 250 miles of its line, and a start will soon be made on the work, providing for the transmission of energy developed from coal in a central power plant. Besides this project, others of similar nature are under consideration, and in several instances are beginning to take concrete form.

Quickening in the demand for such purposes is already to be discerned clearly. Our wire-drawers are already reporting good business and increasing demand. Similar reports come to us from Europe. Germany in particular is using a great deal of copper, and its mills are working night and day. Germany not only has to buy and manufacture copper for the improvement of its national efficiency and for the production of wares for its export trade, but also it has to replace the copper that it stripped from its installations during the war, and is in fact now doing so. For example, the yearly requirements for locomotive fire-box plates is estimated at 90,000,000 lb. Copper is necessary for this purpose, owing to the quality of the coal used in Germany, and is now being replaced as rapidly as possible. Telephone and telegraph wires of copper that were taken down are now being put up again. In the Orient there is not only a distinct movement toward increased electrification in Japan, but, also, China is requiring a good deal of copper for coinage purposes.

Besides all of these standard uses, strenuous efforts are being made to extend the use of copper for building materials. Among other things, a form of copper shingle has been developed, which holds out good promises. This is important in itself, but perhaps the most stimulating development will be the general attention on the part of everybody interested in the copper industry to develop new uses for copper and expand its uses in the old field. Such concerted effort cannot fail to be fruitful.

Up to the advent of the war the use of copper was increasing more rapidly than the increase in population, owing to its possibilities toward elevating the scale of living of the people. The war checked this by demanding all available copper for military purposes. The industrial world is therefore in the position of going back to where it left off at the middle of 1914 and making good the requirements that there would naturally have been, but which had to be postponed.

The war produced a world-wide economic cataclysm, such as no living man ever experienced, and the after-effects were no less serious than the causes that produced them. In this general upset, resulting in a crisis of eighteen months' duration, it was inevitable that the copper industry had to suffer, but the situation was met courageously by the producers; and it is clear now that through their bold action in closing the mines, despite the regrettable hardships that resulted for many, stockholders and employees alike, they have succeeded in bringing the copper industry rather swiftly along toward a healthy condition; and it is certain that the accumulation of surplus stocks will soon be reduced to the proportions that are normally required for a safe industrial balance wheel, and that copper mining and copper production may be resumed without any incubus. With the development of this satisfactory condition, we may rest easy in confidence that even if the readjustment of other industries be prolonged, the world's need for copper is so positive that this industry will be in a superior position.

The Outlook for Lead

More White Lead Used in 1921 Than in Any Other Year—Approach To Normal Consumptive Demand Expected in Lead Products—The 1922 Average Price Will Probably Exceed That of 1921

BY IRWIN H. CORNELL
Vice-president and Sales Manager, St. Joseph Lead Co.,
New York

THE YEAR 1921 was probably the most unprofitable year for the lead miner since 1897. The average price for the last twenty-five years, f.o.b. cars New York, was 5c. per lb., as compared with 4.54c. for 1921. The price of lead in New York during December, 1920, was lower than in any month since October, 1915. Lead as a commodity has been liquidated. In four months, the price dropped from 8.90 to 4.50c. per lb., while the number of pounds of lead that could be produced for $1 on Jan. 1, 1921, was probably less than at any time in the history of lead mining in the United States. The cost of transportation in 1921 constituted a large part of the 4.54c. per lb. received for lead in New York. As an example, before the war it cost $100 to move a car of pig lead from East St. Louis to New York. In 1921, until Dec. 10, it cost slightly more than $330. Smelter products freight rates were advanced out of proportion to most of the other commodity rates.

The pounds of lead produced for $1 should certainly increase to a limited extent in 1922, but the average price will have to be greater than 4.50c. New York, to bring out a production of more than 400,000 tons from American mines. The price, although affected largely by the cost, must depend on, first, the tariff; second, on the consumption, and, third, on the visible and invisible stocks. The production will depend on the price.

A curve of price and production under the different tariff laws would prove without doubt that the Underwood tariff, except through extraordinary world conditions, would keep the price of lead below the point where the metal could be economically produced in this country under the present standard of wages and living conditions. To believe in better conditions in 1922, it is therefore necessary that ample protection be given the lead industry, and that the Fordney Tariff Bill be enacted into law early in 1922.

No accurate statistics concerning the consumption of lead in the United States by industries have been collected except by the United States Government agencies during the war, and these were never published. The consumption of lead must vary directly with the general business prosperity of the country, but by approaching each important industry separately, it is possible, from present conditions, to form some opinion concerning the probable demand for the metal in 1922. The most important question is whether the use of lead in the arts is decreasing or increasing. No substitute has replaced lead in any of the important industries in the United States, nor can it be argued that the present curtailment in demand is due in any way to the elimination of lead in manufactured articles.

Despite greatly disturbed business conditions, more white lead was manufactured and sold during 1921 than in any other year. There is reason to believe that the demand for lead pigments will gradually increase, although it will be remarkable if 1922 exceeds the record of 1921.

The storage-battery industry, which is second in importance to that of the paint industry, operated between 50 and 60 per cent of capacity in 1921. The outlook for 1922 is somewhat better, but the most optimistic manufacturers do not expect the business for the new year to approximate the record year of 1920. The industry as a whole should grow and probably will grow faster in the next decade than any other lead-consuming industry, and before long it is possible that in prosperous times it will consume as much lead as the paint industry.

Many lead-incased cable factories were running full time in 1921, although the probable lead consumption was about 75 per cent of normal. Lighter cables and possibly thinner sheathing were partly responsible for the reduction, and some important factories were not running full time. Business in 1922 is expected to be on about the same scale, although, as a matter of fact, the diminishing industrial loads have undoubtedly enabled the public service corporations in the big cities to get through the short days of winter on a minimum of cable, and a resumption of business might create a big demand for this grade of cable. With the growth of the telephone and the increase of underground power conductors, the cable industry should always maintain its important position with respect to the lead industry.

Lead pipe, traps, and other blue-lead products used in the building trades were in fair demand during the first half of 1921, and for the last six months of the year business was even better. The industrial demand for this class of material has been poor. For the whole year the lead presses probably turned out about 80 per cent of the normal tonnage. A large amount of building work has been planned. In certain districts the mortgage loan market has greatly improved, and if early readjustment of labor costs occurs in the large cities, a good business may be confidently expected.

The demand for sporting ammunition, in common with the demand for paint, is usually expected to be good during hard times. The last year has proved an exception to this rule. The demand from the Southern States was particularly poor, the consumption of lead by this industry being between 50 and 60 per cent of normal. There is nothing in the present situation to indicate a great increase in activity during 1922.

With the curtailment in general industrial business, the demand for bearing metals of all kinds has fallen off greatly and certainly may not be expected to be worse in 1922.

There was a small demand for sheet lead throughout the year; probably less than 30 per cent of the normal production was marketed. Added to the poor industrial situation, the low price of cotton adversely affected the demand for this commodity. With the higher price of cotton, the growers will buy fertilizers, and the chemical companies should come into the market for some sheet lead before the summer of 1922. Activity of the lead mills, however, will depend on general business conditions.

FOIL, TYPE AND SOLDER USES OF LEAD

The redeeming feature of the foil business in the last year has been the buying by the cigarette manufacturers. Though the demand for foil for other purposes fell off greatly, the entire industry operated at from 60 to 75 per cent of capacity. This industry in a normal year is estimated to consume about 25,000 tons of lead. The demand for foil is affected by the price, and with the present low cost of lead the industry should experience a decided improvement. Should the custom of wrapping chewing gum in foil again be adopted by the prominent makers, the outlook would be bright. The consumption of type metals runs about the same from year to year. The demand for solder, caulking lead, rubber, glass and oil oxides and counterweights for locomotive driving wheels has been small owing to the general business depression. Though each of the above-mentioned uses consumes a relatively small amount of lead, in the aggregate at least 50,000 tons in normal times is used for these purposes.

VISIBLE AND INVISIBLE STOCKS

The visible stocks of lead at no time during the last year became unwieldy. On the other hand, they are at this time decidedly unbalanced. The stocks of desilverized lead today are small, probably smaller than the average stocks before the war. Missouri lead, on the other hand, is held in fairly large quantities. The activity in white lead, which has saved the lead-mining industry from an almost complete shutdown, has placed a premium on lead of a corroding quality.

In August, the freight rates from the Rocky Mountain states to North Atlantic ports were greatly reduced to meet the rail and water competition via the Panama Canal. There was no corresponding reduction in all-rail rates to intermediate points from the West or from the Mississippi Valley to Boston, New York, Philadelphia, or Baltimore. The large imports through the ports of New York and Philadelphia that began to arrive in April, and the August freight reduction from Rocky Mountain points to the seaboard, had the effect of drawing the St. Louis and New York markets close together, and thus denying to Missouri lead its usual outlet in the East. As before stated, the sheet lead and battery industries, both large users of Missouri lead, were far below normal. Manufacturers of foil, cable, caulking lead, lead pipe, babbitt, and other lead alloys situated in the East, who in the past had used some Missouri lead, used desilverized almost exclusively. The Spanish lead brought to Atlantic ports was sold largely to Eastern manufacturers. The combination of these circumstances brought about the conditions responsible for the accumulation of stocks of Missouri lead and the comparative scarcity of desilverized lead. Invisible stocks are low, as manufacturers in general have been following a hand-to-mouth policy of purchasing.

SECONDARY LEAD

The production of secondary lead has increased steadily from year to year. In 1912, the U. S. Geological Survey estimated a production of 67,168 tons. In 1919 it had reached the large amount of 125,000 tons, and in 1921 was probably almost as large. To this should be added the tonnage of shrapnel balls imported under the classification of type metal and paying a 15 per cent ad valorem duty. About 16,000 tons of this material was imported in 1921.

Stocks of pig lead on Jan. 1, 1922, including metal in the hands of consumers as well as in those of producers, are probably little if any larger than one year ago. Production in 1921 was about 400,000 tons, or 75,000 tons less than in 1920. The production in 1922 will probably be about the same if the price does not average over 4.50c. per lb., New York. Imports of lead and type metal less the exports for the first ten months of 1921 were around 65,000 tons. Imports in 1922 will depend on the tariff.

With the indicated betterment in business conditions in the majority of the lead-consuming industries, and with the prospect of a falling off in imports, it is assumed that a domestic production equal to the production in 1920, about 475,000 tons, will be required. Though the price during the last two months of 1921 was undoubtedly held down by the stocks in producers' hands, heavy buying during the final weeks of the year had a material effect on this situation, and it is reasonable to assume that the average price for 1922 will have to exceed that of 1921 to bring out the lead which it is estimated will be needed.

PRODUCTION OF LEAD (REFINERY STATISTICS) 1916-1921 (*a*)

In Tons of 2,000 Lb.

Domestic	1916	1917	1918	1919	1920	1921
Desilverized.......	330,189	319,015	284,733	226,085	236,912	202,649
Antimonial........	22,819	16,265	18,658	14,864	8,992	5,419
S. E. Missouri.....	206,105	205,861	189,207	158,182	206,836	142,804
S. W. Missouri.....	33,128	40,575	63,635	55,790	29,004	56,155
Totals..........	592,241	581,716	556,233	454,921	471,744	406,896
Foreign						
Desilverized.......	17,832	50,962	98,596	61,380	51,700	47,697
Antimonial......	3,304	2,991	2,083	1,547	2,197	2,361
Totals......	21,136	53,953	100,679	62,927	53,897	50,058
Grand totals......	613,377	635,669	656,912	517,848	525,641	456,954

(*a*) These figures include the lead derived from scrap and junk by primary smelters.

MONTHLY AVERAGE PRICE OF LEAD

Month	New York			St. Louis			London		
	1919	1920	1921	1919	1920	1921	1919	1920	1921
January.......	5.432	8.561	4.821	5.316	8.300	4.747	37.227	47.095	23.387
February......	5.057	8.814	4.373	4.784	8.601	4.228	28.675	50.256	20.650
March.........	5.226	9.145	4.084	4.992	8.894	4.000	27.952	46.054	18.911
April..........	4.982	8.902	4.356	4.722	8.618	4.272	24.888	39.225	20.589
May...........	5.018	8.576	4.952	4.773	8.352	4.784	23.852	38.488	23.399
June..........	5.340	8.323	4.485	5.070	8.169	4.293	22.544	34.330	22.563
July..........	5.626	8.338	4.410	5.408	8.283	4.260	23.457	34.960	23.399
August........	5.798	8.687	4.382	5.583	8.725	4.217	24.750	36.304	23.489
September.....	6.108	8.177	4.600	5.853	8.160	4.392	25.330	35.452	23.148
October.......	6.487	7.070	4.690	6.249	7.018	4.439	28.473	35.238	23.679
November.....	6.808	6.159	4.683	6.649	6.127	4.356	34.731	32.489	24.483
December.....	7.231	4.727	4.700	6.955	4.717	4.369	41.202	24.089	25.322
Year........	5.759	7.957	4.545	5.530	7.830	4.363	28.590	37.832	22.752

New York and St. Louis, cents per pound. London, pounds sterling per long ton

The Outlook for Zinc

Constructive Upward Movement Beginning—Production Outside of the United States Declines—A Return to Normal Conditions Foreshadowed World's Supply of Brass Scrap Now Exhausted—Foreign Situation

BY A ZINC SPECIALIST

A SENSIBLE PESSIMIST would be likely to feel encouragement in the present prospect for zinc, because he would find it difficult to anticipate during 1922 a duplication of all the unhappy factors, economic and political, which affected affairs in general and the zinc industry in particular during 1921.

A sensible optimist would be likely to feel greater encouragement, because he does not find it difficult to note already not only the gradual disappearance of many of the adverse factors but also the inevitable beginnings of a new constructive era: cheaper money, consequent upon increased frugality, and, for the time being, slow business and reduced calls for credit; rising security prices, with their facilitation of increased financing of under-equipped railroads and public utilities whose lack of purchasing power has been no mean factor in the past depression; cheaper prices for such manufactured articles and foodstuffs as enter largely into the average man's "cost of living"; production systematically curtailed for a long enough time to start an upward movement in price level of most of the abnormally depressed commodities; small inventories; and in general, a growing uniformity in the levels of liquidation. All these factors are symtomatic of the beginnings of a constructive upward movement and are pertinent to any discussion of zinc, even though this industry has been additionally affected in the immediate past by conditions peculiarly its own.

For a thorough understanding of the precarious situation of the zinc industry in 1921 and its prospects for 1922, consideration must be given to the changed position of the United States in the world's market. Although zinc was a metal notably stimulated by the demands of the World War, it is significant that the world's production of zinc has never exceeded the total for 1913, when 1,113,860 tons was produced. Of this total, roughly 70 per cent was produced outside of our country. From that time on, European production progressively declined, and though complete figures for 1921 are not available they will show a marked decrease from 1920, when production outside of the United States totaled only 315,000 tons, or less than 50 per cent of its 1913 production. In other words, the entire increase incident to war needs was supplied by the United States, where production rose from 353,000 tons in 1913 to 682,000 in 1917, declining only to 435,000 tons in 1920, and in the pit of the depression in the winter of 1920 going on at the rate of 360,000 tons per annum, or above the highest pre-war average, and this at a time when not only had we many months previously stopped exporting zinc but were actually importing large tonnages of European metal, a state of things which continued into April and May of last year, when we imported nearly 7,000 tons of foreign metal.

The condition of the zinc industry in this country in 1921 was a logical aftermath of these facts. And the facts were an equally logical outcome of the peculiar structure of our zinc industry, as developed by the war, and its direction by too many, and unfortunately too inexperienced, hands. Many factors facilitated the tremendous and temporarily profitable growth of the United States zinc industry during the World War—cheap fuel, particularly gas, contiguous to the largest zinc-mining district; relatively cheap and simple plant construction; demand for zinc at continuously rising prices, which permitted the mining of much low-grade ore, including the reworking of tailings and nearly exhausted properties in the Joplin district, and which, in conjunction with the recent development of oil flotation, electro-magnetic and electro-static concentration processes, released for use large quantities of hitherto useless ore.

With the removal of war stimulus to production, the industry, highly decentralized and with no one interest controlling more than 15 per cent of the total productive capacity and all eager to retain their previous position in it, seemed carried on by the resulting momentum. Too few of its operators seemed to realize its disproportionate size to the normal demands of this country, its only natural market, and they were encouraged in their failure so to realize by the abortive industrial boom which began in 1919 and ended in disaster in the fall of 1920. Belated realization came in 1921. Production, which on Jan. 1, 1921, was at the rate of 342,000 tons per annum, or 28,500 per month, dropped sharply on April 1 to 15,500 tons per month, at approximately which rate operations were being conducted at the end of the year.

In considering the outlook for zinc, it must be remembered that no basic industry can remain for more than a limited period on a non-paying basis. Such a period existed throughout 1920 and 1921 and represented the inevitable adjustment due an industry when the causes for its sudden growth beyond its normal sphere in the country's industrial economy disappear temporarily. The United States is self-contained with respect to its zinc requirements and supplies, and so, taken as a unit, is the rest of the world. We are now producing at the rate of less than 200,000 tons a year, as against an average production, all used domestically, of over 300,000 tons for the six years preceding the war—all of them quiet, unspectacular years in the business world, and so reflecting genuinely normal production needs in all our basic industries. Merely to return to the consumptive requirements of these years—and we are definitely on the way by all known signs—would be a great improvement for the zinc industry. It is impossible not to anticipate a greater improvement when one realizes that the factors of standard of living, population increase and financial strength which dominate the normal growth of every basic commodity have not been impaired to any real extent.

Granted that there is before us a return to relatively normal conditions, with gradually improving business, it is logical to examine some of the major factors specific to the zinc industry which affect supply and demand. The brass industry has for some time been practically out of the market for zinc, finding ample supplies of scrap. It has been estimated that the zinc contents of the world's supply of brass scrap totaled nearly 200,000 tons on Jan. 1, 1919. The total had decreased to less than 100,000 tons by Jan. 1, 1921, and though exact figures for the present status are lacking, the total today is very small. There are no available stocks of real moment in the country, three-quarters of the Government's scrap having been sold by the end of 1920 and the remainder in 1921. Europe has turned from a seller to a buyer, and the sole remaining stocks, in England, are being rapidly depleted by demands from the home industries, from this country and from Europe. Stocks of 60-40 material have been exhausted and only a little 70-30 brass scrap remains.

So far as the supplies of ore are concerned, the condition is a healthy one from a market standpoint. With the exception of the electrolytic production and retort production of high-grade metal in the East, zinc smelters will undoubtedly be restricted to drawing upon the Mid-Continental ore fields, as none of the major Western mines are likely to supply ore until the price of zinc has advanced somewhat over a cent a pound above the present level. For that matter, higher ore prices are likely in the Joplin district if even the present low production is to be maintained. During the last two years of depression in the zinc industry, with ore selling at from $53 to $35 per ton during 1920, averaging $46, and from $28 to $20 during 1921, averaging, so far as figures show at this time, about $24, as against an average of $43 per ton for the five-year pre-war period, it is believed in many directions that production has been maintained only at the expense of mining the richest ore, that operators are now getting into poorer ground, and that ensuing operations will be carried on with diminishing margins on the basis of the present market. Moreover, though smelting costs have been steadily reduced, plant operations are still unprofitable, and so an increase in the supply of both ore and metal can be logically assumed to depend upon higher prices.

The present foreign situation and the outlook abroad warrant a high degree of optimism, and a study of conditions will do much to relieve us from the fear, concretely expressed in our proposed zinc tariff, of an influx of foreign metal to the detriment of the domestic industry. In the first place, curtailment of production abroad was far more closely and quickly proportioned to curtailed demand, and in the early part of 1920 stocks of zinc were relatively lower there than here. For example, in Great Britain, in April, the first date in 1920 for which figures became available, stocks stood at 29,000 tons, as against 32,000 for this country; a year later they stood at 19,000 tons in Great Britain and 81,000 tons here. On the Continent production for 1921 steadily declined. Belgium started the year at the rate of 9,000 tons per month and finished at the rate of 5,000 tons per month; the remainder of the Continent began the year producing at the rate of 10,000 tons per month, of which 6,000 was produced by Germany, and steadily declined.

The result was that when an estimate of stocks was made near the end of 1920, the stock of zinc in the entire world outside of the United States was less than stocks here, despite our own healthy reduction. In the meantime, improved business abroad had set in. It was reported, for example, that in September alone, the first month of real recovery for Great Britain, nearly 60,000 tons of galvanized sheets were booked there for export, later months showing continued improvement. Still, production abroad has not increased, and it therefore comes within the range of possibility that export of zinc from this country may take place to meet foreign demand—a striking contrast to the apprehension of last spring of our domestic market being swamped with cheap foreign metal.

Though some increase in production abroad is to be expected should conditions there continue to improve, several reasons suggest that it is likely to increase but slowly. More than half of Europe's pre-war production was derived from ore imported into the smelting countries, particularly Belgium, France, and Germany, from Australia, Indo-China, Africa, Italy, Spain, Greece, and Russia. An essential to this situation was cheap ocean freights, and, though freight rates have declined, they are still far too high to permit an early profitable return to the old basis of operations. Smelting costs are also very high, owing particularly to fuel costs.

Furthermore, there are changed conditions in the mining situation of Australia, the largest source of

AMERICAN PRODUCTION OF ZINC 1916–1921

In Tons of 2,000 Lb
By Ore Smelters Only

	1916	1917	1918	1919	1920	1921
Arkansas	7,634	25,701	26,750	31,396	29,966	14,917
Colorado	8,908	7,735	3,897	2,779	1,682	1,200
Illinois	181,495	176,071	141,808	118,631	109,483	52,183
Missouri-Kansas	154,396	86,505	31,834	43,347	25,131	31,784
Oklahoma	169,064	204,587	143,371	119,454	97,690	36,644
Electrolytic	10,963	27,245	38,885	25,962	57,441	11,553
East and others	147,555	154,567	138,805	130,115	158,379	67,333
Totals	680,018	682,411	525,350	471,684	479,772	215,614

Production for 1920 and 1921 through the courtesy of the American Zinc Institute.

ZINC PRODUCTION, STOCKS AND SHIPMENTS

Compiled by American Zinc Institute
In Tons

1921	Zinc on Hand First of Month	Produced During Month	Total for Month	Shipped During Month	Zinc on Hand End of Month	Increase	Decrease
January	71,058	25,916	96,974	21,021	75,953	4,895	....
February	75,953	17,769	93,722	15,702	78,020	2,067	..
March	78,020	15,741	93,761	12,771	80,990	2,970	.
April	80,990	16,550	97,540	17,959	79,581		1,409
May	79,581	18,026	97,607	13,886	83,721	4,140	.....
June	83,721	19,443	103,164	13,275	89,889	6,168	..—.
July	89,889	15,495	105,384	12,976	92,408	2,519	...
August	92,408	14,621	107,029	20,480	86,549	.....	5,859
September	86,549	14,367	100,916	19,781	81,135	.....	5,414
October	81,135	14,538	95,673	24,849	70,824	.....	10,311
November	70,824	21,135	91,959	24,910	67,049	.....	3,775
December	67,049	22,013	89,062	22,454	66,608	..	441
Tons	......	215,614	....	220,064	......	...	.....

RETORTS

1921	Capacity	Available	Average Number Operating During Month	Average Number Operating End of Month	Increase or Decrease
January	157,676	139,632	....	44,781	D. 13,848
February	158,176	140,132	41,893	37,782	D. 6,999
March	158,178	140,132	34,386	35,297	D. 2,485
April	158,176	140,132	38,732	39,673	I. 4,376
May	155,256	136,972	40,607	40,043	I. 370
June	150,792	133,964	37,907	35,789	D. 4,254
July	153,736	135,792	32,543	30,349	D. 5,440
August	155,656	137,712	29,518	29,576	D. 773
September	155,656	137,712	29,110	29,429	D. 147
October	155,656	137,712	26,859	27,949	D. 1,480
November	155,656	137,712	46,567	46,444	I. 18,495
December	155,656	137,712	41,080	42,369	D. 4,075

Note: Stored for account of customers, Dec. 31, 1,916 tons.

MONTHLY AVERAGE PRICE OF ZINC

	St. Louis				London			
Month	1918	1919	1920	1921	1918	1919	1920	1921
January	7.661	6.922	9.133	5.413	54.000	56.045	58.643	25.262
February	7.639	6.273	8.708	4.928	54.000	46.150	61.338	24.850
March	7.286	6.150	8.531	4.737	54.000	38.500	53.467	25.077
April	6.715	6.114	8.184	4.747	54.000	36.188	47.388	25.530
May	7.114	6.079	7.588	4.848	54.000	35.477	45.088	26.923
June	7.791	6.551	7.465	4.421	54.000	36.763	41.193	26.750
July	8.338	7.523	7.720	4.239	54.000	41.815	41.886	26.262
August	8.635	7.439	7.835	4.186	54.000	39.338	41.220	25.068
September	9.092	7.160	7.661	4.235	54.000	40.935	39.690	25.256
October	8.451	7.473	7.150	4.605	54.000	43.630	39.756	26.315
November	8.141	7.827	6 247	4.665	54.100	46.588	35.028	25.949
December	7.813	8.350	5.824	4.837	56.050	53.101	27.762	26.900
Year	7.890	6.988	7.671	4.655	54.180	42.879	44.372	25.845

St. Louis, cents pe rpound. London, pounds sterling per long ton.

pre-war European ore supply. Its great mining center, the Broken Hill lode, has been operated since 1884. Early operations there had lead ores as their object, and immense dumps of zinc-bearing ores and zinc tailings were accumulated as a result of lead-ore mining and concentration. These were estimated about twenty years later to total nearly 6,000,000 tons, running slightly less than 20 per cent zinc. As demand developed for sulphide ores, the dumps became important sources of supply, particularly with the application of the oil flotation method of concentration. Today, however, the dumps are approaching exhaustion, and to again approach Australia's pre-war production fresh mining operations are necessary, entailing more expense and resulting in less remunerative ore, as most of the orebodies now being exploited and available for exploitation are deep-seated. In fact, it is estimated that a decrease rather than an increase in production is likely for Australia.

There are other districts where increased production may occur, particularly in Burma, from the Bawdwin mines. There are also interesting possibilities in the electrolytic zinc development in Tasmania, but these sources of future increase all entail expensive equipment and large-tonnage operations for profitable working, and so will not make themselves felt until world business conditions show a far greater improvement than exists today.

The Outlook for Tin

Uneventful Market in 1921—Pegged Prices in Straits Necessitated In Local Emergency—Uncertainties of Tin Statistics—Visible Supplies And Eastern Stocks Preclude Domination of Speculative Groups

By J. H. Lang
Tin Specialist, The American Metal Company, Ltd.,
New York

THE TIN MARKET of 1921, though characterized by the usual wide variations in price, was tame and uneventful compared to the wild and exciting times of 1920. The price range in London was only £62, from £210 to £148, and in New York from 38¾c. to 25½c. In 1920, the price range in London was from £420 to £195, a total of £225, and in New York from 65c. to 32½c. It was only in January, 1921, that the extreme fluctuations of 1920 persisted, the market in that month declining from its high for the year (£210) to £164 on Jan. 25. Thereafter there was a further decline, until the low of the year was reached on March 9 at £148 London and 27c. New York. There was a reaction from this low point to £184 on May 23, and a subsequent decline culminating Aug. 25 at £150 London and 25½c. New York. After this there was a slow and gradual recovery to £174 London and 33¾c. New York, on Dec. 16. The close was £170½ and 33¼c. Though March 9 was the lowest in London, Aug. 25 was the lowest in New York, owing to lower exchange in August. Of the subsequent rise from 25½c. to 33¾c. about 50 per cent was due to the rise in the tin market itself and 50 per cent to the advance in exchange.

This in brief was the course of the market during 1921. As to the causes thereof, the year opened with a "pegged" price in the Straits equivalent to about £229 f.o.b. Singapore. Though the economic fallacy of the pegging policy was universally recognized, the general impression was that it would be maintained and carried to a successful conclusion as in 1919. Confidence in this belief was shaken by a reduction early in February, and finally at the end of February the Straits government withdrew altogether as buyer, whereupon the market declined sharply to its low point in March.

In justice to the government of the Federated Malay States, it should be said that nobody realized better the unsoundness of the policy pursued. It was adopted as a temporary expedient under pressure of social and political conditions peculiar to the Straits. The mines are worked almost exclusively by imported coolie labor, which would begin to starve and riot if without work for even a few weeks. In a country so sparsely settled and inadequately policed this constituted a menace necessitating immediate remedial measures. The mines would have closed just as the copper mines closed in this country had not the government stepped in and bought the tin. The alternatives were to support the coolies in idleness or to deport them. The proper remedy would have been to close the mines, but in that event the whole industry would have been ruined and could not have been established again in a generation.

The government took practically the only available steps for meeting the emergency, but it bought as little as possible, reduced the price as soon as it could, and abandoned the scheme at the earliest practicable moment. Even so, it had accumulated about 10,000 tons, against which $10,000,000 in bonds were issued, and the matter stands in that position today. How to sell the tin and liquidate the bonds is one of the most pressing problems engaging the attention of government officials there at the present moment. The carrying charges are a heavy burden on the revenues of the country, the prosperity of which has suffered severely from drastic declines in other commodities as well as in tin, particularly in rubber. Aid had to be extended to that industry also.

A similar policy was adopted by the government of the Dutch East Indies, which likewise accumulated tin and held it off the market, the general estimate being that there are now between 5,000 and 6,000 tons in Java awaiting higher prices. To the end of September, Banca production was 1,000 tons more than in 1920. For the year, shipments were 3,000 tons less. Unfavorable Chinese exchanges seriously interfered with exports from that country. It is reported that between 3,000 and 4,000 tons of tin is now lying in Hongkong. We thus have 18,000 or 20,000 tons, exclusive of Bolivia, in "invisible" supplies—i.e., not appearing in statistics.

Aside from this matter of invisible stocks, which can never be dealt with satisfactorily in statistics, the latter as at present compiled are exceedingly unreliable, because they include at best only two-thirds to three-quarters of the output, presenting an incomplete and often misleading picture of the situation. A case in point is cited later. There is urgent need for statistics which will deal with the entire primary production and consumption of tin in a clear and concise manner. A proposition to that end has been made by the New York Metal Exchange to the London Metal Exchange, and it is hoped to work out the problem more efficiently than is being done at present.

UNCERTAINTY OF TIN STATISTICS

Statistically also, the position of tin has deteriorated, the visible supply having increased 5,600 tons from 18,439 tons at the beginning of 1921 to 24,060 tons at the end, or a total stock, visible and invisible, of more than 40,000 tons, which is unprecedented. These increased stocks are due entirely to the great falling off in American deliveries, caused by large supplies carried over from 1920 and the slump in business. The average monthly deliveries, January to August inclusive, were only about 1,500 tons, and for the whole year the total was fully 50 per cent less than that of 1920. Europe, despite its troubles, has done measurably well, absorbing practically the same quantity as in the preceding five years, though 10,000 tons less than its average annual takings for five years before the war.

The improvement in deliveries to the United States during the last five months of 1921 was due partly to better business, partly to depletion of stocks, but more to the peculiar conditions surrounding the domestic output of tin. This latter is almost wholly dependent upon Bolivian ores. The situation in that country is obscure, but on account of low prices, labor troubles, unfavorable legislation, voluntary restriction, or other causes, the Bolivian shipments of 1921 will amount to only about 15,000 tons, instead of approximately 30,000 tons as usual. The situation must come to an end and more normal conditions be restored before long. Even at the low prices of the year, depreciated Bolivian exchange enabled sellers to realize in the currency of that country prices almost equivalent to those formerly obtained with tin at £200. That the mines can produce profitably at the return they are now receiving seems beyond question.

The reduction of the Bolivian output has curtailed the production of domestic tin and compelled consumers to use correspondingly larger quantities of imported tin. Imported tin is included in statistics. Domestic tin is not. As a consequence, deliveries are always larger than shown in statistics. When statistics showed 1,500 tons monthly deliveries, the deliveries were as a matter of fact considerably larger. Conversely, the published figures now benefit through the smaller quantity of domestic available and the additional imports of foreign tin required to make up the deficiency. Hence, we are not now on a basis so near normal as appears, any more than we were during the first seven months of the year on a basis so far below normal.

Immediately the domestic smelters are again able to operate fully and displace imported metal with the home-made article, the relatively favorable showing of the past few months will be impaired unless and until consumption so improves as to absorb not only the increased domestic output but the larger quantity of foreign tin now imported to take its place. The Government's conservation policy initiated during the war has been exceptionally succesful in the case of tin, the amount recovered from old material and used again rising from 12,000 tons in 1914 to 24,000 tons in 1920. This tin is not, of course, included, and cannot be included in statistics.

FUTURE IN THE TIN MARKET

The large supplies now visible, plus the large Eastern stocks overhanging the market, make it impossible for speculative groups to dominate and control the situation as they have done almost continually for a generation or more. What tin is worth without such speculative control and manipulation we do not know, but we do know that the Dutch government's cost of production before the war was not over £50 per ton, and that within a generation tin has sold as low as £56 in London and 12⅜c. New York. We also know that the cycle of post-war liquidation and deflation resulting in cheaper costs of production and lower prices, which the world must have before prosperity can be restored, is not yet completed.

Eventually, and without speculative control and manipulation, tin should sell at the cost of producing the quantity required, plus a fair profit, and no more. Absorption of stocks is likely to be slow. Decreased American deliveries account for increased stocks, but increased American deliveries will meet increased supplies, leaving stocks intact. Increased supplies do not necessitate increased production, but only that the tin produced shall be marketed. With the same production in 1922 as in 1921, 20,000 tons more will be shipped (unless stocks are further accumulated at the source of supply).

With remunerative prices, production should return to normal, which implies an increase of 20,000 tons in 1922 over 1921, or a total of 40,000 tons more available during the next twelve months than in the twelve months just past, and this without drawing on stocks, either visible or invisible. If the invisible is sold and shipped, we shall have 60,000 tons more, or just about double the quantity available in 1921—all predicated, of course, on high prices. Low prices alone can prevent it. What are high and low prices for tin? Everybody is agreed that £400 was high; £200 was the three-year average prior to the war (1911-12-13). The market lately has shown a disposition to regard £150 as low. Whether or not this decision will stand, remains to be seen. Decreased production has either been voluntary or enforced by abnormal conditions. The latter are righting themselves, and the former will be abandoned.

Tin is one of the most highly speculative commodities in the world. The great volume of speculation compressed within the narrow limits of the tin market often results in prices out of all proportion to value. Nor are all the speculators confined to the gambling fraternity. Many dealers and consumers who would possibly resent the charge are nevertheless great speculators in tin, as was shown in 1918 and again in 1920, with most disastrous results in both instances.

Subsequent events proved that at the time of the Armistice in 1918 we had a year's supply of tin hidden away, and there is no doubt that we were heavily overbought at the end of 1920. If we insist on repeating these costly experiences, doubtless both the surplus stocks and the increased production can be unloaded on us at high prices. Momentarily the market is strong, and predictions of further advances are freely made. Perhaps these predictions will be realized, but it should be borne in mind that America makes and unmakes the tin market. The steam gage is in London, but the boiler is here. Supplies are ample. If we pursue a sane and conservative buying policy, we should have no fear of a runaway market. The situation on its merits does not warrant high prices.

NEED OF AN ACTIVE NEW YORK METAL EXCHANGE

When Europe speculates she does so on the metal exchange. She does not take delivery except of what she needs, but trades in contracts, as is done here in wheat, corn, and cotton. Hence the uniformity of her deliveries in good times and bad. America, on the other hand, buys real tin, takes delivery of it, pays for it, and stores it away outside of the visible, thus distorting statistics, and giving an exaggerated idea of consumption, and adding fuel to the speculative flames, until the inevitable crash comes, catching us with large stocks on hand, against which we have no hedges and for which there is no market. All of which is crude, wasteful, and unscientific. We stack the cards against ourselves. There is no less speculation in Europe than in America, but until we learn to use our metal exchange as Europe uses hers, we will be at a disadvantage. An active metal exchange in New York would broaden the market and be of great benefit to all the metal trades, both at home and abroad.

MONTHLY AVERAGE PRICES OF TIN

	New York				London	
	99%		Straits			
Month	1920	1921	1920	1921	1920	1921
January	61.596	31.470	(a)	36.000	376.512	199.464
February	58.466	28.534	59.932	32.142	395.750	166.250
March	61.037	27.296	61.926	28.806	369.489	156.024
April	61.120	28.990	62.115	30.404	345.450	163.905
May	53.230	31.431	55.100	32.500	294.813	177.411
June	46.125	28.514	48.327	29.423	250.614	167.506
July	45.798	26.755	49.154	27.655	261.886	164.530
August	43.856	25.662	47.620	26.301	274.048	155.318
September	41.940	26.280	44.465	26.680	270.120	156.750
October	39.310	27.278	40.555	27.655	258.190	156.380
November	35.667	28.592	36.854	28.935	241.080	158.898
December	31.135	32.106	34.058	32.486	212.440	169.738
Year	48.273	28.576	49.101	29.916	295.866	165.265

(a) No average computed.
New York in cents per pound; London in pounds sterling per long ton.

The following tables illustrate the price fluctuations, visible supply and stocks and deliveries in recent years:

CLOSING PRICE OF SPOT STRAITS TIN AND OF STERLING EXCHANGE—END OF EACH MONTH OF 1921

	Spot Straits Tin, London,	Currency Equivalent, New York,	Spot Straits Tin, New York,	Spot Sterling Exchange, New York
	Pounds	Cents	Cents	
January	187–10	32.23	33.75	$3.85
February	176–10	30.42	30	3.86
March	166–10	29.14	29	3.93
April	178–10	31.48	32	3.95
May	178	30.74	31.50	3.87
June	167–10	27.89	28.875	3.73
July	160–5	25.54	26.50	3.57
August	157–15	26.26	27.	3.73
September	157	26.08	26.625	3.72
October	157	27.60	28.25	3.94
November	162–15	29.05	29.75	4.00
December	171–15	32.23	33.125	4.21

VISIBLE SUPPLY AND LONDON PRICES FOR SPOT STANDARD TIN AT THE END OF 1912-1921

Pounds Sterling per Ton of 2,240 Pounds.

	Tons	London Price
1921	24,060	£170–10–0
1920	18,439	£206– 0–0
1919	21,320	£341– 5–0
1918	20,945	£296– 0–0
1917	19,057	£193– 0–0
1916	17,561	£179– 0–0
1915	16,108	£170– 0–0
1914	15,858	£148– 0–0
1913	14,571	£170– 0–0
1912	11,668	£229–10–0

SUPPLIES, DELIVERIES AND STOCKS OF TIN AT THE BEGINNING AND END OF EACH YEAR 1913-1921 IN TONS OF 2,240 POUNDS.

	1921	1920	1919	1913
Visible supply Jan. 1	18,439	21,320	7,787	11,668
Supply				
Straits	36,107	45,431	51,045	62,467
Australian	1,175	3,000	2,600	3,300
Banca and Billiton	11,874	14,762	13,801	17,142
Standard	10,537	14,336	8,536	......
Total supplies	59,693	77,529	75,982	82,909
Total available	78,132	98,849	83,769	94,577
Deliveries				
Europe	28,394	27,191	29,445	40,540
United States	25,678	53,219	33,004	39,466
Total deliveries	54,072	80,410	62,449	80,006
Visible supply Dec. 31	24,060	18,439	21,320	14,571

The Outlook in Iron

Living on Stocks in 1921 Has Swept the Country Bare of Steel—Railroad and Building Main Dependencies of the Industry—Increase in Iron and Steel Production in 1922 Expected

BY ALVIN I. FINDLEY
Editor, *The Iron Age*, New York

REVIEWERS of 1921 and prophets of 1922—economists, financial writers, and leaders in banking and business—have made hopeful expressions concerning the new year. This is generally the case with business forecasts. At the opening of 1921 very few who wrote of the future seemed to look for anything like the severe industrial depression that developed. Predictions concerning the steel trade were no exception. There were even some iron and steel men who had an idea that 1921 would bring some rebound from the declining prices of the late months of 1920. Nothing of that sort happened, with the exception of a few jog-like advances that were succeeded by fresh declines. The price lines of the year trend uninterruptedly downward.

Sentiment in the steel trade today agrees generally with the views of the prophets who have already written about 1922. But steel manufacturers are not much given to definite prediction. Those of them who have been in the business for two or three decades have seen so much of the alternation of the lean and fat, and of the rapidity with which one condition can succeed the other, that their most dependable formula is that it is the unexpected that happens.

LIVING ON STOCKS

One reason for looking for better things in steel in 1922 is that the history of the trade shows no year in which the output was so small a percentage of capacity as it was in 1921. And the reason for such a record was that the country never entered on a year with so much finished iron and steel in the hands of the manufacturing consumer, or such large warehouse and storeroom stocks of the products of metal-working industries, as existed on Jan. 1, 1921. How the builders of ships, railroad cars, implements, automobiles, electric equipment, machine tools, and the manufacturers of builders' hardware, plumbers' supplies, domestic ware, and the thousand and one articles made from wire, sheets, and tin plates got through the twelve months with so little call upon the mills was the continuing wonder of the owners of steel plants, who scarcely knew a week ahead whether they would be able to operate.

Scanning the production curves of the last thirty years, to find backing for the hope of larger steel output in 1922 than in 1921, the steel maker sees that in 1894, following the panic year 1893, the line dipped deeply, but came up sharply in 1895. Similarly after 1907, with its November panic, 1908 was a year of low production, whereas 1909 even went beyond 1907. In 1914, with business paralyzed for five months after the outbreak of the war, came another drop, followed by a high figure in 1915.

Coming on to 1920, the crash came in the autumn, so that it was after all a year of good output in steel: then 1921 brought a precipitous drop. The tradition of the trade that a 50 to 60 per cent operation is to be expected, even in depressed times, from mere wear and tear, quite broke down, for at 19,250,000 tons of steel ingots (castings not included), 1921 was something less than a 40 per cent year. That argues strongly for a compensating output in 1922 unless we say that the Great Upheaval has put to confusion all the cycles and the curves.

THE COUNTRY BARE OF STEEL

Putting aside charts and records, the expectation of a larger demand upon the steel mills in the coming year than in 1921 is based in no small part upon the fact that the country has been swept bare of steel in the using up of inventories of every description. That this had gone far in some quarters was shown by the replenishment demand that sprang up last fall and that was more particularly noticeable in the wire and wire nail trade and in tin plates. Jobbers and manufacturing consumers of all forms of steel came to the point where broken stocks had to be patched up, and the aggregate of this imperative buying gave an impulse to the mills that had not exhausted itself at the year's end.

Railroad buying of steel, which includes car and locomotive works buying, was probably much less than 15 per cent of the country's output of 1921. While the railroads are following a very careful policy, and many officials have said they did not feel warranted in increasing their outlay for maintenance until they could make better earnings, the immediate promise for 1922 is for larger railroad buying than for last year.

PROSPECTS IN OTHER LINES

Building, next to railroad consumption, is thought of as one of the main dependences of the steel industry for the coming year. There has been some liquidation in wages and working conditions in the building trades, but not enough. The amount of house building last year was large. There are prospects of activity on a greater scale this year, but the feeling that labor must come down is more intense.

Agriculture should do more for the steel trade in the new year, but implement makers know that the farmer must harvest another crop before his buying power will count heavily in their behalf. Warehouses are still carrying implements made in 1920, but the liquidation has been steady, and unquestionably the worst has been passed.

The oil fields have come to the rescue of the steel mills in the last few months, and tank work has made up to the plate mills a part of their loss in shipyard tonnage. Pipe-line extensions have helped out also, and a good deal more work of this sort is in prospect.

The motor-car industry exceeded expectations in 1921, but the industry is in a transition, and predictions are made with reserve.

It is fair to look for a considerable consumption of steel in the twelve months just ahead in the large number of miscellaneous lines not generally enumerated in charting the main feeders of the steel mills. The aggregate of the uncounted use of steel may be put at 25 per cent of the total. It embraces many wear-and-tear requirements that have not been to the front since the breaking out of the war. They have much to do with replenishment and repair, in the common uses of iron and steel that touch the ultimate consumer.

The foundry industry, which was the buyer of from 7,000,000 to 8,000,000 tons of pig iron per year before the war, fared badly in 1921, steel foundries in particular being sufferers.

EXPORT TRADE IN IRON AND STEEL

In the export trade the outstanding difference between today and one year ago is that the steel companies then had a good-sized carry-over in 1920 business. Half of our shipments of iron and steel into the export trade last year were made in the first quarter. The start in export trade for 1922 is made from the scratch.

Exchange difficulties have not grown less. Some exporters of steel have considerable balances in South American countries which they cannot transfer to the United States because of the losses that would be involved in converting into dollar exchange. Japan is still one of our best customers in steel, taking over 100,000 tons of sheets alone last year. These are used extensively for roofing, for billboards, household utensils, and in a great variety of ways, many of them new. Japan also does a good deal of galvanizing.

THE COURSE OF PRICES

One year ago producers of iron and steel in all lines, particularly in pig iron, were giving reasons why the prices of their products could go down little if any until their costs had been readjusted. They believed lower ore, lower coke, and, more important, lower transportation was necessary to any material reduction in the prices of pig iron and finished steel. Events of the year show, however, that prices are made not by costs but by necessity growing out of the relation of supply and demand. Wage reductions have amounted to about 40 per cent in the last year, and in some cases common labor is receiving not more than half its war-time wage. Ore has been reduced, but it is still high in relation to finished material. Carrying charges stand where they were put by the 40 per cent advance of 1920.

The year's decline in pig iron is represented by a composite of $18.68 at the opening of 1922 as against $34.13 one year previous. The market today is but 19 per cent above the ten-year pre-war average of $15.72. The liquidation of finished material has gone far and the stress has been severe. The average price at mill, of the seven leading forms of finished steel—rails, plates, shapes, bars, plain wire, black pipe, and black sheets—was 2.06c. per lb. at the beginning of 1922, against 3.08c. one year previously and a ten-year pre-war average of 1.68c. Thus, finished material is today only 24 per cent above the ten-year average.

While it cannot be said that prices are at the bottom, it is evident that the process of deflation is far advanced. Manufacturers realize at the same time that the return to a profitable basis must be the road of reduced costs rather than of higher prices. Works managers studied economies from every angle in 1921 and much remains to be done.

Labor troubles may figure in no small way in steel works operations this year. Unemployment is still a serious problem in all centers of steel production. Work at iron mines will be scarce through the winter, and accumulations of ore at lower Lake docks and in blast-furnace yards will still be heavy as the season of navigation opens. So far as the steel industry itself is concerned, the year promises to be as free of strikes as 1921. There may not be two men for one job all the year but at no time will the labor surplus be inconsiderable.

Briefly, the outlook for iron and steel production in 1922 is for some increase upon that of 1921, this expectation being based on the indications that all industries passed their worst point last year and on the fact that the country's consumption of steel in 1921, bad year as it was, was greater than the production. There are no stocks to use up now, and the mills are the sole dependence. Having been slightly under 40 per cent of capacity in 1921, production may reach 50 per cent this year, and at some time in the year a 60 per cent operation may be attained. Prices may go lower than they are today, but reductions would rather be due to lowering of costs than to further cutting by manufacturers that would increase their current losses.

But any prediction of a larger operation in iron and steel in 1922 carries the reservation that the adjustments yet to be made by railroads, coal mines, and the building trades can be brought about without prolonged strikes in those industries.

Our Foreign Trade in Metals and Minerals

Record for 1921 Shows a Tendency To Return to Pre-War International Trade Conditions—Copper Exports Increased, While Those of Lead and Zinc Decreased—Tariff Being Strongly Urged by Producers

BY FELIX EDGAR WORMSER
Assistant Editor, *Engineering and Mining Journal*

FOREIGN trade in the metals and minerals is a small part of the foreign commerce of the United States. Although rich in mineral resources, the domestic demand for our own metal products and strong competition from other countries in international trade has left little room to build an export business in any of the non-ferrous metals except copper. The large cheaply mined copper deposits of the United States, American control of South American sources of supply, and the predominance of American refined production in the world's output have combined to make the great European manufacturing nations look to the United States for an adequate supply of copper. Unlike the commerce in other metals, such as lead and zinc, export trade in copper stands squarely on both feet and is able to meet competition from anywhere on the globe. No protection has been necessary to build up the industry.

Although exports of copper in 1921 are estimated to have been slightly smaller than the preceding year, less metal to be refined was imported, so that the record may be considered more satisfactory. The following table brings out this relation:

MOVEMENTS OF COPPER TO AND FROM THE UNITED STATES IN TONS, 1910—1921

Year	Imports	Exports		
1910–1913 (Average)	187,300	399,500		
1920	184,616	311,810		
			To France	59,245
			United Kingdom	49,740
			Germany	44,590
			Japan	41,450
1921 (eleven months)	125,778	310,000		
			To France	45,000
			United Kingdom	30,570
			Germany	106,000
			Japan	23,700

One of the surprising features of copper export trade during 1921 was the consistent predominance of German purchases and importations. Month after month, ever since December, 1920, German copper buying has exceeded that of any other nation, and as Germany was the largest consumer of exports before the war, this is a healthy sign of a return to normal conditions. Although Germany ranked third in importance as a copper importer in 1920, she has now moved up to first place. Especially during the last half of 1921 did the imports of France and England decline.

Besides the sales to Europe, the copper sold to Japan in 1921 was highly important and furnished a convenient outlet for copper refined on the Pacific Coast. Since June, 1921, when purchases suddenly began, Japan has been the second largest purchaser of American copper, importing about 8,000,000 lb. monthly. Prior to June, Japanese purchases were negligible.

There is no minimizing the fact that a healthy export trade is necessary for a prosperous copper-mining industry. Without it, as at present, mines will close down. Whether he wills it or not, the American copper producer is vitally concerned in the political and economic developments in Europe and Asia. They directly affect his pocket-book.

The Copper Export Association functioned satisfactorily during 1921, despite criticisms from abroad which predicted its disruption. The association has not stifled competition, as several large producers continue to sell copper abroad independently. Furthermore, Australian and African copper competes with American copper in European markets. For years manufacturers and others in Europe have been organized to enter foreign trade, and American copper producers, in adopting these tactics, are merely playing the same game.

Foreign trade in lead and zinc has reverted almost completely to its pre-war status. During the latter half of 1921, exports of "bonded" lead made from foreign ores were large, due to the attractive lead market in Europe and the possibility of shipping the lead there without the payment of a high duty. Mexican lead is shuttled about in seeking a market; when American prices are higher than those abroad the metal enters the United States; when London prices are better Mexican lead goes abroad. The London market was so much higher than that of New York in December that domestic lead also was sold to Europe, a most unusual situation and one that is not likely to continue. An estimate of lead movements in tons follows:

Year	EXPORTS From Domestic Ores	EXPORTS From Foreign Ores	IMPORTS Lead in Ore and Bullion	IMPORTS Pig Lead and Old
1910–1913	.	70,200	83,192	1,608
1920	2,735	16,837	62,796	35,719
1921 (eleven mos.)	631	22,492	42,569	31,068

Lead producers have been active in advocating a higher tariff. The imports of lead from Spain and France early in 1921 lent color to the plea. In May, 23,480,000 lb. and in June, 17,440,000 lb. of lead were imported, the only two months, however, that were favorable for such importations. Attempts are being made to import additional tonnages, but the market is too low and the tariff too high to make importations profitable. On the contrary, American lead, as stated in a preceding paragraph, has gone to Europe.

Zinc producers have accepted the abrupt change from heavy war-time exports of zinc to practically none, a tendency that was forecast long ago. They have been more concerned over importations of foreign zinc, which have encouraged an attempt to obtain a higher protective tariff. In March and April of 1921 large quantities of zinc entered the country, about 6,220,000 lb. in each month, but importations ceased abruptly in April and have been a negligible market factor up to January, 1922. Neither export or import trade in 1921, taken in the aggregate, is worth mentioning. A comparison of foreign commerce in zinc with other years, in tons, follows:

Year	EXPORTS From Domestic Ores	EXPORTS From Foreign Ores	IMPORTS In Ore	IMPORTS Blocks, Pigs,	IMPORTS Other Forms
1910–1913	6,300	11,100	18,110	4,300	574
1920	74,065	28,132 (a)	22,487	15	17
1921 (eleven mos.)	1,320	640 (b)	2,665	6,674	15

(a) Also 11,833 tons of zinc sheets; (b) Also 1,655 tons of zinc sheets.

The great unsettlement in the European zinc industry, particularly in Upper Silesia, and the doubtful outlook in other parts of the world, render it difficult to predict how foreign trade in zinc will be affected, but there is little reason to suppose that the situation will be much different from that prevailing before the war.

Of the precious metals, gold, silver, and platinum, import trade has been more important than exports. Gold shipments to the United States were so heavy during the year that record stocks have accumulated—about 40 per cent of the world's gold is now held in this country. Silver imports and exports both show decreases, the Pittman Act naturally diverting all domestic silver to the Treasury. Platinum imports were smaller in 1921, and exports larger, partly accounting for the relatively high price of platinum during the year. Owing to a possible modification in the attitude of European countries and the United States toward Soviet Russia, it would not be surprising if importations of platinum during 1922 showed a marked increase.

A table of imports and exports of the precious metals follows:

	Gold	Silver	Platinum
IMPORTS			
1910–1913 Average	$58,772,000	$44,868,000	116,374 oz.
1920	417,068,000	88,060,000	81,741 oz
1921	691,267,400	63,242,670	57,055 oz
EXPORTS			
1910–1913 Average	$69,041,000	$64,135,000	1,080 oz.
1920	322,091,000	113,616,000	1,302 oz
1921	23,680,000	51,575,400	3,264 oz

Imports of the minor metals generally declined during 1921. Imports of nickel dropped from 41,500,000 lb. to 2,200,000 lb., which is expressive of the condition of the nickel market. Imports of aluminum, arsenic, antimony, and the ores used in ferro-alloy manufacture, chromite, manganese, and tungsten, also show decreases. In none of these metals or ores, with the possible exception of aluminum, is export trade important.

IMPORTS OF MINOR METALS AND ORES 1920-1921

	1920	Eleven Months 1921
Aluminum, lb	40,074,132	26,884,573
Antimony, lb.	26,310,530	19,062,800
Arsenic, lb	8,166,089	6,286,665
Cobalt, lb	157,412	
Iridium, osmium, palladium, oz	18,683	14,953
Chromite, ton	160,275	81,855
Manganese ore, ton	601,437	386,454
Tungsten ore, ton	1,740	1,424
Monazite, lb	2,810,096	542,130
Nickel, lb.	41,586,108	2,023,681
Tin ore and oxide, ton	10,489	13,133
Bars, blocks, pigs, lb	[illegible]	43,321,622
Quicksilver, lb	672,630	528,005 (a)
Iron ore, ton	1,273,456	313,013

(a) Nine months.

Phosphate rock, sulphur, borax, and salt were the most important non-metallic minerals exported from the United States in 1921, but all show a falling off when compared with the record for 1920. The remaining non-metallics of importance, asbestos, chalk, nitrates, potash, fluorspar, mica, pyrites, talc, and china clay, were imported in smaller quantities, as the following tables indicate:

IMPORTS OF THE NON-METALLICS 1920-1921

	1920	Eleven Months, 1921
Abrasives (corundum) ton	3,374	1,496
Asbestos, ton	149,605	58,485
Chalk, ton	159,146	49,019
Magnesite, ton	43,154	46,655
Nitrates (soda) lb.	1,321,922	363,808
Potash, lb.	93,571,981 (a)	43,162,697 (b)
Kainite, ton	53,790	58,299
Fluorspar, ton	21,975	5,316
Meerschaum, lb	13,386	1,731
Mica, lb.	1,447,208	445,687
Gypsum, ton	265,542	224,443
Graphite, ton	18,835	7,157
Pyrites, ton	352,606	184,065
Talc, lb.	43,458,629	20,780,447
Mineral wax, lb.	4,272,341	8,111,423
Sulphur, ton	44	4
China clay, ton	323,488	119,535
Blue clay and bauxite, ton	49,000	31,256
Barytes, ton	24,874	6,315 (c)
Bauxite, ton	42,895	24,883 (c)

(a) 136,786 tons also came over as muriate and sulphate. (b) 66,851 tons also came over as muriate and sulphate. (c) Nine months.

EXPORTS OF MINOR METALS AND MINERALS 1920-1921

	1920	Eleven Months 1921
Aluminum, lb.	9,407,653	2,076,244
Asbestos, ton	549	463
Bauxite, ton	22,257	5,591
Potash, lb.	2,819,459	297,002
Borax, lb.	14,325,037	3,658,059
Sulphur, ton	477,450	267,179
Clays, ton	117,286	40,699
Phosphate, ton		
High-grade hard rock	344,896	175,294
Land pebble	693,355	506,395
All other	31,761	5,236
Iron ore, ton	1,145,037	438,126
Nickel, lb.	1,215,232	425,740
Platinum, oz.	1,302	3,264
Graphite, lb	1,213,616	1,797,066
Quicksilver, lb.	116,493	27,626
Salt, lb.	278,544,338	194,530,200
Iron ore, ton	1,145,037	438,126

For a time in 1921 it appeared that early action would be taken by Congress upon the tariff, but, presumably due to realization that the whole question is inextricably interwoven with the prosperity of the country as a unit and with the larger issues of debt cancellation, excessive gold reserves, and other economic problems of readjustment, a decision and report of the bill have been delayed. Whatever tariff is finally decided upon will have an important effect upon the foreign commerce of the United States in metals and minerals.

Metal-Market Problem for the Miner

Conditions Under Which Copper, Copper Ores and Mattes Are Sold Examples of Sales Contracts—How Silver, Lead, Zinc, and Tin Ores Are Marketed—Tungsten Concentrates—Crude Platinum

BY ALBERT R. LEDOUX
Of the Firm of Ledoux & Co., New York

NUMEROUS INQUIRIES at my office would indicate that some producers of ores and their derivatives, especially those abroad, do not now know where they can best find a market nor what are the usual forms for contracts, especially in view of recently changed conditions; nor how to calculate what net prices they might expect to receive for shipments; and I presume it is to throw a little light on these problems that the Editor of *Engineering and Mining Journal* has asked me to prepare a brief statement which may perhaps serve as a guide to those interested. Doubtless similar requests for information come to the *Journal*.

In addition to these inquiries, despite the fact that my firm are neither brokers nor commission merchants nor dealers in metals, it has happened occasionally that certain producers, particularly some doing business abroad, have consigned material to us for sale. Under such circumstances we have been compelled, however unwillingly, to act, and have placed the ore in the hands of brokers or commission houses to make the best bargain possible for the sellers. We have, however, many copies of contracts made without our intervention which have enabled us to make settlements with buyers or refiners on behalf of the sellers who have retained us not only to sample and assay but to complete the settlements.

As to these forms in general I would say that there is still no fixed standard, though the general tendency is in the direction of simplification, but there are sometimes variations of importance which may be overlooked. For instance, I recall two contracts made about the same time. In one of them it was provided that the payment for the metals contained should be based on the price established so many days after the arrival of the shipment in the buyer's works; in the other, so many days after the shipment arrives at the railroad terminus or at the steamship wharf. The latter form is the one usually adopted, being fair to the shipper and buyer because on a falling market there may be a suspicion that the buyer has induced the railroad company to hold cars in its yards or the captain of a lighter to permit his vessel to remain for a few days, loaded, alongside of the wharf. In that way time might be gained and a lower price paid than in the former instance. Though there are few if any buyers who would thus take advantage of a seller, it is well to eliminate a possible cause of suspicion.

Such occurrences being rare, it may be wondered why I mention one of them, but in past years sellers have, in some instances, discovered that the contract was based on the cost of casting copper, or cathodes, not knowing the difference in the price between these and ingots or wire bars. On a falling market my firm have been accused of delaying the sampling and assaying. We have no control of the sampling date; whenever the buyer is ready to sample we are present, but cannot expedite it. Therefore it is better to take, for the settlement date or quotation date, so many days after the arrival of the material rather than the date of sampling or the date of agreement of assays.

As to the general conditions of payment and the prices which the shipper is to receive for metals, these are, in the East at least, based on quotations for the average of the week of sampling, or for some other period, as stated by *Engineering and Mining Journal*. (The "week" means Thursday to Wednesday.) In some Western sections, however, the price paid is based upon the quotations of the Western Union Telegraph Co., and these, I understand, are obtained from the New York Metal Exchange. In my opinion, the quotations of the *Journal* are most likely to be representative of the actual market conditions, for it has access not only to the files of sellers but those of buyers, and their books are open confidentially for inspection. Furthermore, certain sales of ingots, wire bars, and other forms may not have taken place at the actual price for fine metals named in the contracts, an understanding being, whether stated in writing or not, that an allowance shall be made for all or part of the freight, say, to the Naugatuck Valley, or a special discount for cash payment in, say, New York, or payment deferred for sixty or ninety days without interest charges. These facts are known to the representative of the *Journal* who visits the trade in preparation of quotations, and are allowed for. They sometimes account for differences in quotations as between those issued by the Metal Exchange and those published in the *Journal*.

COPPER CONTRACTS ARE SIMPLIFIED

It is well known that there are few copper mines the products of which do not contain also certain proportions of other metals, particularly gold and silver, which in early days might not have been paid for but at present are accounted for in settlement. On the other hand, there are undesirable impurities, such as zinc, arsenic, or other metals. In some locations silica is penalized; also, in others, the smelter needs silica and may even have to buy it in the form of quartz or even beach sand, if the ores he smelts do not contain enough.

There was a time when silver in copper matte was not paid for unless it amounted to over 30 oz. per ton. There was therefore an inducement to add silver in some form to shipments of matte, to bring the assay up to or over 30 oz. per ton. In some instances at present, and more largely in the past, American smelters have penalized lead in matte, and of course zinc, antimony, and sometimes bismuth, as indicated before; whereas, on the other hand, some European buyers, particularly those in Germany, have surprised shippers of leady copper matte by paying for the lead also instead of penalizing it.

The tendency of today is in the direction of simplification of contracts. Despite seemingly complicated details of settlement, we have already advanced a long way from the former British terms which paid for copper in ores, concentrates, and mattes on the basis of landing weights in Great Britain. There were arbitrary deductions of so many pounds per ton for "draftage";

others for dock dues, town dues, master porterage fees, or other charges. The copper was paid for not on the electrolytic assay which shows the actual amount of total copper present but on the "produce" based on the supposed imitation in the crucible of smelter operations, and might or might not represent approximately the real amount of copper in the shipment. Then the settlement was based not on so many pence per pound of copper content but upon so many shillings per unit. The unit is 1 per cent per ton; that is to say, a unit of a ton of 2,000 lb. would be 20 lb. and payment would be so many shillings per ton for every 20 lb. of copper present; but the British custom was not based on the unit of the ton of 2,000 lb., nor yet upon the ton of 2,240 lb., but upon the "miner's ton" of 2,352 lb.

All contracts for ore, matte or blister in the United States are now based on the electrolytic assay for copper, but there still lingers an old trade custom of deducting from the electrolytic assay of ores or mattes 1.3 per cent, which is supposed to represent the differenc between electrolytic and "fire" assay. I hope to live to see the day when the payments for copper-bearing material, at least, will be based upon the actual amount present as shown by as perfect an assay as possible, the buyer paying so many cents per pound of copper content, as his knowledge of the character of the shipment and of the difficulty or ease of smelting or refining suggests.

I might interject here also the opinion that shippers would serve their interests best by employing reputable brokers in ores and metals, rather than by attempting to shop around by corresponding with various buyers. This refers particularly to sellers to establishments in the eastern United States. Though the tendency of the age is to get rid of the middleman as far as possible, I do not think the time has yet come when it is advisable to attempt this in connection with the sales of ores and metal products, particularly if the seller has no agent of his own on the spot, or if he be a foreigner unfamiliar with American conditions of marketing.

As an example, a much-condensed suggestion for a contract for the sale of copper matte based on examination of a large number of such contracts in my possession is given herewith. Some of the contracts date back several years; others were entered into during 1921. Matte is gradually disappearing from the market, but numerous mining companies, whose product is hardly large enough to justify the use of converters, or where fuel is unavailable, or other conditions do not admit of reverberatory practice, at least want to know the market for mattes. Suggestions for such a contract follow:

Contract—The seller states that he is producing a grade of copper matte running from 35 to, say, 55 per cent copper content, amounting on the average to so many tons monthly. He agrees to deliver this material (with the usual strike and accident clause reserved) at buyer's works or at a certain port during a period of —— years in as nearly as possible equal monthly shipments. The buyer agrees that the material on arrival shall be weighed and sampled by him jointly with Messrs. Doe & Roe, assayers, who shall represent the shipper. The buyer will make his own assays and Messrs. Doe & Roe those for the seller. Extra samples shall be sealed by both parties and held for umpire in case of difference in assays. The splitting limits shall be as follows: For copper, 0.25 per cent; for silver, 1.00 oz. per ton of 2,000 lb.; for gold, 0.03 oz. per ton of 2,000 lb.

If the assays of both parties agree within the foregoing splitting limits, they shall be averaged for settlement; otherwise one of the sealed samples shall be submitted to an umpire agreed upon, the umpire's assay to be averaged with that of the seller or the buyer which is nearest to his figures. If, however, the umpire shall be lower than both buyer and seller, or higher than both buyer and seller, his assay shall be thrown out and the average of the first two assays be taken in settlement. In settlement for the copper the usual trade allowance of 1.3 per cent shall be deducted and the copper paid for at —— cents under the quotation for refined electrolytic ingots or wire bars as given by *Engineering and Mining Journal* of New York City for the average of the week in which the material arrived at (a) the buyer's works or at the nearest port. (In the event of material arriving by ocean steamer, it is more customary, or at least more desirable, that the average of the week shall be taken during which the steamer arrived at the port of discharge. There is a larger deduction from the copper price paid for mattes below 45 per cent and a less deduction for mattes averaging above 50 per cent of copper.)

For the silver present the buyer will pay for 95 per cent of the content as shown by the settlement assay of the average United States or foreign bullion price quoted by *Engineering and Mining Journal* (or Handy & Harman) for the week in which settlement is made.

[Prior to the war, the price for silver was generally the London price, but conditions established by our Government under the Pittman Act have made the American price artificial, so that the London quotation more normally represents the market price. The American price is based on silver 999 fine; the London price is for "Standard" 925 fine, and the so-called foreign price is quoted here at the New York equivalent. On Dec. 15, 1921, the *Engineering and Mining Journal* quoted United States silver at 99⅝, and the London price (with exchange at $4.17) at the equivalent of 66¼c. per oz. (The American price is always used for silver originating in this country.)]

All the gold content is to be paid for without deduction at $20 per oz., if over 0.05 oz. per ton.

In many contracts, there are provisions for advances to the shipper on the part of the buyer against railroad or ocean bills of lading, such advances running from 80 to 90 per cent of the assumed value, based either on preliminary sampling or assaying at the shipping point or on the statement of the shippers as to their estimate of the value of the lot. Interest is always charged for such advances. As an indication as to how a settlement of this kind would turn out, I give the figures in the table for a certain lot of imported copper matte, omitting, of course, the names of the contracting parties and the date of the settlement:

SETTLEMENT FOR IMPORTED COPPER MATTE

	Buyer's Assays	Seller's Assays	Settlement
Copper, per cent	47.45	47.43	47.44
Silver, oz.	0.53	0.59	0.56
Gold, oz	0.10	0.10	0.10
Moisture	0.50 per cent		

		Pounds	
Net weight of lot		100,000	
Less moisture at 0.50 per cent		500	
Dry weight		99,500	
Copper assay—47.44 per cent less 1.30	46.14 per cent of 99,500 lb.		45,909 lb.
45,909 lb. copper at 13c.		$5,968.17	
Less smelting and refining charge at 2.90	per lb. copper	1,331.36	
Value of copper			$4,636.81
95 per cent of silver content at 66¼c. per oz			17.54
Gold content at $20 per oz.			99.50
			$4,753.85
Less advances			4,000.00
Net			$753.85

The foregoing is nearly an ideal contract, and might, under today's conditions, serve as a practical basis for a sale covering a single shipment or a period of a few months, but perhaps not for a long contract. New long-term contracts now being negotiated or recently entered into both for the sale of copper matte and blister copper recognize the changing conditions of labor and fuel costs, and, as a protection for both parties, include certain "variables," such as a clause providing that "This contract is based on present costs of fuel and labor and shall be readjusted [say] quarterly, as the cost of smelting and refining goes up or down."

The contracts for blister copper, say 98 per cent fine, are somewhat similar in their terms to those above out-used for matte, and in some of them, instead of the 1.30 deduction from the copper assay, there is a deduction of five pounds of copper, or some other figure, per ton of bars, to cover losses in process. There is or should be a penalty against non-fulfillment of contract on the part of the seller, especially in all long contracts where the works depend almost entirely upon this particular seller and would have to shut down in whole or in part if he failed to live up to his agreement. Of the copper, as found by assay, 99.75 per cent is paid for at the market price upon the agreed day of settlement. Of the silver, 95 per cent is paid for if less than 50 or 60 oz. per ton; if over 50 or 60 oz. per ton, the excess over the agreed limit is subjected to a further deduction of 5 per cent. All the gold is paid for at $20 per oz. There is a smelting or refining charge of, say, $27.50 per ton.

The calculation of the out-turn under this basis is, after all, not complicated, although I still think it would be better, where the copper constitutes the greatest element of value in the shipment, to do away with the refining charge entirely and to pay so many cents less than the value of the copper as established by the quotation accepted, but where it is simply a refining contract and the copper is returned to the shipper or sold for his account, the element of possible additional gain to the refiner, due to increase in the market, is removed from his estimate of profit.

There is usually insistence on the part of the buyers that moisture occluded in blister copper shall be deducted. It is found in some instances that the tops of the bars are porous and that if a shipment is rained on there is an appreciable amount of moisture present, and when the metal has been water-cooled in casting, this occlusion may be deep-seated and the weight thereby considerably increased. It is not infrequent that in drilling such blister copper for a sample the drill will enter a cavity half filled with water.

The contracts for copper ores differ considerably. The following are fairly typical of those entered into by two great metal houses in the East:

A—Copper paid for less 1.30 at the *Engineering and Mining Journal's* average quotation for the week in which sampling takes place—less a deduction of 2c. from this quotation. All gold paid for at $20 per oz. Ninety-five per cent of silver content paid for at Handy & Harman's quotation for the week of sampling. Treatment charge, $2 per ton of 2,000 lb., based on net, dry weight. Splitting limits: For copper, 0.2 per cent; for silver, 0.8 oz. per ton of 2,000 lb.; for gold, 0.05 oz. per ton of 2,000 lb. Payment sixty (60) days after arrival of importing steamer at New York. Delivery, c.i.f. New York. Assays settled between buyers and Doe & Roe, representing sellers. Usual umpiring clause. Empty bags to be returned to seller or sold for his account.

B—Delivery f.o.b. smelter's wharf, or c.i.f. New York. In latter case seller pays cost of lightering—say, $1.50 per ton. Copper less 1.30 paid for, less —— cents smelting and refining charge. Silver, if over 1 oz. per ton, 95 per cent paid for. If ore is of American origin, silver is paid for on the New York quotation; if of foreign origin, on the New York equivalent of the foreign price for silver. Gold, if over 0.05 oz. per ton, paid for at $20 per oz. Smelting charge of $ —— per ton. If ore is so fine that it must be briquetted, —— cents per ton is charged for briquetting. (This relates chiefly to concentrates. This degree of fineness is based on a test: If 35 per cent or over goes through a ¼-in. mesh screen, the penalty is enforced.)

Excess of alumina (Al_2O_3) over —— per cent is penalized; also zinc in excess of —— per cent; likewise arsenic, antimony, and bismuth. Neutral ores are desirable, and any excess over an agreed maximum of silica and (or) iron penalized at —— cents per unit.

Date of payment, —— days after arrival, or of agreement of assays, or after sampling or according to other terms of the agreement.

Some ores are imported which are most valuable for their silver content, lead being negligible, although both gold and copper are paid for. These ores have sold, under the most recent contracts, on the following basis: Ninety-eight and one-half per cent of the silver ascertained by assay is paid for at the New York price for foreign silver as quoted by *Engineering and Mining Journal* on the tenth day after the date of sampling, provided the silver content is under 6,000 oz. per ton of 2,000 lb. If the silver content is 6,000 oz. or over, 99 per cent of the content is paid for. If there happens to be no quotation for silver on the date above mentioned, the quotation for the day next following applies. All the gold is paid for at $20.60 per oz. If copper is present to the extent of 10 per cent or over, 1.30 being first deducted from the assay, this copper is then paid for at 3c. below the New York price of electrolytic copper as quoted by the *Engineering and Mining Journal* on the same day taken for the silver valuation. There is a smelting charge of $25 per ton of 2,000 lb., based on the net dry weight of material. Payment twenty days after sampling at buyer's works; delivery at buyer's works.

LEAD ORE SETTLEMENTS COMPLICATED

With respect to lead ores, diverse conditions must be considered. Contracts vary as between low- and high-grade lead ores, between Western and Eastern terms, and between American and imported products. Most of such ores arriving at works on the Eastern seaboard are of a low grade and carry, naturally, silver. Here are two typical contracts:

A—Ninety per cent of the lead content is paid for on the wet assay, less 1.50 per cent; that is to say, if the ore contained 15.50 per cent lead by wet assay, 14 per cent is paid for. The price is based on the New York quotation of *Engineering and Mining Journal* on the tenth day after the date of sampling at buyer's works and after further deduction from the assay of 3 per cent. In this instance, on the above assumption, the lead content, which is supposed to have been 15.50, and 14 per cent after the deduction of 1.50 per cent, is subjected to a further deduction of three points; that is to say, 11 per cent net will be paid for. In addition, a deduction to cover part of the supposed smelting costs is made at the rate of ½c. per lb. There is the provision that the quotation shall be taken as of the day of sampling or upon the next day if there be no quotation. One important point is that in transactions involving the sale of dutiable ores, the import duty is paid by the seller. If gold is present to the extent of 0.05 oz. per ton of 2,000 lb. or over, all is paid for at the rate of $20 per oz. Ninety-five per cent of the silver content is paid for at the *Engineering and Mining Journal's* quotations for foreign silver as of the day when the quotation for lead is taken.

There is a penalty for zinc present at the rate of 50c. per unit on any excess over 8 per cent. A penalty likewise for arsenic of $1 per unit on all present over 2 per cent. There is a smelting charge of $10 per ton on the net dry weight of ore. The delivery is c.i.f. New York and the payment forty days after arrival of steamer at the port of New York. Conditions of sampling and assaying are as in previous contracts.

It will be seen that this is a complicated method of figuring, and I append at this point the results of a recent settlement on ores of this class:

If there be brokerage or commission it will be deducted in remitting the net proceeds as above. In some transactions, bags if in good order are returned to seller by freight at his expense; otherwise they are sold for his account either as second-hand bags or junk, and the proceeds remitted.

INVOICE FOR 960 BAGS LEAD ORE [illegible]

960 bags weighing [illegible]		[illegible]
Moisture 0.3 per cent		289
		[illegible]194
Gold—0.03 oz. per 2,000 lb.		
Silver 172.20 oz. per 2,000 lb. = 8,282.5[illegible] oz. [illegible]	[illegible]	
69.625		$5,[illegible]
Per Cent		
Lead 23.60		
−1.50		
22.10		
3.00		
19.10 per cent = 18,430 lb.		
Cents		
90 per cent = 16,587 lb. at 4.675		
0.500		
4.175		[illegible]
		$6,170.7[illegible]
Refining charge at $10 per ton	$48[illegible]	
Zinc 15.26 per cent penalty over 8 per cent = 7.26 per cent; 349.18 units at 50c.	[illegible]	
Arsenic 2.5 per cent penalty over 2 per cent = 0.5 per cent; 24.05 units at $1	24.[illegible]	[illegible]
Net proceeds		$5,4[illegible].12

B—*Delivery*—F.o.b. smelter, or c.i.f. New York; in the latter arrangement, lighterage charges being for account of seller.

Lead—90 per cent of the lead contents, as per dry assay, that is, wet assay less 1½ units is paid for at the New York quotation or London quotation for pig lead, less a refining charge of 1½c. per lb. of lead paid for.

Silver—If contents exceed 1 oz. per ton of 2,000 lb., 95 per cent of the silver content (minimum deduction 1 oz. per ton of 2,000 lb.) is paid for at the New York price of silver as quoted by Handy & Harman. Because of the operation of the Pittman Act, if the silver is of domestic origin the New York quotation for domestic silver is stipulated; if of foreign origin, the New York foreign price of silver is stipulated.

Gold—If content exceeds .05 oz. per ton of 2,000 lb., all gold is paid for at $20 per oz. No payment is made for gold if content is .05 oz. or below per ton of 2,000 lb.

Smelting Charge—$15 per dry ton of 2,000 lb. of ore.

Penalties—Sulphur—Content in excess of —— per cent penalized at —— cents per unit per dry ton of 2,000 lb. ore. *Zinc*—In excess of 8 per cent penalized at 50c. per unit per dry ton of 2,000 lb. ore. *Arsenic, antimony,* and *bismuth combined*—In excess of 1 unit penalized at 50c. per unit per dry ton of 2,000 lb. ore. *Tin*—In excess of —— per cent penalized at —— cents per unit per dry ton of 2,000 lb. ore.

Payment for precious metals, and charge for smelting and refining is due sixty-days after date of sampling. This is at times varied, fixing payment thirty days after date of agreement of assays or after arrival of the material at works or port of entry.

Only a small amount of zinc ore is imported, and, indeed, much less than was previously produced under 1921 conditions. The usual "Joplin terms" are based on 60 per cent of zinc, paid for at the price ruling or agreed upon, less a deduction or addition of $1 per unit per ton of 2,000 lb. in accordance as the assay goes below or above 60 per cent.

Tin ores are becoming more and more an important import, though there are as yet only three or four buyers. Here is a recent contract:

> Tin content is paid for at the average of cash and three months' prices of standard tin as quoted in London during the two calendar weeks following the arrival of the importing steamer at the port of discharge, these quotations being converted into United States currency at the average of the demand rate of exchange on London which rules on the days which are taken for pricing. There is a treatment charge of about $85 per ton of 2,240 lb., based on the net dry weight of ore and on a tin content of 60 per cent.
>
> For each unit of tin content below or above 60 per cent, $1 per ton of 2,240 lb. to be added to or deducted from treatment charge; fractions pro rata. It will be noted that the unit of this ton is 22.40 lb. and that the payment of $1 is based on the ton of 2,240 lb., not on the ton of 2,000 lb.
>
> Usual terms of payment are cash thirty days after arrival of shipment at buyer's works. The delivery, however, is at the dock in New York City, if the ore, as is usually the condition, is [illegible] in the [illegible] of New York. The assays are made under the same conditions as those outlined for copper shipments. Sampling takes place at buyer's works. The seller pays the charges of samplers who represent him in weighing and sampling [illegible].

Shipments of tungsten concentrates still come in, though at an ever-diminishing rate, and buyers are more and more particular. They are sold on a simple contract based on the unit of tungstic oxide (WO_3). These have been generally sold on the weights and assays of one firm of chemists, if coming to New York, but I believe that it is always better that the weighing should be made jointly by buyers and the representatives of the sellers, and that assays should be compared, the average taken, and a provision made for umpiring in case of difference. This avoids complications and claims against either the seller or the assayers representing both parties. It is more satisfactory that assays be compared, and if there be any serious differences, either party or both parties should reassay or an umpire satisfactory to both be selected.

Though the settlement, when determined, is simple, conditions as to grade and impurities are important. The shipment is usually sold on a guarantee of 60 per cent of tungstic oxide—sometimes 65 per cent. Some buyers refuse the lot if tin, phosphorus, arsenic, sulphur, copper, bismuth, or manganese are present in excess of certain specified amounts—e.g., copper over 0.05 to 0.10 per cent. Phosphorus must be below 0.05 per cent and other requirements of like nature observed.

In the Chinese product, though tin is present, the concentrates are taken, at a price, and the tin and some other impurities are separated, before treatment in the electric furnace.

With the increasing amounts of crude platinum coming to New York, there has gradually developed a standard for its sale. The quotations of *Engineering and Mining Journal* are not taken as a rule, in the settlement under contracts, largely because there are so few buyers of crude platinum, and they apparently establish a price either by conference or otherwise. Most of the crude coming forward contains upward of 80 per cent platinum, 1 to 2 per cent gold, about 2 per cent of osmiridium, and from 0.6 to 1 per cent of palladium, and is consigned to banks or other houses having Central American connections. The banks make advances to the shipper and sell the platinum at a price high enough to protect themselves, of course getting as much as possible in addition for the shipper. The buyers usually state what they would consider to be the market price of platinum and pay about $2 per oz. below this price for the platinum content of the shipment. All of these crude platinums contain osmiridium and palladium as well as other of the rare metals, and also gold. For the osmiridium present buyers pay from 45 to 50 per cent of the agreed price for platinum content; for palladium they pay about $20 per oz.[1] below the platinum price, and for all the gold $20 per oz. Nothing is paid for the small quantities of other rare metals, if present.

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[1] This is not a fixed price for palladium, but varies from [illegible] and considerably.

Future of the Non-Metallic Minerals

Analysis of Inefficiencies in Mining, Milling and Marketing—Grade Association Movement—Consolidation of Small Companies—Improvements In Methods and Utilization

BY RAYMOND B. LADOO*
Mineral Technologist, U. S. Bureau of Mines.

THE INEFFICIENCIES which long have characterized the production, treatment, and utilization of many of the non-metallic minerals have at last begun to attract the serious attention of engineers, chemists, and even financiers. There are many signs indicating that the non-metallic mineral industries are entering upon a new era. Improvements in methods and equipment are being forced upon the producers by many circumstances and conditions.

Before discussing the causes for and means of improvement, it may be well to summarize some of the present and past inefficiencies. These may be grouped under mining, milling, and marketing, and are as follows:

MINING

1—Lack of knowledge of markets, causing unwise ventures.

2—Lack of knowledge of deposits, resulting in improper methods of development and mining, low grade of product, premature exhaustion of deposits, unwise location of waste dumps, and other adverse conditions.

3—Lack of engineering and technical control of operations, resulting in wastes, inefficiences, accidents and high costs.

4—Lack of adequate financing, either for equipment or working capital.

MILLING

1—Use of improper and inadequate materials and machines, resulting in high costs and poorly prepared products.

2—Absence of technical and chemical control of processes resulting in poorly prepared products lacking in uniformity.

3—Production on too small a scale to permit economies in methods, equipment, and marketing.

4—Lack of co-ordination between mine and mill, caused by mill owner not controlling source of raw material.

MARKETING

1—Lack of standardized grades, tests and specifications, making uniformity of products impossible.

2—Marketing through jobbers and brokers, rather than direct, rendering impossible the necessary direct contact between producer and consumer.

3—Lack of knowledge by producers of consumers' needs as to grades of product.

4—Lack of knowledge by consumers as to the sources of their raw materials and as to the requisite physical and chemical properties of such materials.

As long as costs, prices, and freight rates were low, the importance of remedying some of the difficulties enumerated was not so urgent. Moreover, consumers had not realized keenly the necessity of a careful technical study of their raw materials. But within the last few years high costs and prices have caused consumers to seek better quality, to set up more rigid standards and tests, and to seek lower-priced raw materials. High freight rates have caused them to seek to supply their needs from nearer sources.

Potters have learned that low-grade feldspar, not uniform in qualities, causes high kiln losses, that such losses can be reduced by obtaining a high-grade, standard feldspar, and that it is good business to pay higher prices to guarantee high quality. Old-fashioned producers have found their methods and equipment inadequate to meet the rising standards, and they are being forced to improve or lose their customers to more progressive competitors.

TENDENCIES TOWARD IMPROVEMENT

Changes and improvements now going on are taking several forms. The most important of these are the trade association movement, consolidation of small companies into larger units, acquiring of sources of raw materials by comsuming companies, operation of several smaller companies under technical and managerial control from a parent company, and new, independent, unit companies. It is interesting to note that marked improvements by long-established companies acting as individuals are not common. The reasons for this are either conservatism or too high capital investment, caused by poor accounting or unwise ventures.

The trade association has been the most important factor in increasing prosperity and raising general efficiency in many industries. In a few instances, such associations have given too much attention to price fixing and have got into difficulties with the Government. But by far the majority of the trade associations in the mineral industries are honestly and energetically seeking to improve methods and equipment, to standardize products, devise new uses, encourage research, and expand markets by advertising and publicity. The association does for the small producer many of the things which he cannot do for himself. Some of the most valuable results of association work have been the setting up of uniform standards for products and method of testing, through co-operation with the American Society for Testing Materials and various governmental agencies, such as the Bureau of Standards, the Bureau of Mines, the Bureau of Public Roads, and other public boards and bureaus.

BENEFITS OF CONSOLIDATION

The consolidation of smaller companies into larger units has taken place in several industries, and has been beneficial to producers and consumers alike. It has cut down overhead, substituted all the financial and operating advantages of large companies for the disadvantages and handicaps of small companies, promoted efficiency of operations, made more uniform and better products, and tended to lessen senseless and ruinous competition.

The tendency of consuming companies to acquire their own sources of raw materials is becoming more marked each year, and will become a menace to the independent producer unless the fundamental causes for such action are removed. Paper companies are acquiring their own clay and limestone deposits; potters are grinding their own feldspar; chemical companies are opening limestone deposits and burning their own lime. In many, probably most, instances the consuming companies have no desire to enter the mineral field, but they are forced into it through their inability to obtain proper materials from present producers. Often they do not understand their new field and waste much time and money before they produce regularly, but they eventually succeed and are satisfied even if their costs are somewhat higher than good management can sanction. It would be well for present producers to note this tendency and seek to remove every cause for dissatisfaction with their product before their markets are permanently closed to them.

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The operation of several smaller companies under technical and managerial control by a larger parent company as yet has been attempted only by a few organizations and on a small scale; but for some of the minor, non-metallic mineral industries this plan offers the greatest advantages with the least risk. It gives all the financial power and stability of a large company, at the same time furnishing the necessary specialized technical, managerial, and sales technique for each individual project. It minimizes the financial risk by distributing it over a number of dissimilar but related projects. It seems probable that this type of organization will become increasingly important. Independent unit companies will probably always continue to spring up, but the need for large-scale operations will make the success of this type of organization increasingly difficult.

IMPROVEMENT IN MINING AND MILLING METHODS

Marked improvements in methods of mining and milling must, in many instances, imply larger-scale operations, control by larger companies, or co-operative effort through trade associations or similar agencies. Many labor-saving devices cannot be used economically on small tonnages, and some types of machines are not made in small sizes. Adequate engineering and technical control involves the employing of high-salaried men, which small companies, working independently, cannot afford. It should not be implied that large companies are always operated efficiently, for some of the largest companies are grossly inefficient. But large companies can afford economies of operation not available to smaller organizations.

The essential points of successful operation of mines and mills, assuming adequate and well-located deposits of raw material of commercial grade, are efficient engineering and chemical control and adequate capital. Technical control will insure reasonable costs of production, uniformly high grades of product, and the keeping pace with improvements in methods and equipment. Adequate capital is needed for the purchase of equipment necessary to efficient operation, to tide over market depressions, and to provide sufficient working capital so that raw material and finished products may be stocked and customers' accounts be carried without the need for selling through jobbers.

The tendency toward greater utilization of labor-saving machines and equipment is marked. This change has been prompted by high labor costs, inefficiency of labor, the development of more efficient machinery, needs for greater speed of production and larger output, and gradual exhaustion of the more easily and cheaply minable deposits.

As the non-metallic minerals become more the subject of scientific investigations and research, new uses will be found for materials now produced, as well as for materials not now mined or discarded as waste in mining other products. An illustration of this tendency is the recent widespread interest shown in bentonite. Several new companies are now producing this material, hitherto mined in only small quantities, and through systematic study and investigation, are introducing it into many industries. A petroleum company in California has discovered a method of chemical treatment of a bentonite found in that state whereby it produces a bleaching agent for petroleum five times as powerful as the best fuller's earth. The utilization of New Jersey greensand for the extraction of potash is another well-known example.

GREAT WASTE IN SLATE QUARRYING

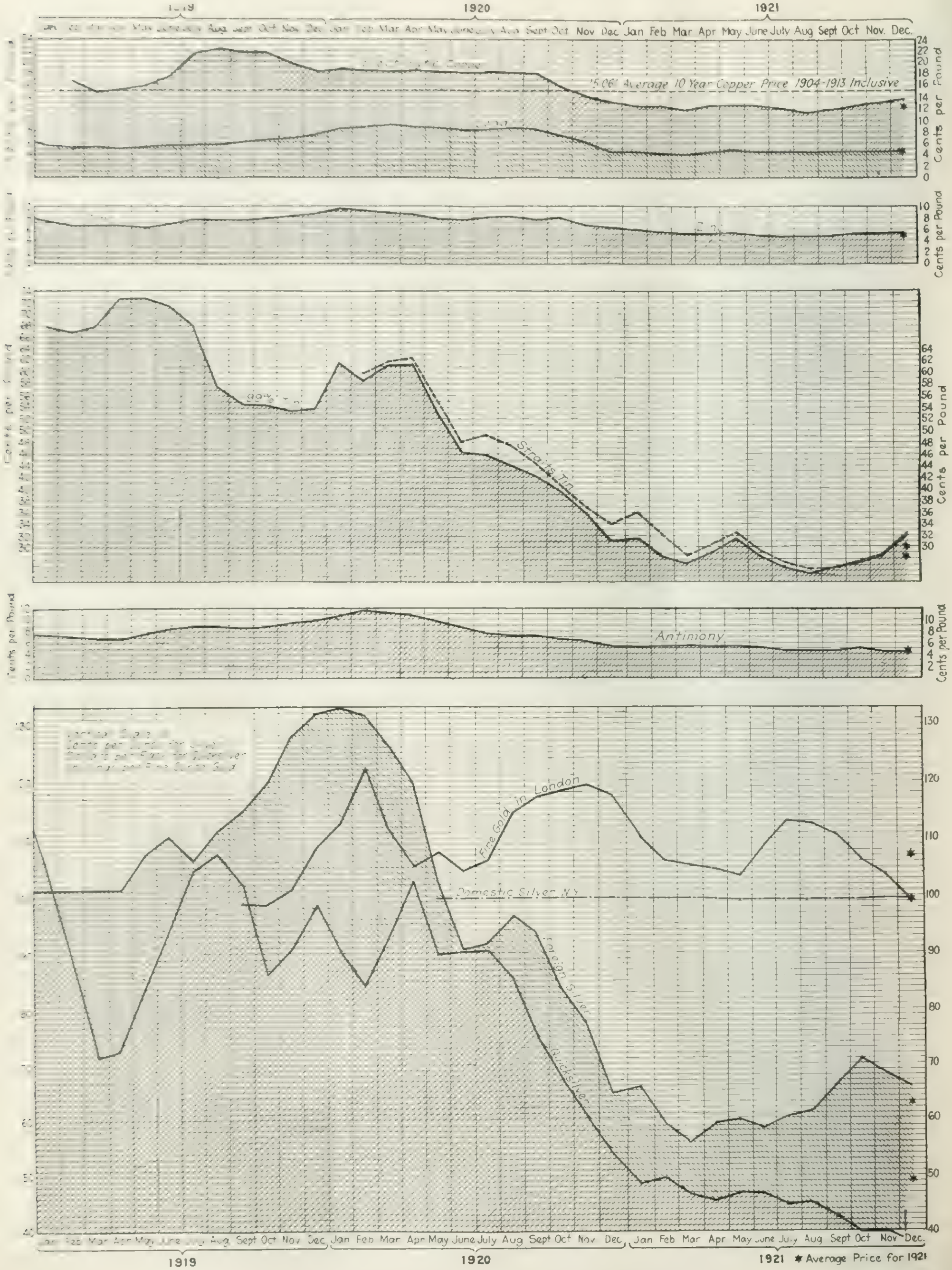
The quarrying of slate involves the production of large amounts of waste, sometimes as high as 80 per cent. Recent investigations by Oliver Bowles, of the U. S. Bureau of Mines, have shown that this waste slate may be pulverized and used advantageously as a filler in road asphalt mixtures, in pressed and molded rubber goods, and for other purposes. Biotite, or black mica, has always been a worthless waste product in quarrying feldspar, but recent developments indicate the possibility of a market for fairly large quantities of this material.

Consumers of the non-metallic minerals are beginning to study their raw materials more critically and to formulate ideal specifications to fit their needs. The filling of these specifications requires a careful survey of available materials, which often results in opening new deposits.

Many of the non-metallic mineral industries have sought high tariff protection and have insisted that without such protection the domestic industries cannot live. Among the industries seeking such protection are graphite, magnesite, potash, mica, talc, barytes, fluorspar, and high-grade clay. It is true that some domestic industries cannot survive without protection, but whether or not such protection is desirable from a national standpoint has been questioned.

No one can predict the amount of tax which will be granted in the final tariff bill, but it probably can be assumed that most minerals will be accorded some degree of protection. However, it has been predicted that the rates granted in the Fordney Bill, which passed the House of Representatives, will be generally scaled down before the final passage of the bill. Without high protection, the domestic production of some of the non-metallic minerals will undoubtedly decline, or, rather, some of the non-metallic industries will not recover from their present depressed condition. But the surviving companies will be the stronger and more efficient ones, and the technology may be improved thereby.

The future promises improvements in the non-metallic mineral industries in many directions. These may be summarized as follows: Wider recognition of the importance of the non-metallics by producers, consumers, engineers, chemists, and investors; increased production and wider utilization of products; larger and stronger producing companies; improved methods of mining and milling; better standardization of products and methods of testing; better and more uniform grades of product, made necessary by better informed and more intelligent utilization; wider utilization of new products and of present waste products; greater co-operation among producers for the general benefit of their industries; increasing use of mechanical equipment to supplant hand labor; development of new machines specifically adapted to the milling of the non-metallic minerals.



MONTHLY AVERAGE PRICES OF METALS

Mining Dividends

DIVIDENDS OF MINING AND METALLURGICAL COMPANIES IN THE UNITED [illegible]

				Dividends Paid 1920		1921			Latest		
Company Name	Situation	Shares Issued	Par Value	Per Share	Total	Per Share	Total	Total to Date	Date		Amount
Ahmeek, c	Mich.	200,000	$25	$1.50	$300,000			[illegible]	[illegible]	[illegible]	[illegible]
Am. Sm. & Ref.	U. S.-Mex.	609,980	100	4.00	[illegible]	$1.00	[illegible]	[illegible]	[illegible]	[illegible]	1.00
Am. Sm. & Ref. pfd.	U. S.-Mex.	500,000	100	7.00	3,500,000	7.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Am. Smelters, pf. A	U. S.	[illegible]	100	6.00	[illegible]	6.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Am. Smelters, pf. B	U. S.	30,974	100	5.00	150,601	[illegible]	154,870	[illegible]	[illegible]	[illegible]	[illegible]
Am. Zinc, Lead & Sm. pfd.	U. S.	80,540	25	6.00	483,240			2,188,401	[illegible]	[illegible]	[illegible]
Anaconda, c. s. z	Mont.	2,331,250	50	4.00	10,490,625			[illegible]38,750	[illegible]	[illegible]	[illegible]
Argonaut Consol., g	Cal.	200,000	5	.10	[illegible]			[illegible]	[illegible]	[illegible]	[illegible]
Arizona Copper	Ariz.	1,519,896	5s.	[illegible]	[illegible]			[illegible]7,894	Mar.	[illegible]	[illegible]
American Metal	U. S.	140,000	100		1,400,000	6.00	840,000	(Not reported)	Dec.	'21	[illegible]
Barnes King Dev., g	Mont.	400,000	5	.15	60,000			440,000	[illegible]	'20	[illegible]
Bunker Hill & Sullivan, l. s.	Ida.	327,000	10	6.00	1,962,000	3.00	981,000	[illegible]	Dec.	'21	[illegible]
Caledonia Mining, l. s.	Ida.	2,605,000	1	.08	208,400	0.01	26,050	4,[illegible]	Dec.	'21	0.01
Callahan Zinc Lead, z	Ida.	464,990	10	2.00	755,606			7,721,688	Dec.	'20	0.50
Calumet & Arizona, c	Ariz.	642,521	10	4.00	2,570,084	2.00	1,285,043	46,915,514	Sept.	'21	0.50
Calumet & Hecla, c	Mich.	100,000	25	5.00	500,000			152,250,000	June	'20	5.00
Camp Bird pfd., g. s.	Col.	649,625	£1	7%	£45,473.75				July	'20	[illegible]
Cardiff, l. g	Utah	500,000	$1	.15	$75,000			875,000	Dec.	'20	0.15
Central Eureka, g	Cal.	392,616	1	.32	125,637	0.06	23,557	1,087,296	Mar.	'21	0.06
Champion, c.	Mich.	100,000	25	6.00	600,000			25,850,261	Apr.	'20	6.00
Chief Consolidated, s. g. l.	Utah	884,022	1	.40	353,689.20	0.20	176,805	2,048,523	Nov.	'21	0.05
Chino Copper	N. M.	869,980	5	1.12½	978,728			2[illegible],991,710	Sept.	'20	0.375
Copper Range, c	Mich.	494,363	25	1.50	592,500			26,998,345	Sept.	'20	0.50
Cresson Consol., g	Col.	1,220,000	1	.20	244,000			8,857,163	June	'20	1.00
Daly, s. l. g	Utah	150,000	20	.30	30,000			3,142,500	July	'20	0.10
Daly West, s. l.	Utah	250,000	20	.90	225,000			6,868,000	Dec.	'20	0.25
Davis Daly, c. s.	Mont.	600,000	10	.25	150,000			900,000	Mar.	'20	0.25
Dragon Con., s. c. l. g. i.	Utah	1,875,000	1	.02	37,500			206,250	Apr.	'20	0.01
Eagle & Blue Bell, l. s.	Utah	893,146	1	.35(a)	312,601	0.05	44,657	1,607,663	Apr.	'21	0.05
Electric Point, l	Wash.	793,750	1	.18	142,875			444,500	Oct.	'20	0.12
Federal M. & Sm., pfd.	Ida.	120,000	100	6.00	720,000	4.00	480,000	16,413,837	Dec.	'21	1.00
Gemini, g. s.	Utah	5,000	100	6.00	30,000			2,490,000	Aug.	'20	6.00
Gold Chain, s. l. g	Utah	1,000,000	25	....		0.01	10,000	140,000	Jan.	'21	0.01
Golden Cycle, g	Col.	1,500,000	1	.08	120,000	0.08	120,000	9,633,300	Dec.	'21	0.02
Grand Central, g	Utah	500,000	1	.03	15,000	0.01	5,000	1,830,250	Jan.	'21	0.01
Granite Gold Mng. Co.	Col.	1,650,000	1	...	...	0.03	49,500	418,500	Feb.	'21	0.03
Hecla Mining, l. s.	Ida.	1,000,000	0.25	.65	650,000	0.50	500,000	9,505,000	Dec.	'21	0.17
Homestake, g	S. D.	251,160	100		....	2.00	502,320	42,924,664	Dec.	'21	0.25
Inspiration Consol., c	Ariz.	1,181,967	20	5.00	5,909,835			38,983,701	Oct.	'20	1.00
Internat. Nickel pfd.	U. S.-Can.	89,126	100	6.00	534,756	6.00	534,756	8,555,982	Nov.	'21	1.50
Iron Blossom, s. l. g	Utah	1,000,000	0.10	.05	50,000	0.025	25,000	3,300,000	Dec.	'21	0.025
Iron Cap Copper	Ariz.	142,100	10	.50	71,050	....		1,031,893	Sept.	'20	0.25
Judge Mn. & Sm. s. l.	Utah	480,000	1	.37½	180,000	....		2,550,000	Sept.	'20	0.125
Kennecott Copper	Alaska	2,787,121	....	2.00	5,574,162			53,502,411	Dec.	'20	0.50
Marsh Mines Con.	Ida.	1,980,000	0.25	...	...	0.02	40,000	40,000	June	'21	0.02
Miami Copper	Ariz.	747,114	50	2.00	1,494,228	2.00	1,494,228	24,444,887	Nov.	'21	0.50
Mohawk, c	Mich.	100,000	25	5.50	550,000	...		9,675,000	Nov.	'20	1.00
National Lead	U. S.	206,554	100	6.00	1,239,324	6.00	1,239,324	10,999,001	Dec.	'21	1.50
National Lead pfd.	U. S.	243,676	100	7.00	1,705,732	7.00	1,705,732	23,880,248	Dec.	'21	1.75
Nevada Consol. Copper	Nev.	1,999,457	5	.75	1,499,592.75	...		46,768,627	Sept.	'20	0.25
New Cornelia Copper	Ariz.	1,800,000	5	.50	900,000			1,350,000	Aug.	'20	0.25
New Jersey Zinc	U. S.	454,664	100	12.00	6,100,000	8.00	3,498,656	(Not reported)	Nov.	'21	2.00
North Star, g	Cal.	250,000	10	0.30	75,000	0.20	50,000	5,662,040	Mar.	'21	0.20
Oroville Dredging, g	Cal.	686,538	£1	1 6	£51,490,135	9d	£25,745	£454,781	Mar.	'21	9d
Osceola Consol., c	Mich.	96,150	$25	$1.00	$96,150			$17,756,375	June	'20	0.50
Phelps Dodge Corp	U. S.	450,000	100	10.00	4,500,000	5.50	2,475,000	98,846,000	Oct.	'21	1.00
Portland Gold	Col.	3,000,000	$1	.06½	195,000			11,692,080	Oct.	'20	0.015
Quincy Mining	Mich.	110,000	25	1.00	110,000	...		27,002,500	Mar.	'20	1.00
Ray Consol., c	Ariz.	1,577,179	10	1.00	1,577,179			25,412,621	Dec.	'20	0.25
Silver King Coa.	Utah	1,250,000	5		....	0.15	187,500	15,386,060	May	'21	0.15
St. Joseph Lead	Mo.	1,549,369	10	2.00	2,889,371	1.00	1,549,364	23,304,375	Dec.	'20	0.25
Shattuck Arizona, c	Ariz.	350,000	10	.25	87,500			7,612,500	Jan.	'20	0.25
Tamarack & Custer, l. s.	Ida.	1,776,288	1	..		0.04	75,091	590,209	Jan.	'21	0.04
Texas Gulf Sulphur	Texas	635,000	10	..		1.00	635,000	635,000	Dec.	'21	1.00
Tintic Standard, l. s.	Utah	1,174,700	1	.50	587,350	0.15	176,208	1,714,546	Dec.	'21	0.05
Tonopah-Belmont, s. g.	Nev.	1,500,000	1	.10	150,000	0.10	150,000	10,343,063	Apr.	'21	0.05
Tonopah Extension, g. s.	Nev.	1,282,801	1	.15	192,420	0.20	258,544	2,812,364	Dec.	'21	0.05
Tonopah Mining, g. s.	Nev.	1,000,000	1	.05	50,000	0.10	100,000	15,025,000	Oct.	'21	0.05
United Eastern, g	Ariz.	1,363,000	1	0.72	981,360	0.60	817,800	3,952,700	Oct.	'21	0.15
U. S. Sm., Ref. & Min.	U. S.-Mex.	351,115	50	6.00	2,106,690	0.50	175,558	15,315,780	Jan.	'21	0.05
U. S. Sm., Ref. & Min. pfd.	U. S.-Mex.	486,350	50	3.50	1,702,225	3.50	1,702,225	26,553,492	Oct.	'21	0.875
United Verde, c	Ariz.	300,000	..	6.00	1,800,000	6.00	1,800,000	(Not reported)	Dec.	'21	1.50
United Verde Ext., c	Ariz.	1,050,000	0.50	2.00	2,100,000	1.00	1,050,000	12,705,000	Nov.	'21	0.25
Utah Apex, c	Utah	528,200	5	.25	132,050			132,050	Nov.	'20	0.25
Utah Copper	Utah	1,624,490	10	6.00	9,746,940	2.50	4,061,225	115,570,888	Sept.	'21	0.50
Vanadian Corp	Col. and Peru	373,334	....	4.50	1,680,003	1.00	373,334	1,953,337	Jan.	'21	1.00
Vindicator-Consol., g	Col.	1,500,000 *	1	.01	15,000			3,847,500	Jan.	'20	0.01
Wellington, g	Col.	1,000,000	1	.10	100,000			2,050,000	Sept.	'20	0.10
Wolverine, c	Mich.	60,000	25	.50	30,000			10,350,000	Jan.	'20	0.50
Yellow Pine, z. l. s.	Nev.	1,000,000	1	.06	60,000			2,596,008	June	'20	0.03

CANADIAN, MEXICAN, SOUTH AND CENTRAL AMERICAN MINING COMPANIES

Alvarado, g. s.	Mex.	350,000	$20	$1.50	$52,500	..	..	52,000	Oct.	'20	0.50
Amparo, g. s	Mex.	2,000,000	1	.20	400,000	0.12	240,000	3,952,177	Nov.	'21	0.04
Asbestos Corporation	Que.	30,000	100	11.25	337,500	8.00	240,000	690,000	Oct.	'21	1.50
Asbestos Corp'n pfd.	Que.	40,000	100	13.00	520,000	9.00	360,000	1,360,000	Oct.	'21	1.75
Beaver Cons., s	Ont.	2,000,000	1	.03	60,000			71[illegible]	May	'20	0.03
Belmont Surf Inlet, g.	B. C.	2,500,000	1	.10	250,000	0.02½	62,500	562,500	Jan.	'21	0.025
Cerro de Pasco, c.	Peru	898,230		4.00	3,592,917	0.50	449,115	18,704,427	Mar.	'21	0.50
Coniagas, s.	Ont.	800,000	5	.62½	500,000	0.125	100,000	10,250,000	May	'21	0.125
Consol. M. & S. Canada	B. C.	421,348	25	2.50	1,053,370	....		7,099,596	Oct.	'21	0.625
Dome Mines	Ont.	400,000	10	1.00	400,000	5.00	476,668	2,376,668	Oct.	'21	1.25
El Oro M. & R. R., g. s.	Mex.	1,147,500	£1	1 sh	£57,375	1 sh.	£57,375	£2,070,500	Nov.	'21	1 sh.
Frontino & Bolivia, g	Colombia	140,000	£1	2 sh	£14,000				July	'20	1 sh.
Frontino & Bolivia pfd.	Colombia	23,390	[illegible]	5%	£10,000				July	'20	5%
Granby Consol., s. l. c	B. C.	150,000	$100	$1.25	$187,500			10,526,885	May	'20	1.25
Green Cananea, c.	Mex.	500,000	100	1.00	500,000			17,097,165	Nov.	'20	0.50
Hollinger Consol., g.	Ont.	4,920,000	5	.45	2,214,000	0.65	3,198,000	16,558,000	Dec.	'21	0.05
Howe Sound, c.	B. C.	1,984,150	1	.20	396,830	0.05	99,208	1,190,490	Jan.	'21	0.05
Kerr Lake	Ont.	600,000	5	.12½	75,000	0.50	300,000	685,000	Oct.	'21	0.125
Lake Shore, g	Ont.	2,000,000	1	.04	80,000	0.06	120,000	400,000	Nov.	'21	0.02
Lucky Tiger-Comb., g.	Mex.	715,337	10	1.85	1,323,373	1.06	758,257	8,227,830	Dec.	'21	0.14
McIntyre Porcupine, s.	Ont.	3,640,283	1	.15	541,542	0.15	541,542	2,542,071	Sept.	'21	0.05
McK.-Dar.-Sav., s	Ont.	2,247,692	1	.12	269,724			5,955,382	Oct.	'20	0.03
Mexico Mines of El Oro, g. s.	Mex.	180,000	£1	4 sh	£36,000				June	'20	4 s.
Min. Corp. of Can., s.	Ont.	1,600,050	$5	$0.37½	$622,519			5,498,875	Sept.	'20	0.125
N. Y. & Hond. Ros., s. g.	C. A.	200,000	10	1.60	320,000	0.30	60,000	5,270,000	Jan.	'21	0.30

(Continued on page 150)

[illegible] MEXICAN, SOUTH AND CENTRAL AMERICAN MINING COMPANIES—Continued

Company Name	Situation	Shares Issued	Par Value	1920 Per Share	1920 Total	1921 Per Share	1921 Total	Total to Date	Latest Date	Latest Amount
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1,800,000	0.25	1,140,000	25,280,000	Oct. '21	0.15
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£2,418				Sept. '21	2 sh
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£105,000	[illegible]	£105,000	£260,000	Dec. '21	7 sh
[illegible]	[illegible]	[illegible]	[illegible]	1.12	£8,500	[illegible]	£6,250	....	July '21	6d.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£10,000		£5,000		July '21	1 sh
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	£10,000			£1,011,450	July '20	1 sh.
[illegible]	[illegible]	[illegible]	[illegible]	0.016	40,000			2,175,000	Jan. '20	0.016
				HOLDING COMPANIES						
[illegible]	[illegible]	[illegible]	[illegible]			1 sh.	£37,500	417,111	Mar. '21	1 sh.
[illegible]	[illegible]	[illegible]	$25	1.50	180,000			[illegible]	Aug. '20	0.50
[illegible]	[illegible]	[illegible]	25	2.00	320,000	1.00	160,000	12,480,000	Dec. '21	1.00
[illegible]	[illegible]	[illegible]	10	.05	10,000			360,000	Feb. '20	0.05
[illegible]	[illegible]	203,433		1.00	203,433	...		3,254,928	Sept. '20	1.00

[illegible]

Mining Stocks in 1921

Stock	Exch.	High		Low		Last	Sales
		COPPER					
Ahmeek	Boston	63	Dec. 15	49	Aug. 22	62½	9,455
[illegible]	N. Y. Curb	[illegible]	Nov.	0.20	Aug. [illegible]	2[illegible]	27,950
Allouez	Boston	24	Nov. 14	16	Aug. 5	24	5,698
Anaconda	New York	[illegible]	Dec. 27	32[illegible]	Aug. 25	41[illegible]	898,500
Arcadian Consol.	Boston	[illegible]	Jan. 6	1½	Sept. 21	3	32,928
Arizona Comml.	Boston	10½	Apr. 28	6½	Jan. 5	9	22,008
Big Ledge	N. Y. Curb	0.44	Oct.	0.18	July	0.25	1,474,925
Bingham Mines	Boston	14	Oct. 6	8	Mar. 8	12	23,267
Calumet & Ariz.	Boston	60	Dec. 15	40	Jan. 3	59	35,020
Calumet & Hecla	Boston	280	Dec. 16	210	Apr. 5	272	6,356
Canada Copper	N. Y. Curb	0.42	Dec.	0.14	July	0.38	224,151
Centennial	Boston	10	Jan. 28	7	Jan. 4	9	4,093
Cerro de Pasco	New York	36	Dec. 12	23	Mar. 10	34	286,105
Chile Copper	New York	16½	Dec. 15	9	Mar. 9	15	736,900
Chino	New York	29½	Dec. 15	19	Mar. 20	28	265,600
[illegible]	Salt Lake	0.42		0.10½	Dec. 3	0.10½	.
[illegible]	N. Y. Curb	0.18	Nov.	0.01	June	0.03	48,200
[illegible]	N. Y. Curb	2½	Jan.	0.85	Aug.	1⅞	123,744
Copper Range	Boston	40½	Dec. 16	27	Jan. 3	38½	47,052
Crystal Copper	Boston Crb	0.65	Dec.	0.20	Oct.	0.64	
Davis-Daly	Boston	7½	Jan. 6	5	Mar. 28	6½	58,095
East Butte	Boston	11½	Dec. 16	7	Aug. 23	11½	55,153
First National	Boston Crb	1½	Jan.	0.50	June	0.75	.
Franklin	Boston	3½	Jan. 6	1½	Apr. 2	1½	14,859
Gadsden Copper	Boston Crb	0.65	Jan.	0.38	Aug.	0.50	.
Granby Consol.	New York	34½	Nov. 25	15	Aug. 16	28½	40,250
Phelps Dodge	Open Mar	185	Nov.	125	Mar.	180	. .
Quincy	Boston	46	Dec. 9	33½	Aug. 25	43	8,178
Ray Consol.	New York	16	Dec. 15	11	Mar. 12	15½	272,150
Ray Hercules	N. Y. Curb	0.75	Feb.	0.12	Dec.	0.12	293,220
St. Mary's M. L.	Boston	45	Dec. 15	28	Jan. 3	43	9,475
Seneca Copper	Boston	24½	Nov. 22	12½	Mar. 11	22½	4,960
Shannon	Boston	1½	Dec. 1	[illegible]	Jan. 3	1	18,975
Shattuck Ariz.	New York	9½	Dec. 16	4½	Jan. 3	8½	34,900
South Lake	Boston	2	Jan. 18	0.35	Nov. 17	0.62	4,445
Superior & Bost.	Boston	2¼	Feb. 17	1	June 23	1 5/16	60,780
Tenn. C. & Chem.	New York	11	Dec. 12	6¾	Aug. 26	10	193,350
Trinity	Boston	0.85	Dec. 2	0.34	Aug. 19	0.75	108,510
United Verde Ex.	Boston Curb	30	Dec.	20	Aug.	29½	.
Utah Consol.	Boston	5	Jan. 12	1½	Nov. 16	1½	21,738
Utah Copper	New York	66¾	Dec. 15	41½	Aug. 25	63½	801,900
Utah Metal & T.	Boston	2 3/32	Jan. 31	0.95	Jan. 4	1⅞	112,462
Victoria	Boston	2¼	Feb. 17	0.40	May 4	1½	14,020
Winona	Boston	0.80	Mar. 4	0.35	Jan. 6	0.35	11,683
Wolverine	Boston	14	Feb. 21	8½	July 5	11	6,948
		NICKEL-COPPER					
International Nickel	New York	17	May 2	11½	Aug. 24	12	537,970
Int. Nickel pf.	New York	85	May 4	60	Dec. 30	65	6,955
		LEAD					
National Lead	New York	87	Dec. 13	67¾	July 28	87	64,950
Nat'l Lead pfd	New York	108	May 4	100	June 20	108	9,250
St. Joseph Lead	New York	14½	Dec. 2	10½	Aug. 26	12⅞	28,903
		QUICKSILVER					
New Idria	Boston	2	Dec. 17	0.40	Nov. 22	1	2,920
		ZINC					
Am. Z. L. & S.	New York	14½	Dec. 15	6½	Sept. 1	13½	64,150
Am. Z. L. & S. pfd	New York	40½	Dec. 16	22½	Aug. 22	36	21,800
Butte C. & Z.	New York	6½	Dec. 13	[illegible]	Aug. 24	5½	126,800
Butte & Superior	New York	22	Dec. 16	10½	June 20	22	126,900
Callahan Z.-L.	New York	7½	Jan. 8	3½	Aug. 25	5⅝	336,900
New Jersey Zinc	N. Y. Curb	158	Jan.	110	July	125	3,763
Yellow Pine	Los Angeles	0.60	Jan.	0.35	Nov.	0.47	
		GOLD					
Alaska Gold	New York	1	Feb. 9	[illegible]	Dec. 14	[illegible]	137,600
[illegible]	New York	1	Feb. 9	[illegible]	Oct. 31	[illegible]	231,600
[illegible]	New York	15	Nov. 28	11½	Dec. 22	11¼	13,100
[illegible]	N. Y. Curb	2½	Nov.	[illegible]	Jan.	2[illegible]	1,881,500
[illegible]	Toronto	0.80	Mar.	0.38	Jan.	0.71	20,848
Dome Mines	New York	21	Apr. 21	10½	Jan. 3	19	236,400
[illegible]	N. Y. Curb	0.56	Sept.	0.12	Jan.	0.26	2,413,800
[illegible]	Colo. Springs	0.80	Dec.	0.53	Mar.	0.62	
[illegible]	N. Y. Curb	0.11	Feb.	0.03	Oct.	0.04	594,864
[illegible]	Toronto	7.95	Nov.	5.55	Jan.	7.74	237,271
[illegible]	New York	61	Mar. 13	49	Mar. 2	55	18,600
[illegible]	Toronto	0.36	Jan.	0.26	Nov.	0.27	377,125
[illegible]	Toronto	1.45	Mar.	1.08	Jan.	1.25	216,760
[illegible]	Toronto	2.16	Nov.	1.80	Jan.	2.11	486,161
[illegible]	Toronto	0.29	[illegible]	0.10	[illegible]	0.16	463,303
[illegible]	Toronto	0.24	Mar.	0.14	Apr.	0.17	1,320,447
[illegible]	Colo. Springs	[illegible]	[illegible]	0.33	Nov.	0.40	
[illegible]	[illegible]	[illegible]	Feb.	0.17	Jan.	0.31	442,650
[illegible]	[illegible]	0.50	Dec.	0.03	Apr.	0.50	408,536
[illegible]	[illegible]	[illegible]	Apr.	0.09	Jan.	0.15	1,124,450
[illegible]	[illegible]	[illegible]	Feb.	0.32	Oct.	[illegible]	
[illegible]	[illegible]	[illegible]	Mar.	2	Aug.	2[illegible]	617,431
[illegible]	[illegible]	[illegible]	Feb.	0.17	Feb.	0.22	
[illegible]	N. Y. Curb	[illegible]	[illegible]	0.02	Sept.	0.05	541,845
[illegible]	[illegible]	[illegible]	Oct.	[illegible]	Apr.	1[illegible]	111,423
		SILVER					
[illegible]	New York	[illegible]	Jan. 10	[illegible]	Aug. 8	[illegible]	15,150
[illegible]	[illegible]	[illegible]	Feb.	0.16	Dec.	0.18	377,037

Stock	Exch.	High		Low		Last	Sales
		SILVER					
Coniagas	Toronto...	2.10	Mar.	1.14	Nov.	1.50	16,027
Crown Reserve..	Toronto.	0.20	Feb.	0.07½	July	0.08	230,119
Kerr Lake	N. Y. Curb	3¾	Aug.	2	May	3⅛	365,400
La Rose	Toronto..	0.38	Oct.	0.16½	June	0.33	207,725
McKinley-Dar	Toronto..	0.31	Jan.	0.14	July	0.14	111,745
Min. Corp. Can	Toronto...	1.26	June	0.80	May	1.15	56,406
Nipissing	N.Y. Curb	8¼	Jan.	4	July	6⅜	110,780
Ontario Silver	New York	6	May 9	3½	Aug. 23	4	19,950
Ophir Silver..	N. Y. Curb	0.25	May	0.11	Oct.	0.12	28,765
Temiskaming	Toronto.	0.28	Aug.	0.17½	May	0.25	155,080
Trethewey..	Toronto..	0.21	Apr.	0.05¼	Dec.	0.05¾	632,604
		GOLD AND SILVER					
Boston & Mont	N. Y. Curb	1⅜	Oct.	0.37	Jan.	0.87	10,037,235
Cash Boy	N. Y. Curb	0.09	Jan.	0.03	Sept.	0.05	806,350
Greene-Cananea	New York	29½	Dec. 15	18¼	Mar. 11	27¼	42,800
Hancock	Boston	3½	Jan. 6	1½	Sept. 7	2	3,757
Howe Sound	N. Y. Curb	3½	Jan.	1⅞	May	2⅜	57,250
Inspiration Cons	New York.	42¼	Dec. 16	29⅝	Mar. 12	40¼	636,100
Iron Cap	Boston Crb	9½	Jan.	4½	June	7½	. . . .
Isle Royale	Boston	24½	Dec. 16	16¼	Jan. 3	23½	11,675
Kennecott......	New York.	27⅞	Dec. 27	16	Mar. 11	26⅝	613,300
Keweenaw......	Boston....	2	Dec. 15	0.98	Sept. 20	1¾	10,040
Lake Copper....	Boston....	3½	Dec. 15	2	Jan. 4	2⅝	8,556
La Salle	Boston	2¼	Feb. 11	1¼	Jan. 25	1¾	11,852
Magma Chief	N. Y. Curb	0.21	Jan.	0.03	Sept.	0.08	20,500
Magma Copper.	N. Y. Curb	0.28	Dec.	0.17	Mar.	0.28	72,610
Majestic ..	Boston Crb	0.15	Feb.	0.02	Dec.	0.04	...
Mason Valley...	Boston....	2	Sept. 13	1¼	Jan. 22	1⅜	7,495
Mass Consol.	Boston	3½	Jan. 8	0.55	Apr. 9	2½	18,361
Miami Copper...	New York.	28	Dec. 16	15¼	Jan. 3	27⅝	177,650
Michigan....	Boston.	3¼	May 5	1¼	Aug. 4	2	4,070
Mohawk.......	Boston....	59	Dec. 15	43½	Jan. 3	55½	15,469
Mother Lode Co	N. Y. Curb	7½	Dec.	3½	July	7¼	221,615
Nevada Consol..	New York.	15⅝	Dec. 12	9	Mar. 31	14⅞	199,900
New Cornelia...	Boston	18¼	Dec. 16	12¼	Sept. 2	18	47,542
North Butte....	Boston....	14½	Dec. 15	8	Mar. 23	13	102,289
North Lake.....	Boston	0.50	Jan. 7	12	Nov. 17	0.20	5,988
Ohio Copper....	N. Y. Curb	0.13	Dec.	0.05	Oct.	0.08	73,700
Old Dominion..	Boston....	25¾	Nov. 22	15⅜	Jan. 3	23	21,005
Osceola........	Boston....	35½	Dec. 16	21	Aug. 10	32	8,063
Dolores Esper'za	N. Y. Curb	2½	July	0.75	Dec.	1	19,950
El Salvador...	N. Y. Curb	0.56	Jan.	0.03	Dec.	0.04	1,621,010
Jim Butler......	N. Y. Curb	0.19	Feb.	0.05	Dec.	0.06	433,300
Jumbo Extens..	N. Y. Curb	0.12	Feb.	0.01	Dec.	0.03	545,100
Louisiana Con...	N. Y. Curb	¼	Jan.	¼	Jan.	¼	6,000
MacNamara M.	N. Y. Curb	0.31	May	0.04	Dec.	0.08	1,015,500
Tonopah-Belm't	N. Y. Curb	1 11/16	Feb.	0.98	July	1¾	173,550
Tonopah-Divide	N. Y. Curb	1⅞	Jan.	0.54	Sept.	0.65	931,897
Tonopah-Exten.	N. Y. Curb	1⅝	Jan.	1⅛	Apr.	1 5/16	172,875
Tonopah Mining	N. Y. Curb	1¼	Mar.	1 1/16	May	1⅜	63,745
West End Cons..	N. Y. Curb	1 3/16	May	0.65	Aug.	0.75	197,565
		SILVER-LEAD					
Caledonia	N. Y. Curb	0.17	Jan.	0.05	Dec.	0.06	659,800
Cardiff M. & M..	Salt Lake..	1.22½	July	0.82	Nov.	0.92	
Chief Consol..	Boston Crb	3¾	Oct.	2⅛	Aug.	3	
Consol. M. & S..	Montreal..	21	Jan.	12½	June	18	27,149
Daly Mining....	Salt Lake..	2.50		1.50	.....	..	.
Daly-West.....	Boston....	4¼	Jan. 18	1⅛	Nov. 16	1⅞	4,683
Eagle & Bl. Bell.	Boston Crb	3	Sept.	1½	Jan.	2¼	.
Electric Point...	Spokane...	0.08½	Feb.	0.03	July	0.04	
Federal M. & S.	New York.	13¾	Dec. 13	5⅛	June 20	10	3,960
Fed. M. & S., pfd	New York.	43½	Dec. 14	21	Aug. 30	39	28,570
Florence Silver..	Spokane...	0.19½	Dec.	0.02¼	Nov.	0.19½	. .
Grand Central...	Salt Lake..	.		.	.	0.41	
Hecla Mining...	N. Y. Curb	4⅞	Nov.	3¼	Mar.	4¾	131,680
Iron Blossom Cn	N. Y. Curb	0.53	Dec.	0.12	Mar.	0.30	246,470
Judge M. & S.	Salt Lake.	3		2.40	Dec. 10	2.50	
Marsh Mines .	N. Y. Curb	0.11	May	0.03	Aug.	0.04	667,080
Prince Consol....	Salt Lake..	0.38	Feb.	0.05	Nov.	0.07½	
Rambler-Cariboo	Spokane	.		.	.	.04	
Rex Consol.	N. Y. Curb	0.14	May	0.04	Jan.	0.07	1,222,830
South Hecla	Salt Lake	1.15	.	0.20½	.		.
Std. Silver-Ld .	N. Y. Curb	0.18	Jan.	0.08	Sept.	0.10	122,050
Stewart Mining.	N. Y. Curb	0.11	Feb.	0.01	Dec.	0.01	165,400
Tamarack-Custer	Spokane .				.	2.22	.
Tintic Standard	Salt Lake .	3.42		1.60		1.80	
Utah Apex	Boston	3	Oct. 7	1¼	Aug. 16	3	40,833
Wilbert Mining	N. Y. Curb	0.04½	May	0.01	Jan.	0.01	879,740
		VANADIUM					
Vanadium Corp	New York	41	Jan. 11	25½	June 21	31½	912,700
		ASBESTOS					
Asbestos Corp	Montreal	82½	Jan.	56	Aug.	48½	15,679
Asbestos C. pf	Montreal	95	Jan.	65	Sept.	75½	6,380
		SULPHUR					
Freeport Texas	New York	20	Jan. 17	9	Aug. 24	13½	146,700
Texas Gulf	New York	42	Dec. 28	32½	Dec. 1	41	155,150
		MINING, SMELTING AND REFINING					
Am. Sm. & Ref	New York	47½	Dec. 12	29½	Aug. 25	45½	526,600
Am. S. & R. pf	New York	90	Dec. 12	63¼	Aug. 26	86½	64,100
Am. Sm. Sec. pf. A	New York	88	Dec. 2	63	Jan. 11	87½	30,715
U. S. Sm. R. & M.	New York	39½	Dec. 14	26	Apr. 1	36	54,650
U. S. Sm. R&M pf	New York	45	Dec. 28	37	Aug. 9	45	9,100

THE MARKET REPORT

Daily Prices of Metals

Jan.	Copper, N. Y., net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
12	13.50	32.375	33.125	4.70	4.375@4.40	4.75
13	13.50	32.375	33.00	4.70	4.375@4.40	4.75
14	13.50	32.375	33.00	4.70	4.375@4.40	4.75
16	13.50	31.875	32.50	4.70	4.375@4.40	4.725
17	13.50	31.50	32.125	4.70	4.375@4.40	4.725
18	13.50	31.75	32.25	4.70	4.375@4.40	4.70@4.725

*These prices correspond to the following quotations for copper delivered: Jan. 12 to 18 inc., 13.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Jan.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
12	65⅜	66¼	73	167¼	168¾	24¼	24	26½	26⅞
13	65½	66¼	73	166¼	168	24⅛	24	26⅝	27
14	.	..	...	....	....	..	...	...	...
16	65⅝	66⅜	73	165	166¾	23⅞	24	26½	26⅞
17	65⅛	65⅞	72½	163⅜	165	23⅛	23⅛	26⅛	26½
18	64½	65⅜	72	163⅞	165¾	23⅛	23⅛	26⅜	26¾

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Jan.	Sterling Exchange "Checks"	Silver			Jan.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
12	422½	99⅝	65¾	35⅛	16	422¼	99⅝	65⅞	35⅛
13	422	99⅝	66¼	35⅜	17	422¼	99⅝	65¾	35
14	422	99⅝	66⅛	35⅜	18	421¾	99⅝	65⅞	35⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Metal Markets

New York, Jan. 18, 1922

Business continues poor in the metal markets, with few price changes. In fact, the only changes of importance occur among the minor metals, platinum showing a sharp advance, and bismuth, the price of which is fixed in London over long periods, being revised from 7s. 6d. to 9s.

Copper

Producers have done less business than last week, and the outside market continues extremely quiet. The large interests report small domestic sales at 14c. delivered, but it is difficult to understand why any consumer should pay this price except where delivery charges are extremely high or where other considerations are involved. Some of the smaller producers have sold lots of a few hundred tons for first-quarter delivery at 13.75c. delivered, during the week, and were ready to supply larger amounts at the same figure. Large tonnages could also be obtained for second- and third-quarter delivery at this price. Some small lots of prompt copper were obtainable in the outside market at 13.625c.

The statistical position of copper is continuing to improve, and higher prices are likely as soon as buying is again on the scale of the closing months of 1921. The increase in production which will take place with the resumption of mining by the large companies will no doubt act as a brake on price advances during the second half of the year, however.

Export demand has been quiet, with moderate orders from the Continent and from Japan. The European business through the Export Association has in general been booked to net producers here slightly less than 14c. per lb. Outside interests have not been able to do quite so well on export business.

Lead

The official contract price of the American Smelting & Refining Co. remains at 4.70c.

Lead has been in about the usual demand at practically unchanged prices. A scarcity of some grades exists in the East, and some producers are off the market or are quoting 4.75 or 4.80c. to discourage most of the business. All of the Mexican lead continues to go abroad, but with the fall in London yesterday, so far unaccounted for, there is no immediate probability of sales of domestic lead for export. Common lead continues in free supply in the St. Louis district. One or two interests are quoting 4.375c. and have done rather a good business at that level. Others are selling at 4.40c., and still others are quoting 4.425c., but so far as we are advised have made no sales. Desilverized and corroding grades have been in demand at 10 to 15 points' premium; orders for these grades in Cincinnati were booked by more than one interest during the week at 4.75c. Forward lead is not being traded in to any extent, but would no doubt command a slight premium.

Zinc

Zinc has continued the weakness shown last week, and the market has declined a few points further. A small tonnage has been sold as low as 4.70c., but at this level few producers are willing to enter the market. The price of Joplin ore is still too high to make any profit with present metal prices. Inquiries have been smaller in number, and larger producers are only satisfying the requirements of regular customers. High-grade zinc continues to be sold in fair volume at 6c., with freight allowed.

Tin

Demand for tin from consuming interests has been quite active during the last few days, the tin-plate orders from the Standard Oil Co., California packers, and others having had their effect. Formerly all the tin-plate manufacturers purchased their tin supplies several months ahead, but owing to the disorganized state of the market in recent months, one of the largest concerns is now buying only from hand to mouth; others have followed. This has re-

resulted in an extraordinary demand for spot tin which, as a result now commands a slight premium. One boat bringing about 2,000 tons to this port has been compelled to put in at Alexandria, Egypt, as a result of a broken shaft, which will add to the scarcity at the end of the month. Electrolytic is in limited supply at approximately the same prices as Straits.

Straits tin for forward delivery: Jan. 12th, 32.75@33.00c.; 13th, 32.50@32.75c.; 14th, 32.50@32.75c.; 16th, 32@32.25c.; 17th, 31.75@32.00c.; 18th, 31.75@32.00c.

Arrivals of tin, in long tons: Jan. 10th, Straits, 35; London, 800; 13th, Straits, 500; 16th, Straits, 110; China, 15.

Gold

Gold in London: Jan. 12th, 97s. 3d.; 13th, 97s. 4d.; 16th, 97s. 6d.; 17th, 97s. 7d.; 18th, 97s. 11d.

Foreign Exchange

The foreign exchange market has been quiet during the last few days. A slight reaction in most quotations occurred yesterday. On Tuesday, Jan. 17, francs were 8.14c.; lire, 4.3575c.; and marks, 0.525c. New York funds in Montreal, 6$\frac{3}{16}$ per cent premium.

Silver

The market has continued dull, with limited buying for prompt New York and San Francisco delivery at about the London parity, and any material increase in the demand for silver seems unlikely until after the settlement period of the Chinese New Year.

Mexican Dollars—Jan. 12th, 50; 13th, 50¼; 14th, 50; 16th, 50; 17th, 50; 18th, 50.

Other Metals

Quotations cover wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony—Chinese and Japanese brands, 4.375@4.50c.; W. C. C. brand, 5.25@5.75c. per lb. Cookson's "C" grade, spot, 9c. per lb. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—7½c. per lb.

Bismuth—The London price increased on Jan. 17 from 7s. 6d. to 9s., which has occasioned an advance in the New York market to $1.85@$1.95 per lb.

Cadmium—$1@$1.10 per lb. in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb. Demand is somewhat improved.

Platinum—$93@$105 per oz. Rise attributed to scarcity of spot supplies and their close control. Considerable amounts of metal have been bought on the rise. Consuming demand has tapered off. Jewelers are not viewing the sudden rise with joy.

Palladium—$60@$65 per oz. Has risen in sympathy with platinum.

Iridium—$170@$200 per oz.

Quicksilver—$50@$52 per 75-lb. flask. San Francisco wires $48.70.

The prices of the following metals remain unchanged from the figures published in these columns on Jan. 7: Cobalt, Molybdenum, Monel Metal, Nickel, Osmium, Rhodium, Selenium, Thallium and Tungsten.

Metallic Ores

The market is generally exceedingly quiet, and prices on the following ores remain unchanged from the figures published in the Market Report in the Jan. 7 issue: Chrome, Iron, Magnetite, Manganese, Molybdenum, Tantalum, Titanium, Tungsten, Uranium, Vanadium, Zircon, and Zirkite ores.

Zinc and Lead Ore Markets

Joplin, Mo., Jan. 14—Zinc blende, per ton, high, $31.10; Basis 60 per cent zinc, premium, $28; Prime Western, $27@$26; fines and slimes, $25@$24; average settling price, all grades of zinc, $29.38.

Lead, high, $62.50; basis 80 per cent lead, $60; average settling price, all grades of lead, $59.80 per ton.

Shipments for the week: Blende, 5,207; lead, 917 tons. Value, all ores the week, $207,960.

Shipping is partially held up awaiting the freight rate reduction promised to be effective on the 20th. Still only about 10,000 tons is sold ahead of delivery. The purchase this week was practically the same as the shipment, showing only an excess of 70 tons.

Buyers cut prices generally $1 per ton on virtually all grades, in the purchases this week for future delivery. Some buyers had orders not to exceed a $26 basis Prime Western, but about an equal tonnage was purchased on $27 basis. The weakness of slab zinc is given as a reason for lowering prices.

Platteville, Wis., Jan. 14—Blende, basis 60 per cent zinc, $30. Lead ore, basis 80 per cent lead, $60 per ton. Shipments for the week: Blende, 376 tons. Shipments for the year: Blende, 746 tons. Shipped during the week to separating plants, 821 tons blende.

Non-Metallic Minerals

Generally dull markets exist for the non-metallic minerals, and there is no quotable change in the following from the prices published in our Jan. 7 issue: Asbestos, Barytes, Bauxite, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Kaolin, Limestone, Magnesite, Mica, Monazite, Phosphate Rock, Pumice Stone, Pyrites, Silica, Sulphur and Talc.

Mineral Products

Sodium Sulphate — For 95 per cent material, $12.50 per ton, f.o.b. in bulk, Western mines, spot and six months' contract; $18@$21 per ton, New York.

Prices of Copper Sulphate, Potassium Sulphate and Sodium Nitrate are unchanged from the quotations published Jan. 7.

Ferro-Alloys

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 11½c. per lb. of chromium contained; 4 to 6 per cent carbon, 12c., f.o.b. works.

No quotable changes have taken place in the following ferro-alloys from the prices quoted in the Jan. 7 issue: Ferrotitanium, Ferrocerium, Ferromanganese, Ferromolybdenum, Ferrosilicon, Ferrotungsten, Ferro-Uranium and Ferrovanadium.

Metal Products

Nickel Silver—27.75c. per lb. for 18 per cent nickel, grade "A" sheets.

Prices of Copper Sheets, Lead Sheets, Yellow Metal, and Zinc Sheets are unchanged from the quotations published on Jan. 7.

Refractories

Prices on the following are unchanged from the figures published in the Jan. 7 issue: Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick and Silica Brick.

The Iron Trade

Pittsburgh, Jan. 17, 1922

Steel mill operations are gradually increasing, after the curtailment in the last two weeks of December, and operations are likely to be at as high a rate by Feb. 1 as on Dec. 1, with an ingot production rate of 22,000,000 or 23,000,000 tons a year.

Buying of steel is increasing and is marked by the smallness of individual orders and the mixed character of specifications. Probabilities are that buyers will be disposed in the next few weeks to begin replenishing stocks.

Finished-steel prices are now steady. There has been no decline in any important steel product in four weeks, and concessions from regular prices, for large orders, are small or absent entirely. Sheets are rigidly maintained at full asking prices, 3c. on black and 4c. on galvanized. Bars, shapes, and plates are 1.50c., with concessions infrequent. In the South and West, departures from Pittsburgh basing are common with many products, owing to local competition.

Iron Ore—Prices of Lake Superior iron ore at Lake Erie dock will be down 50c. to $1 a ton for the 1922 season, depending largely on adjustments in the rail freights, mine to lake, and the vessel rate. For 1921 there was a reduction of $1, making Mesabi non-bessemer $5.55.

Pig Iron—The market remains inactive, prices being quotable at $19.50 for bessemer, $18.25 for basic, and $19.50 for foundry, f.o.b. Valley furnaces, freight to Pittsburgh being $1.96.

Coke

Connellsville — Furnace, $2.75@$3; foundry, $3.75@$4.50.

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Volume 113 New York, January 28, 1922 *Number* 4

Licensing the Mining Industry

WE ARE BEGINNING TO WONDER who invented the word "engineer" and what should be done to him if he could be located. The question has been brought up by the discussion concerning engineer licenses, so widely pushed in many states. It appears that mining engineers are overwhelmingly opposed to engineer licenses, if we may judge from the referendum of the Mining and Metallurgical Society of America, the instructions of the Board of Directors of the American Institute of Mining and Metallurgical Engineers to their representatives on American Engineering Council in Washington, and the enthusiastic meeting on Jan. 11, of the New York Section of the Institute, which repudiated to a man the whole principle of licensing engineers. To a man—with perhaps one exception—a gentleman who is a member of the Institute, and yet somehow differentiated himself sharply from the mining engineer type with which we are familiar; a man who proclaimed that he had put through the New York bill, and framed the definition of engineer which prevailed as the criterion in enforcing the bill. There was a consensus of opinion that he should as an engineer be classed not primarily as a mining engineer but as a political engineer, despite his experience in quarrying; and there was a further tendency to the belief that political engineers should be licensed before they should be allowed to submit bills or to embark upon lobbying enterprises.

The New York definition of engineer in question provoked Homeric laughter among the Institute members. It recited in effect that an engineer was anyone who did or claimed to do anything that an engineer does in conducting engineering work; which, being shortened, said that an engineer was an engineer. Subsequent to the meeting, we inquisitively consulted the Standard Dictionary. It does better than the New York State definition. According to it, there are two kinds of engineers:

> "1. One versed in or practicing any branch of engineering.
>
> "2. One who runs or manages an engine: engine driver, engine runner, or engine man."

Clearly, what we are seeking to define is the former kind of engineer; so, consulting the word *engineering*, we find:

> "Engineering: The science or art of making, building, or using engines and machines, or of designing and constructing public works or the like, requiring special knowledge of materials, machinery, and the laws of mechanics."

There is an evident certain limitation of this definition to mechanics, which makes it clear that a mechanical or a civil engineer, or an architect, or a yacht designer, is an engineer, since their work involves special knowledge of "materials, machinery, and the laws of mechanics"; but this definition does not so evidently include the land or mine surveyor, the assayer, the agriculturist, the geologist, the chemist, the mine manager or the metallurgist, to cite only a few examples.

The Standard Dictionary enumerates the following branches of engineering: Chemical, civil, dynamic, electrical, hydraulic, marine, mechanical, military, mining, agricultural, sanitary, municipal, steam, structural, topographical.

To anyone looking over this list it is evident that it is far from complete, and that current terminology has run ahead of this group, for we hear of investment engineering, metallurgical engineering, geological engineering, and even human engineering; and even the "editorial engineer" has been proposed as a member of the engineer group. Certainly, also, agricultural engineering, for example, might admit of specializing, as forestry engineering, horticultural or fruit engineering, dairy engineering, or sheep engineering. In fact, it must be evident that the word *engineer* as used does not indicate a certain calling or profession, but a certain very broad group classification. We think we can submit a more accurate and inclusive definition than does the dictionary—somewhat as follows:

> "Engineering: The application of abstract natural science to human economic or industrial uses."

Then we should have, as the definition of engineer:

1. One who practices engineering.
2. One who runs an engine.

From this analysis, and since science and knowledge are respectively the Latin and the Anglo-Saxon words for the same thing, anyone versed in the natural sciences and turning them to utilitarian purposes would be an engineer. Our definition, it will be noted, eliminates the sciences which do not pertain to natural history, and, therefore, rules out as improperly named investment engineering, human engineering—yes, and political engineering. But even with this elimination, and with the broad range currently ascribed to engineering—there yet remains the fact that the definition of engineers includes a broad group, that it is as broad as the definition of capitalists or of workers, and with as shadowy boundaries.

It is impossible to make satisfactory specific laws or blanket rules to cover all the varied and practically unrelated callings grouped under the head of "engineer," or "capitalist," or "manual worker." We must get down to greater specificness, and consider, for example, in the first group, the land surveyor; in the second, the railroad owner; in the third, the coal miner. We have realized this for the last two groups; we must realize it for the first. What in common, for example, has a boiler expert in Seattle with a zinc metallurgist in New Jersey? And how can you make laws or frame examinations, or determine whether or not licenses should be required, in such a way that one blanket will cover all?

The term engineer, in our opinion, has done a lot of damage to us who are in the mining industry. If politics makes strange bed fellows, it is equally true that the pursuit of the word engineer has brought those who have nothing in common under the same covers. We shall mention but not further comment on at present: the Engineering Societies Library, the American Engineering Council, the proposed Department of Public Works. We mining men have jumped the hurdles on all of these: now we have to hurdle the logical *sequitur* of Engineer Licenses.

Well, the Engineer License requirement tucks under its covers no less strange an assortment than it is proposed to warm under the Department of Public Works. We all agree that a deputy mineral surveyor should be granted a permit before he can qualify; but we all agree, also, that the same examination, at least, will not cover the case of the consulting metallurgist or the itinerant geologist, or the shrewd executive who wants to manage a mine; and we doubt the advisability of a general licensing regulation. Such a legislation would have thrown Edison and Ford, both unschooled men, into jail; and their only way of getting forward would have been the practice of bootlegging engineering. Indeed, the New York licensing law makes bootlegging or illegal engineering mandatory, since it requires that no one may lawfully practice engineering until he shall have had six years' experience, of which one year must have been in a position of responsibility. The penalty is fine and imprisonment; and it will be a question for the courts to solve whether engineering practiced in jail will be eventually counted toward the legal requirements.

We fear that the remedy for all our troubles, from the Engineering Societies Library through the Department of Public Works, to Engineer Licenses, will be a more restricted claim on our part to the designation of the nice word engineer, to which we all have been fondly laying claim. We may have to acknowledge ourselves for what we are: a metallurgist, not an engineer; a mine manager, not an engineer; an appraiser of mines, not an engineer; a bond salesman, and not an investment engineer; a common nuisance, and not a political engineer; a geologist, and not a mine development engineer; a cyanide-process specialist, and not a mining engineer; a quarryman, and not a mining engineer. If you will do that, by the laws of many states at least, you will not have to be licensed and restricted in your vocation, and be confused with the boiler expert or the transitman, or the central-station man.

Evidently, the time is almost ripe to unscramble the egg, or disintegrate the hash by flotation; and for our group to recognize that it is not engineering we serve, but the mining industry. Many societies will go to pieces if the word engineer becomes unpopular—so much hangs upon a word. And it looks to us as if it were in a fair way to become less and less popular.

The Lecture System

WE SELECT the following extract from the report of the Committee on Technical Education of the Mining and Metallurgical Society of America:

"American colleges and universities appear to be committed to the lecture system, and teachers in many branches are accustomed to ridicule what they choose to call the 'district-school' method of instruction by means of textbook and recitations when any criticism of the lecture system is advanced. Yet, as we all know, but few teachers are of ever will be really good lecturers. More important is the necessary admission that lectures, as compared with a good textbook, form a most unreliable and ineffectual means of placing any desired information as record in the student's hands. The student is continually distraught between his effort to understand and absorb what the lecturer says and his effort to take it down clearly in his notes. Few students are able to do both things well. The divergence between what the lecturer intends to say and what the average student's notes really contain is appalling, and it can hardly be doubted that many teachers unconsciously take advantage of this loophole of responsibility by giving lectures that for substance, accuracy, and presentation they would be ashamed to see in print."

The reason for the lecture system is that it is the easiest way and a natural one. The earnest, capable student who does his part and follows up his subject with collateral reading will get a good deal out of a subject, even though the lecturer be indifferent. Not every student is canny enough to keep up a systematic notebook, and only a relatively few students are imbued with that pertinacity and vision to realize their immediate opportunities. Most of them are human, and have lazy spells interspersed between periods of energetic effort. It requires a fairly capable man to keep "steam power" up on all the diversified subjects given in a term, and it must be admitted that a cafeteria type of education has sprung up where classes are large and instructors few.

On the other hand, the "district-school" method of instruction by means of textbooks and recitation has only limited application, partly because suitable textbooks are seldom available outside of fundamental courses and partly because experienced instructors make use of methods of individual contact that are an improvement over "district-school recitation." The availability of libraries which are usually segregated for different groups of students has made the absence of good textbooks on some subjects less noticeable. However, a reference book that is comprehensive is an excellent thing to have in the possession of the student.

Experienced instructors generally are aware of the weaknesses of the lecture system and resort to various expedients to overcome them. Some provide systematic notes in mimeographed form. Others advise the weaker students to secure reference books that cover the subject. A series of problems is given where suitable. Still others resort to the laborious checking of the student's notes at intervals. To maintain individual contact, written and oral quizzes are given at regular intervals, sometimes at the beginning of each lecture period. Another method is to require reports and notes upon collateral reading, and still another is to give systematic notes and devote the classroom time to thorough discussion of the subject by the members of the class, led by the instructor. We know of one professor who presents subjects with references and requires his students to prepare a certain number of lectures, each presenting a simple lecture for discussion. With advanced students the lecture is dispensed with and a round-table discussion of the subject undertaken.

An experienced instructor is well aware of the devious methods undertaken by some students to get by without "work," and his ingenuity is taxed sometimes to "beat them to it." The trite expression that the educational method should be one "that makes a student think" involves a principle that is well understood and made use of by skillful instructors. With a class of not to exceed fifteen students, such instructors will do the trick. With larger classes, it becomes more difficult, and with audiences altogether uncertain.

Subjects differ in their degree of difficulty, and methods of presentation have to be changed accordingly. Experienced instructors vary their methods with both individual students and with classes as a whole. We believe that there are many instructors and professors who are doing mighty good work and not getting any publicity from it. We believe that many succeed in "getting everyone in the game" and give their students a good chance to do some of the talking and writing themselves. This is the corrective for "passive receptivity" and the ingrown student type.

Enter Boston & Montana Amid Fanfare of Brokers' Trumpets

WE SHALL LOOK with much interest on the outcome of the Boston & Montana project. As those of our readers who are favored with stockbrokers' circulars—and who is not?—must by this time know, this company has now reached the producing stage, and by the time this appears will be treating possibly 500 tons a day in the new mill. The property is at Elkhorn, in Beaverhead County, Mont., and was first opened in 1865. It is in no sense therefore a young untamed wildcat. Many well-mineralized veins were in evidence, but operations at the property were much hampered by poor transportation facilities. This was remedied two years ago by the construction of a narrow-gage railway from the mine, on the Wise River, to the Union Pacific system at Divide. Development in the last two or three years has been active, and it was stated more than two years ago that $2,500,000 had been spent in exploration.

Some doubt has been expressed by competent engineers as to whether sufficient ore has been developed to warrant the erection of a mill. Others affirm that plenty of ore is available. At any rate, the project cannot be classed with some of the Southern gold mines, about which it is said that "the company closes down as soon as the mill starts," for the Boston & Montana mill has now been operating for two or three months.

We really might be quite enthusiastic about this company except for one thing, and that is the flamboyant stock-jobbing campaign that has been conducted. Every broker's circular is filled with Boston & Montana. The writers overlook nothing, one day confining themselves to cold hard facts, whereas the next day they reach up into the heights of the superlative and attempt to pull down the ultimate in language. The name is fondly coupled with Anaconda, United Verde, and Calumet & Hecla. Recently the stock was compared with Hollinger as an investment—needless to say to the disadvantage of the Ontario bonanza. Moving pictures made at the property are being shown wherever there is a likelihood of collecting a large crowd of men, each with a few idle dollars in his pocket. No stone is being left unturned, except possibly some in the mine, to market the stock.

The Superficial Enrichment of Ores

ONE OF THE NOTABLE FEATURES of the recent meeting of the Society of Economic Geologists at Amherst was the general agreement to the effect that much if not most of the rich silver sulphide (sulpharsenide or sulphantimonide) ores are of primary origin—that is, deposited by ascending waters, which are generally believed to be of magmatic or igneous origin. For a long time it has been the fashion to believe that these rich silver ores were necessarily of secondary origin, due to concentration from a leaner form, through the agency of descending surface waters—were, in short, due to "secondary enrichment," quite as so many copper ores, especially rich sulphides like chalcocite, are actually so formed.

The pendulum of enthusiasm over secondary enrichment is swinging back to the logical and normal. Most marked in the case of copper, this process is least marked, perhaps, in ores like those of gold and tungsten: indeed, it is likely that it is misleading even to use the term in connection with ores of such metals, even though superficial enrichment may be striking, as especially in the case of outcropping gold veins. In this case, however, the enrichment is due largely to mechanical rather than chemical causes—the residual gold, heavier than the eroded and in part dissolved superficial quartz, sinks into crevices and is carried in fine suspension a considerable distance below the outcrop, though characteristically, as is natural from the mode of origin, richest on the outcrop itself.

Finally, even in the case of copper, it has been found that the rich copper sulphides, which were once, in the glow of young enthusiasm over the perception of the importance of "secondary sulphide enrichment" of lean copper pyrites, believed to be necessarily secondary—such rich sulphides as chalcocite and bornite—are in many cases of deep-seated, primary, and immediately (it is assumed) magmatic origin. Therefore, the same rich copper sulphides may form either as primary and deep-seated or secondary and shallow-formed ores; and it is now recognized that the same is true of the rich silver sulphides, with the difference that in the case of silver, the rich ores of primary or deep-seated origin are perhaps quantitatively more important, which, surveying the whole field, is not the case with copper ores.

WHAT OTHERS THINK

The Distillation of Oil Shale

A study of George A. Thiel's article on the subject "Gas an Important Factor in Oil Accumulation," in *Engineering and Mining Journal* of April 10, 1920, suggests the possibilities of gaining much additional information by carrying the tests further.

A large amount of data on the behavior of oil and air and oil and gases can be obtained if the oil investigator will trespass on the field of the metallurgist as relating to the investigations in connection with the use of oils in the flotation process. Thus, two radically different fields of investigation may be of mutual benefit.

It is assumed that in the process of natural distillation of petroleum, or its natural production, natural gas is at the same time evolved. The process may or may not be under pressure. It may be under artesian water pressure or of natural pressure due to the evolution of gas and oil vapors. However, I doubt if pressure, as suggested by Mr. Thiel, is an essential factor. Sulphur is shown by analysis in most oils. Hydrochloric acid may be, and probably is, present or evolved in the presence of salt water in the chemical processes under way. The distillation of oil and gas, contemporaneously, in close confinement, even though not under pressure, would produce a mobile fluid which would readily diffuse through the least-resistent medium, and, under natural physical laws, follow the line of least resistance.

An interesting extension of the experiments made by Mr. Thiel would be to carry them out in connection with the distillation of an oil shale. The test should be made under such pressure as developed in the process of distillation and also under conditions of atmospheric pressure, noting the comparative behavior.

It would be interesting to compare the action of the condensed oil when passed to the tube used after allowing the gas formed to separate and pass off before conducting to the testing apparatus; also to note the behavior, in comparison with this test, when permitting the products, as formed, direct access to the test apparatus.

It would be necessary to connect the two ends of the tube, say as the diameter, with a semicircular pipe with the intake from the distillation apparatus connected midway of the circumference, thus allowing the flow of the products of distillation to both ends of the tube under the same conditions. The pipe might be arranged for condensing, as well, the "crest" of the tube tapped and connected, through a water seal, with atmospheric pressure.

This test would disclose the effect of the natural-gas evolution on the segregation of the oil and behavior of the oil without the gas, in its segregation, as illustrated in the original experiment with artificially evolved gas of a different nature.

Mr. Thiel, in referring to the experiment with the tube inverted (synclinal), remarks: "The first evidences of accumulation were seen on the *upper* surface of the tube throughout its entire length. At the end of thirty-six hours, however, the oil had moved in both directions from the trough of the syncline, forming a concentration in the upper part of the limbs, immediately below the contact between the dolomite and the quartzite. Such behavior indicates that the migration of the oil is not dependent *upon the direct movement of the gas*, as the oil moved toward the source of gas supply." But, he further says: "'This *did not occur* until after a uniform pressure had been developed throughout the oil-sand and water mixture." He mentions no segregation of gas from oil during this stage; hence, we may assume that they were intimately associated, the gas, possibly, as in the flotation process, with its film of oil surrounding, and, together, a mobile fluid now moving under physical laws in a quiescent "atmosphere" ("a uniform pressure had been developed"), through a thus established counter-current of the salt water. This should occur whether the elements are or are not under pressure.

The experiment in connection with distillation from a retort would afford interesting results, as the gas and oil, together, introduced at the upper ends of the syncline, or through the opening at the peak of the arch (used for connecting with the atmosphere), would be traveling together. The dolomite plugs would not be used in connection with the retort experiment. It will be necessary to connect the tube with a vessel of salt water, by siphon or otherwise, to allow for displacement, in the tube, by the oil and gas introduced.

There is a close analogy between the oil-gas mixture, traveling through the minute interspaces of the "sands" —which prevent segregation during migration—and the action of the bubble of air, however minute, inclosed by its film of oil, thus much more buoyant than the oil when alone suspended in fresh or salt water as observed in flotation practice. **L. S. ROPES.**

Helena, Mont.

A New Year's Greeting From Montana

I consider *Engineering and Mining Journal* as part of my equipment for the conducting of my operations. It is *standard* and is accepted so by many that are not subscribers. They will spend $4 for a magazine that purports to cover the same field, but they are very grateful for the opportunity to peruse the *Journal*.

Every so often I have a "round-up" of my journals. Here is the way I look at it: You go for a ride in an auto of the $2,000 or $3,000 class—you enjoy it and say it is fine; then get into a car of the $6,000 to $12,000 class, and the superiority is unmistakable. The analogy is complete. Read any of the several periodicals devoted to the mining industry and then read *Engineering and Mining Journal*. The same superiority is manifest. Superior class of contributors, "the leaders in the business"; superior presentation of the subjects by the contributors, superior class of advertisers and advertisements; and, above all, *reliability*.

I wish the *Journal* its most prosperous year.

Kendall, Mont. **FRANK B. BRYANT.**

The White Iron & Coal Co.

In *Engineering and Mining Journal* of Dec. 24, on page 1035, under the caption "Alabama," George Huntington Clark credits the Great Southern Steel Co. with having absorbed the White Iron & Coal Co., This is an error.

While efforts to that end have been made, they were unsuccessful. The White Iron properties have an especial value in that all the raw materials necessary to the prodution of pig iron are contained in its holdings, thus eliminating the burdensome freight rates of the present day. Plans are being perfected whereby the Robert W. Hunt & Co., as operating managers, will open both coal and iron mines in the near future and it is safe to say that any proposed merger with any company at the present time will be firmly declined by this company.

Chicago, Ill. **H. F. PENNINGTON.**
Vice-Pres., White Iron & Coal Co.

Romance vs. Reality

Permit me to express my appreciation of your comments upon the statements and doings of L. V. J. Kimball, "Romantic" Geologist, appearing in *Engineering and Mining Journal* of Dec. 24, 1921. It certainly seems remarkable to real geologists, who have with arduous and painstaking care followed along the lines of legitimate and accepted research, that a wild-eyed faker, such as the one under discussion, should so easily blind normally sensible people to conditions as they are, and gather their money for the furtherance of worse than wildcat schemes, while the really valuable opinion of the legitimate but not "romantic" geologist would attract no attention.

I hope that *Engineering and Mining Journal* will continue its good work, though it is almost too much to hope that the efforts put forth will be sufficient to overcome the inherent asininity of the mass mind.

Salt Lake City, Utah. **A. G. BURRITT.**

Mineral Resources and Mining Possibilities Of Finland

Scientific Prospecting Under the Direction of the Finnish Government Is Adding to the Knowledge of the Country's Mineral Deposits and Potentialities—Iron, Copper, And Pyrite the Most Important Products Mined

BY J. J. SEDERHOLM[*]

Written for Engineering and Mining Journal

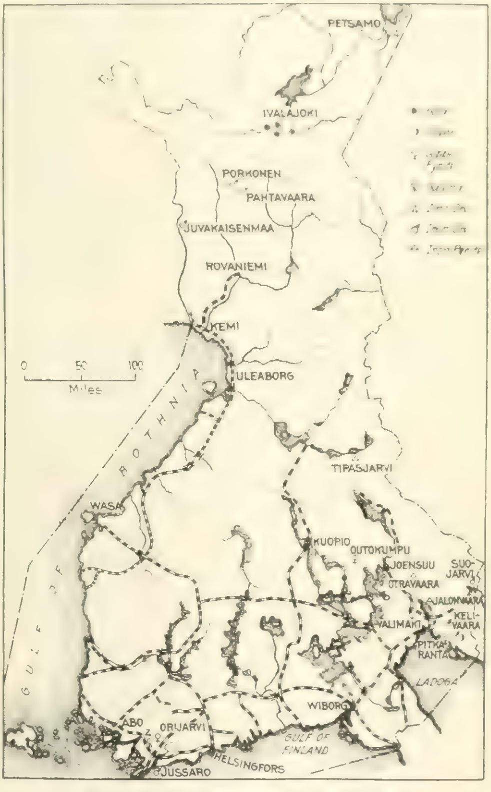
THE ECONOMIC CONDITIONS of Finland have attracted attention from the moment that the country, earlier an autonomous Grand Duchy under the sceptre of the Czar, became an independent republic, free to make new connections and eager to increase her income, so as to balance a steadily growing public expenditure. Besides the agriculture, lumber, and paper industries, the mining industry has been considered worthy of especial attention, though it has not yet attained the development which might well have been anticipated, because Finland has the same geological structure as her neighbor Sweden, which is so rich in various ores.

In Finland practically all rocks are of pre-Cambrian age, and some of them are geologically nearly related to the ore-bearing rocks of Sweden. For a long time, however, no orebodies of considerable importance were discovered in Finland, although prospecting has been done for several centuries, often by experienced Swedish miners. After the political separation of Finland from Sweden, in 1809, systematical efforts to discover new orebodies were continued. Most of the prospecting was by officials of the Finnish government. Since 1877, a geological survey has existed in Helsingfors, from 1885 as a separate bureau. In 1918 this survey was much enlarged. Only twenty years ago Finland was mentioned as having expended a greater amount of money than any other European country in proportion to her population on geological exploration. At present the yearly expenditures of the Geological Survey are considerable in proportion to the area of Finland, according to which Finland now ranks sixth in order among the European states.

GEOLOGICAL SURVEY ACTIVE

During the first decades of the existence of the Geological Survey, its activity was directed mainly to the scientific study of the geology of the country, but since the beginning of the twentieth century the investigation of mineral resources has assumed a more and more predominant place.

Most of the prospecting work in Finland is now being done by the Geological Survey, which has also tried to develop the method of such research, and especially has devoted much study to the methods of electrical prospecting. Some private companies are doing similar work, whereas prospecting by individual miners is done only in a small measure.



MAP OF ORE DEPOSITS OF FINLAND

Prospecting is now conducted in Finland mainly by a detailed survey of those areas where further discoveries may be anticipated, attention being devoted especially to glacial boulders. If among them any consisting of ore are found, or a discovery of boulders of ore has been announced by a prospector or casual investigator, every effort is made to trace the boulders to their origin. For this purpose geological maps are consulted and all available data concerning the directions of the movement of the ice that has carried the boulders are used.

ELECTRICAL PROSPECTING SUCCESSFULLY EMPLOYED

When it seems probable that a certain area contains ore, a magnetometric survey is often made, because experience has shown that the non-magnetic ores are often connected with pyrrhotite or magnetite, and a magnetometric map will often show the strikes of the hidden rock masses.

Frequently electrical mapping is done by methods which allow of exact determinations. Those methods, which are kept secret, differ in many important points from those which have been used elsewhere. No equipotential lines are determined, as in the well-known method of Schlumberger, but the differences in the underground conductivity are ascertained at regular distances. The result is a map similar to a magnetometric map. Where indications of the existence of orebodies have been revealed by these methods, the investigation is continued with the aid of diamond drilling and regular prospecting by mining. These endeavors to discover new ores have been in part successful, several orebodies, one of them very valuable, having been found, and there is hope of further discoveries, which may change Finland to a mining country. Experience denoting the most successful way of prospecting is thus different in Finland from what it has been in many other countries.

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[*] Director of the Geological Survey of Finland

SCIENTIFIC METHODS DISCLOSING MINERAL DEPOSITS

In his important work on international mining laws Theo F. Van Wagenen summarizes the American opinion in the following words: "It is to be remembered that everywhere in the world the mining industry began either with discoveries resulting from the conscious and intelligent efforts of laboring men, or by accident. There are no records of mines found by scientists or professional men of any kind."

In Finland, on the contrary, all discoveries of new orebodies made during the last few decades have been made by professional men employing scientific methods, and it is regarded as proved that such research possesses successful possibilities where even the most intelligent prospector of the laboring classes would fail completely. Scientific prospecting is no more merely a theory; it may be confidently said to be a proved success.

Along the southern shore of Finland stretches a zone of rocks some of which certainly correspond geologically to the iron-bearing "leptitic" rocks of Middle Sweden. Also, in Finland those "leptites" contain intercalated layers of magnetite, but these orebodies are generally small and much mixed up with the Archæan granites, which in this region intimately penetrate all the older rocks. Some ore from these small orebodies was used, when labor was cheap, by the Finnish iron works, but most of them have had recourse to magnetite imported from Sweden. Finnish lake and bog ore may also be used. It occurs at the bottom of many lakes in abundant quantities, mainly where there are deposits of glacial sand from which the iron constituents have been leached out by water containing humic acids.

IRON ORES LOCATED WITH MAGNETIC COMPASS

On the island Jussarö, west of Helsingfors, magnetite forms a large orebody two miles long, as has been indicated by magnetometric surveying, but the ore contains on the average only 25 to 29 per cent iron, but sometimes runs as high as 30 to 35 per cent. Some of the iron is in the form of a ferrous silicate. Moreover, the greatest part of the orebody lies under the surface of the sea, and the main shaft is situated on a small island. Despite these difficulties endeavors have been made, and are still continued, to use that ore with magnetic concentration. Over wide areas of the surrounding sea the compass is disturbed by the influence of these iron ores, a phenomenon that has caused many shipwrecks. These iron ores of southern Finland either occur with old basic eruptive rocks or with limestones intercalated with the "leptites."

A titaniferous iron ore of another type occurs at Välimäki, on the northeastern shore of Lake Ladoga, near the Russian boundary. The ore is a magnetite concentration in a gabbro, and the richest parts of it contain only 23 per cent of iron. The ore has been concentrated by magnetic separation, yielding a product containing only 0.01 per cent of sulphur, practically no phosphorus, and 4 to 5 per cent of titanic oxide.

During the years 1896 to 1907, about 100,000 tons of concentrate was recovered, together with some lump ore, products which were smelted in a blast furnace on the Russian side of the boundary.

Expectations of finding in Finnish Lapland iron ore of the same type as the famous orebodies in Sweden have repeatedly been disappointed. The ore-bearing rocks of Swedish Lapland have a north-south strike, along the boundary, and rocks of that type do not occur on the Finnish side. The iron ores of northern Finland are markedly different from the ores of Kiiruna and Gellivaara, in northern Sweden.

MAGNETITE FOUND IN NORTHERN FINLAND

The greatest bodies of iron ore of northern Finland occur in the Porkonen-Pahtavaara area in Kittilä, more than 100 miles from the nearest station of the Finnish railway system which ends at Rovaniemi, on the Arctic Circle. If a railway were built to the Arctic Ocean, it would pass at a distance of less than thirty miles from these orebodies. They have been known for nearly a century, and the greater part of them were magnetometrically surveyed by Dr Mäkinen, of the Geological Survey of Finland, in 1920; some portions of them earlier than that year. The ore is magnetite, and forms intercalations in a quartzitic schist. It has much the same character as the Keewatin ore of Canada and the ore of South-Varanger, in northern Norway, near to the present boundary, of which it may possibly be a continuation.

Those parts of the ore of Kittilä which are to a large extent visible at the surface occupy an area of 27.1 *har*, or 66.8 acres. The magnetometer reveals an area of at least 36.5 *har*, or 90 acres. For comparison, it may be mentioned that the Kiiruna-Luossavaara area of Sweden measures 114 acres and that of Gellivaara 56 acres.

The dip of the schists in which the Finnish ores are intercalated is predominantly vertical, and the beds are much tilted and contorted. If the depth is assumed to be only 100 m., the total mass of the orebody is at least 150,000,000 to 200,000,000 tons. The ore is everywhere amenable to concentration, most of it containing about 40 per cent iron, 0.15 to 0.5 per cent phosphorus and 0.034 to 0.067 per cent sulphur. The magnetite is finely divided, which makes separation difficult. The ore field is largely owned by private persons, though a part of it is the property of the state.

ONE DEPOSIT KNOWN FOR A LONG TIME

At Kolari, near to the Swedish boundary, there is another iron orebody, Juvakaisenmaa, which has also been known for about three centuries, and which has been recently surveyed magnetometrically and in part also investigated by the aid of diamond drilling. The ore is intercalated with mica schists, and has been followed to a length of about one English mile. The best part of the ore, which has an iron content of about 55 per cent, has a thickness of 6 to 10 ft., and the whole ore zone, which averages about 40 per cent of iron, has double this thickness. The ore does not contain more than 0.01 to 0.09 per cent phosphorus, but carries a rather considerable amount of sulphur, because pyrite is present. Good limestone and quartz occur in the neighborhood. This orebody is more than 100 miles distant from the nearest railway, but possibly one will be built to that continuation of the ore which has been found at the Swedish side.

In Suojärvi, in southeastern Finland, occur layers of hematite 4 to 5 ft. thick and several miles long, which are intercalated with the pre-Cambrian dolomites which belong to the Jatulian formation. A lump ore can be extracted with an average content of 50 per cent iron. This ore field, which is situated near to the terminus of a railway which is now being built, will probably eventually become of much importance. Concentrating ore certainly occurs in several places in the quartzitic areas of eastern and northern Finland.

There is a further possibility, if the pyritic ores of Finland are treated by the chlorination process, or by electrolytic methods, of using purple ore as a material for producing iron. Because of the short transport, imported Swedish iron ore will also be cheap. In the production cost of the pig iron imported from Sweden in 1918, the item for ore formed only about 10 per cent of the whole cost, and as charcoal and labor are cheaper in Finland, it would appear to be advantageous to produce steel from Swedish ore.

ELECTRICAL SMELTING A POSSIBILITY

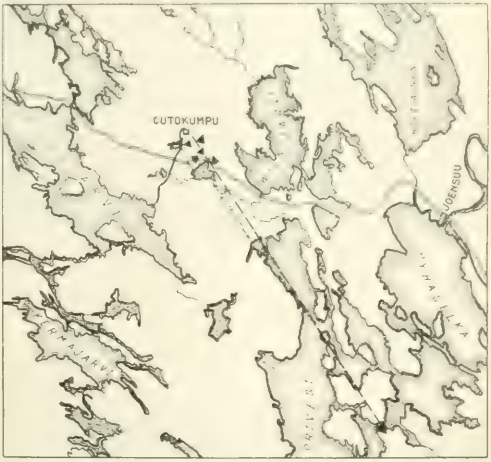
When it is further considered that Finland possesses an abundance of water power and is near to Russia, which may soon again be a good market for industrial products, the possibility of an iron industry on a larger scale does not seem remote. In fact, it is entirely probable that electrical smelting may soon be an important industry in Finland. At the Imatra rapids, which belong to the state, nearly 200,000 hp. are available and will probably be utilized in the near future, and despite the increased cost of construction, it is expected that electric power will be obtained at a price not higher than before the war.

In southern Finland a prospect of nickeliferous pyrrhotite has been found, but it seems to be of no importance. At another place, however, promising prospects of nickel ore exist, although nothing definite can be said about them at present.

ONLY A FEW IMPORTANT DEPOSITS OF PYRITE

Pyritic ores are rather common in Finland, although only a few are of importance. The pyritic copper ore field of Orijärvi, in southern Finland, is geologically analogous to the famous pyritic copper orebody of Falun, in Sweden. But although the last named is one of the largest orebodies of this type existing, having yielded 500,000 tons of copper, 15 tons of silver and 1.5 tons of gold, the Orijärvi field, which has been worked since 1757, has not produced more than 4,500 tons of copper. The average copper content of all the ore mined is only 0.6 per cent, and the ore is found with sphalerite. Also, some gold, connected with selenium, occurs in the orebody. Geologically, the ore is interesting, because it is, as has been shown by Dr. Eskola, connected with cordierite-anthophyllite rock, often rich in quartz. This rock has been formed by a metasomatic change of a fine-grained "leptite" schist caused by the contact action of the oldest Archæan granite of the region. By metasomatosis much magnesia and iron have been added to the original rock. This cordierite-anthophyllite rock has been shown to occur in so many instances in connection with pyritic ores as to be regarded as an important indicator when prospecting for such ores in the Archæan of Fenno-Scandia.

The Pitkäranta ore field, on the northeastern shore of Lake Ladoga, is geologically extremely interesting, although the mining at that place has thus far achieved no great success. During a century, 6,600 tons of copper have been won, together with 488 tons of tin and 11 tons of silver. The magnetic iron ore of Pitkäranta, which forms the main part of the orebodies, has also been used. The quantity of probable ore seems to be at least 12,000,000 tons, but the iron ore is much mixed up with copper pyrites and sphalerite. It is probably a unique instance that the same mine is able to produce copper, zinc, silver, lead, tin, and iron ore. All these different ores occur within narrow zones of crystalline limestone, which form the layers of the Ladogian system, next to its base of granitic gneisses, but the mineralization occurs only near the contacts of a late pre-Cambrian granite, from which gases and solutions have emanated, causing the formation of the ores. This typical example of the contact action of a granite has been well known through the detailed description of O. Trüstedt. At Kelivaara, about 1.5 miles north of Pitkäranta, a similar orebody consisting of magnetite has been discovered by Mr. Trüstedt.



TRACING A BOULDER OF ORE TO ITS ORIGIN, SHOWING WHERE THE FIRST BOULDER OF ORE FROM OUTOKUMPU WAS FOUND AND THE DIRECTION IN WHICH IT TRAVELED

COPPER DEPOSIT LOCATED

Of markedly different character is the copper ore of Outokumpu, in Kuusjärvi, which was discovered in 1909. A boulder of copper ore had been found at the digging of a channel, and the Geological Survey charged O. Trüstedt to trace it to its origin. The neighboring regions had been mapped, and quartzites similar to that which carried the ore were known to exist only in few places, which were visited. In one of them, thirty miles distant from where the boulder was discovered. Mr. Trustedt found an area overstrewn with boulders of similar ore. The outcrops of the ore were hidden, but with the aid of diamond drilling an orebody was detected which has a thickness of three to forty feet and a length of nearly two miles. The ore sheet follows a fissured zone in the quartzite dipping 50 deg. south, and plunges to the west. It is divided by a great fault, but otherwise seems almost as regular as a coal seam. The copper content is 4 to 6 per cent, with 1.15 per cent zinc, 25 per cent sulphur and small amounts of silver and gold. At a depth of 600 ft. it has still a maximum thickness of 28 ft., and the ore in sight is estimated to be at least 8,000,000 tons, and the probable ore is 50 per cent or 100 per cent more.

The ore occurs with a serpentinized peridotite, but it is also cut by pegmatitic veins which have been brecciated and cemented by ore, and it is still an open question whether the basic rocks or the granite has carried the ore. In every occurrence a part of the ore has been dissolved and redeposited at the time of the intrusion of the granite.

COPPER PRODUCTION NOT LARGE

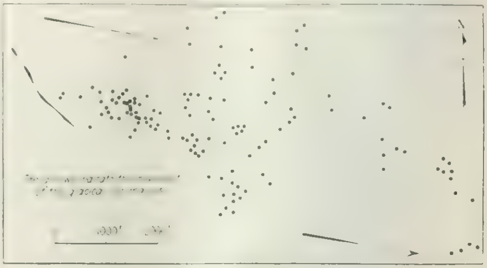
Although this big ore deposit has good communications, lying near to Lake Saima, which is connected with the sea, and a railway having been built to the nearest harbor, the production of copper has thus far been inconsiderable. Half of the mine belongs to the state as its discoverer, and another half to a wealthy firm in Wiborg, owner of the ground where the ore was found. The ore has been treated by an electrical process invented by Mr. Hybinette, the nickel and copper metallurgist, who also leased the mine for a time. The copper works are now again run by the owners.

COPPER PLANT AT OUTOKUMPU USING THE HYBINETTE PROCESS

War and want of capital have thus far hampered the development of the copper industry in that district, but there is no doubt that this great ore deposit, which is capable of a yearly production of at least 6,000 tons, will be in the future an important source of revenue to Finland. Reporting on the mine in a professional capacity, Prof. J. H. L. Vogt has said that he is confident that this property alone will reimburse to the government all the expenditures of the Geological Survey of Finland. The bureau will thus prove to be a directly paying enterprise. It seems not unlikely that more orebodies of the same character may be found.

In the same zone of rocks where these pyritic ores occur, small deposits of pyritic ores of a less reliable character are often found in the metamorphic basic rocks. Some of them, occurring in veins sharply cutting the main rock with a filling of calcite or quartz, may occasionally carry copper pyrite, but they are always irregular, and others forming small indefinite seams in the basic rocks are only prospects of a wildcat character.

Deposits of iron pyrites occur at several places in eastern Finland. The most important is that of Otravaara, twenty miles from the railway between Sordavala and Joensuu. The ore has a thickness of 20 ft. and is of fair degree of purity, with 40 to 47 per cent sulphur. Another deposit of pyritic ore is that of Tipasjärvi, east of Kajana, and of Jalonvaara, in Suistamo, north of Lake Ladoga. The last mentioned was discovered in 1920 by Dr. P. Eskola, in charge of the Geological Survey, and lies at a distance only eight miles from the nearest railway. The map shows the spreading of the erratic boulders from this ore deposit, indicating that it has a much greater length than the portion which the diamond drilling has hitherto detected. It is probable that these iron pyrite deposits, together with the ore of Outokumpu, will fill the sulphur requirements of the Finnish pulp and paper industry, as well as those of the chemical industry, so that no imports of sulphur or pyrite will be necessary. None of these deposits of iron pyrite is situated favorably for export.



SPREADING OF THE ERRATIC BOULDER FROM THE DEPOSIT OF IRON PYRITE AT JALONVAARA

In the Petsamo (Petchenga) area, at the coast of the Arctic Ocean, a territory Finland acquired when concluding peace with Soviet Russia, veins of galena occur, some of which have a thickness of several inches. They are often well mineralized and contain some sphalerite. The galena is in part argentiferous. The gangue consists of quartz or calcite. Various competent authorities have given favorable reports on these veins, but thus far only research pits have been opened.

LEAD ORE FOUND, BUT OF SMALL IMPORTANCE

In Finland proper some galena has been mined at Pitkäranta and Orijärvi, where the probable quantity of the remaining ore has been estimated to be 400,000 tons. A few miles from the latter mentioned mine there is a quartz vein containing a low percentage of lead, together with some gold. It was worked during the war, but is now lying idle. Also, in the "rapakivi" granites of Finland narrow veins of galena occur, but they possess no economic importance.

In 1836, a boulder of dolomite containing native gold was found near Kemi, at the northern end of the Gulf of Bothnia. Despite long-continued and reiterated research, it has not been possible to trace its origin. In 1860, however, placer gold was found at the River Ivalojoki, in northern Lapland, southwest of Lake Enare. Since that time gold has been won in Finland mainly from gravel beds in the narrow valley of the River Ivalajoki and its tributaries which

PRIMITIVE GOLD SLUICING AT SOTAJOKI, TRIBUTARY OF IVALAJOKI IN FINNISH LAPLAND

were rich in water at the close of the Glacial Period, and also from fissures in the underlying bedrock, which is hard and unweathered. At the beginning of operations hundreds of men worked there every summer, but now the work is inconsequential. Altogether, gold to a value of about $300,000 has been won during half a century.

GOLD PLACERS BEING WORKED

A great part of the placer gold is rather coarse, and it is probable that most of the finer gold particles have accumulated below the eastern end of the present narrow river valley, where there are large deposits of river sand laid down during the Glacial Epoch. As the course of the glacial river has probably changed often, and as the underlying bedrock has a rugged surface, it will be difficult to find out where richer deposits may possibly have accumulated, and, if they are found, to work them with the aid of dredges or other machinery. Attempts have been made to win the gold from the deepest parts of the present river bottom, but great difficulty is caused by the rugged character of the surface of the crystalline rocks.

In some of the small tributaries of the Ivalo River the gold is coarse and very little waterworn, forming beautiful feather-like crystals, often combined with quartz and limonite. However, it was only in 1900 that a Finnish miner, who had returned from the United States, succeeded in finding gold in a vein of quartz and limonite, in which the ore occurred as feathery crystals similar to those occurring in the gravel of the river in the neighborhood. He started his work at the contact of a dike of syenite cutting pegmatitic quartz. The gold-bearing veins occurring occasionally at the same place were intermediate in age. It is probable that the ore formed a small although rich pocket in the vein, but deeper below in the same brecciated zone the contents were low.

During the following years effective prospecting was done by several concerns, and a great number of veins were found, consisting in their upper part mainly of limonite and blue quartz. There were many signs of weathering of the upper portions of the veins and redeposition of the gangue minerals of the neighboring country rock, and as it was thought that the limonite portions were the gossan of pyritic veins, it was held probable that there might be a zone of secondary enrichment deeper below. But at a depth of a hundred feet or less the vein filling was found to consist only of calcite, dolomite, siderite, and quartz, with only small amounts of pyrite. If there has been a secondary enrichment, which is possible, it has probably occurred mainly during the weathering of those portions of the veins which are now almost completely destroyed. All the veins hitherto examined were extremely poor, and generally carried only traces of gold. Also, if richer pockets were found, it is probable that most of the veins are not workable.

RARE METALS AND NON-METALLICS REPRESENTED

Platinum and iridium have been found in small quantities together with the placer gold of Lapland. They are thought to be derived from the same veins as the gold, but it seems more likely that they originally occurred in peridotitic rocks which are not uncommon in the region.

Molybdenite occasionally occurs in granite veins in Finland, usually in small quantities. They have been worked at only one place, Mätäsvaara, in eastern Fin-

[illegible] of Joensuu. Radioactive minerals have been found at some places near Lake Ladoga, but thus far they have not been worked on a commercial scale.

At Lake [illegible], metamorphic peridotites are known which contain amphibolitic asbestos. The mineral is rather brittle, is difficult to separate from the other constituents, and does not form veins, but is disseminated through the whole rock mass. It may easily be won in great quantities.

Graphite has been found at several places, usually as layers in schists, or disseminated between their minerals. The most important occurrences are in Tyrvaa and are owned by O. Y. Grafit, A B., which has built a concentration plant.

Talc occurs at a few places, but is not entirely pure and has thus far not been used.

Feldspar and quartz have been won from pegmatitic veins, but good feldspar veins are more rare than might be anticipated in a country consisting mainly of granites. No first-class mica has been found. Mica for grinding might be won, but not in great quantities.

Crystalline limestone occurs in several places in northwestern Finland in great quantities and good quality, and has been used also for producing a cement of superior quality.

Volatilization Experiments on Low-Grade And Complex Ores

The application of the chloride-volatilization process to the recovery of metals in low-grade and complex ores continues to be one of the major problems being studied at the Intermountain Experiment Station of the U. S. Bureau of Mines at Salt Lake City, Utah. The process consists of crushing to the proper fineness; mixing with chloridizing agents, such as sodium and calcium chloride, alone or with other reagents; furnacing at elevated temperatures to effect chloridization and volatilization of the metal chlorides formed, and treatment of the volatilized chlorides to obtain the valuable metals in salable form. Electrical precipitation is considered the most feasible way of collecting the volatilized fume.

The station maintains a semi-commercial plant that includes a large rotary kiln of the cement type, a Wedge roasting furnace, and two electrical precipitators, each with a capacity of 1,500 cu.ft. of gas per minute. The station's plant also includes a small rotary kiln in which preliminary testing is conducted before testing in the large kiln. A new type of furnace, in which the ore charge is introduced at the fire end, has been constructed. Results indicate that better extractions can be obtained than in other types of furnaces tried.

The treatment of the collected fume continues most important, as the fume from each ore is a problem in itself. A laboratory-size reverberatory furnace for the reduction of lead and copper chloride fumes has been constructed to determine whether continous feed can be employed without excessive loss by volatilization. During test runs, by the use of this furnace careful control of the temperatures, keeping them below 1,150 deg. F., eliminated much of the loss by volatilization. Investigations were made to determine the feasibility of introducing the metallic chloride fumes through the side of the furnace underneath the surface of the slag, and these experiments proved to be successful. The small-scale laboratory experiments indicate practically a complete reduction of lead and copper fumes.

The volatilization process is best suited for low-grade oxidized ores of copper, lead, silver, and zinc, and also for the more complex oxidized ores of these metals. Practically complete extractions of lead and copper have been obtained, and the extraction of silver has been from 50 to 90 per cent. Copper ore carrying copper mainly in the form of chrysocolla is difficult to volatilize. The volatilization process seems to be particularly adapted to separating lead and silver from zinc in oxidized ores. The work is being conducted by Thomas Varley, metallurgist, and E. P. Barrett, metallurgical chemist, for the Bureau of Mines, and C. C. Stevenson and Virgil Miller, of the research department of the University of Utah.

Studies in the chemistry of the volatilization process have been made by C. M. Bouton, physical chemist, to determine the chemical reactions involved and the vapor pressure of sodium chloride.

Experimental work in co-operation with the Ontario Silver Mining Co., of Park City, Utah, on low-grade complex ore carrying silver, lead, and zinc, is also being continued by the Bureau of Mines. Practically a complete extraction of the silver and lead has been obtained. Experimental work was carried on with the Yellow Pine Mining Co. at its fifty-ton plant in Goodsprings, Nev., but was discontinued on account of a temporary closing of the plant. As this was the first attempt of the Bureau to employ the volatilization process on a commercial scale, valuable data were obtained.

In tests conducted in co-operation with M. P. Kirk, at a plant in Harbor City, Cal., a high-grade zinc oxide has been made direct from zinc-carbonate ore. Volatilization tests of ores carrying less than one-half of 1 per cent lead gave complete volatilization of the lead. The experiments were successful, and Mr. Kirk plans to erect a larger and more complete plant at or near Harbor City, where volatilization will be employed on a commercial scale. Many other volatilization experiments have been conducted with various mining companies on different types of ores, to ascertain whether the volatilization process could be used. A bulletin covering the volatilization process in detail is in course of publication.

Willow Creek District Examined By Bureau of Mines

The Federal Mine Inspector for Alaska, whose work comes within the supervision of the U. S. Bureau of Mines, recently made an investigation of the Willow Creek mining district in that territory. This district has every indication of being a fairly active one in the near future. All veins that have been seen so far are true fissure veins, carrying free gold. The veins vary from a few inches to several feet thick and carry gold values from $5 to $200 per ton. The average value of the ore now worked is about $50 per ton. This district is about twenty-five miles north of the town of Wasilla, on the Government railroad.

Notes on Lead-Bullion Refining— A Correction

In the article "Notes on Lead-Bullion Refining" which appeared in the issue of Dec. 17, 1921, under the caption "Reverberatory Byproduct Furnace," is the statement: "These two methods give silver which is free from antimonial slag." It should read: "These two methods give silver-free antimonial slag."

The Burden of Mine Taxation—Its Special Problems

Necessity for Reduction of Governmental Expenditures, for the Right Popular Understanding of the Status of the Mining Industry, and for a Fair Apportionment Of Annual Tax Assessments Between Mines and Other Industrial Developments

By Henry B. Fernald

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TAXATION now imposes an unusually heavy burden on the mining industry; first, because there is a great common load of taxation which must be borne by industry today—by the mines, as well as by all other industries of the country; and, second, because there are certain conditions peculiar to mines which vitally affect the taxes which the mining industry must pay.

The first of conditions noted is really the more important. If the aggregate amount to be raised by taxation is small, it should not fall with burdensome force upon any one industry. One may pay slightly more, and another slightly less, than its fair share of government expenditures. Furthermore, if there do prove to be inequities, it is a relatively simple matter to work out such modifications and changes as may be necessary to give each taxpayer a fair measure of relief. If, however, the amount to be raised by taxation is so large that it cannot help but be a burden on all industry, the various differences which were formerly negligible become matters of vital importance, and the greater the amount to be raised by taxation, the harder is it to make the readjustment to give proper relief from an unfair or inequitable impost.

The Common Tax Burden

The common burden on industry arises from certain fundamental sources:

1. DEVELOPMENT AND GROWTH OF GOVERNMENT EXPENDITURES

(*a*) *Federal Expenditures*—The dominating feature of Federal expenditure is, of course, payment for the Great War. The interest on our war debt amounts each year to more than our annual pre-war Federal budget, and the principal must sooner or later be paid off through taxation. Furthermore, we are still having to pay, year by year, a great amount to clear up obligations and commitments which arose from the war, and to maintain an organization to consider and handle these post-war settlements. This accounts for a large part of our increased burden of Federal taxation. Our debt expenditures must continue for years, but we should be able materially to reduce Federal expenditures by elimination of those which are now being made to clear up the war situation.

There are, however, three other important features of increased Federal expenditure. One is that the entire Government organization was geared to a war basis. In war matters the important purpose was that of accomplishment, almost regardless of expense, and it was unavoidable that something of this same spirit should be applied to the peace-time departments. This is not surprising, as much this same condition existed in the industrial concerns of the country. It is not an easy matter, and it is going to take time, for the Government to get back to a normal basis. Real efforts for the accomplishment of this important objective are being made in Washington and should ultimately result, under the present Federal budget system, in a more economical and businesslike administration of Government affairs than the country possessed even in pre-war days.

Another and perhaps more serious feature is the continually increasing extent to which the Federal Government is being urged to take over or to assist in what were formerly regarded as purely state activities. If this merely involved that expenditures heretofore made by the states were in the future to be made from the Federal treasury it would not denote any increase in the aggregate tax burden of the country, but the usual tendency of, and in many cases the arguments for, the Federal expenditure is to have the states make greater expenditures for these same purposes. The additional amounts which must be raised by the Federal Government do not, therefore, serve to decrease, but rather operate to increase, the amounts which must be raised by the states. This statement may properly be made without implication of criticism of the merit of the expenditures.

Perhaps with the increasing population and development of the country it is necessary that both Federal and state expenditures for many of these purposes should be augmented, and if such increase were only proportionate to the expansion in wealth of the country, it would not necessarily involve an addition to the tax burden. The tendency in recent years, however, has been for these expenditures to grow much more rapidly than the increase in wealth, as is evidenced by the continually advancing tax rates. Perhaps it is unavoidable that there should be this enlargement in both Federal and state expenditures and that they should expand much more rapidly than does our national wealth. If so, we must count on a continually increasing tax burden upon industry, at least until we reach what might be termed the "point of saturation." This is a rather pessimistic assumption, because it would lead to the conclusion that the growth and development of the country would produce a constantly increasing tax burden until that burden became so oppressive as to check and retard further development.

A third feature, and one similar to that just mentioned, is the constant demand that the Government should assume entirely new functions or should greatly expand existing activities. Some of these are merely political maneuvers, with little, if any, justification. The majority, however, have some merit. Sometimes the trouble is that, to accomplish some good end, an expensive, elaborate or even impracticable scheme is devised and expenditures are authorized under the urge of enthusiasm for the project proposed. Sometimes the purpose, though worthy in itself, is one which is really not a proper Federal activity but should be left to the states, to the municipalities, or to private

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enterprise. Sometimes the project possesses some merit, but the expenditure required is all out of proportion to any real good to be achieved. In almost every instance these projects will have the support of some honest and enthusiastic individuals and organizations, and the pleas of enthusiastic men and women will often obtain an appropriation regardless of expense or practical considerations.

We must regain our sense of financial values which we lost in the period of inflated values and vast Government expenditures, unless we are to accept the pessimistic view already mentioned, that our tax burden must continually increase and bring about its own natural consequences. This conclusion is not inevitable, because we have already witnessed some effect of the demand for a reduction in Government expenditures, and if there is a general realization that increased expenditures, regardless of their merit or importance, will make necessary the raising of still greater amounts by taxation, we can and should devise a check on the tendency continually to add new activities and to expand existing activities of the Government.

(b) *State Expenditures*—Much the same condition exists with respect to state as to Federal expenditures. The states have not had to raise money for direct war expenditures, but they have undertaken many additional activities on account of the war. There has also been created a loss of perspective because of the vast sums that the Federal Government was spending.

A similar tendency of states to take over or to aid in activities which had previously been considered county or municipal matters is to be noted. There has also been created a feeling that the state must spend every dollar necessary to obtain such Federal aid as was contingent upon state expenditure, often regardless of the merit of the project and often careless of the method of expenditures and neglectful of the results to be achieved. New activities have been introduced and former activities expanded in much the same manner as for the Federal Government. The insistent search for new sources of revenue and the increased tax rates in practically all of our states show how far the state expenditures have outstripped the increase in their wealth.

(c) *County and Municipal Expenditures*—County and municipal governments have been subject to similar pressure to increase and expand their activities, and in general have done so at a rapid rate. The full extent of their additional activities is not always reflected in the increased tax rate, because of the extent to which they have been able to transfer their former functions. Such a transfer does not usually result in reduction of local taxation, because other activities absorb the apparent saving. In fact, the fundamental motive is generally to enable the towns and counties to have this money available for some other purpose rather than to enable them to effect a reduction in the tax rate.

There exists, apparently, a belief that the local taxpayer puts up the money for town and county expenditures, but that it is someone else who pays for the expenditures made by the state. It is true that the state taxes may not fall with the same force on local taxpayers as do those of the town and county, and therefore it may also be true that in any particular town or county the taxpayers contribute less toward the cost of certain activities if these are conducted by the state than if they were under the direction of the town or county. An increased tax burden must, however, be borne somewhere within the state. Under some conditions the larger scale of operations under state administration should enable them to be conducted more economically, but this is probably offset by the greater demands for such expenditures which arise when the taxpayers do not see so clearly that it is their own money which is being spent. It can almost be accepted as an axiom that the closer expenditures are to the source of revenue, the more closely will the taxpayers watch the nature and result of the expenditures.

This matter of Government expenditures is the fundamental factor in the tax situation today. Were our Government expenditures low, there should be no special tax burden upon the mines. If we could go back to the old Federal tax of 1 per cent on income, and the old rates and assessments for local taxes, it would not be a matter of great importance whether or not mines paid slightly more or less than their fair share of the general tax burden.

2. POPULAR SENTIMENT REGARDING TAXES

A real problem to be met is the popular sentiment that industrial corporations represent great wealth, presenting unlimited tax possibilities. In response to popular demand a shifting of the tax burden has been effected. Step by step, the taxes on corporations and wealthy individuals were increased. In pre-war days this had no real detrimental effect on business, because governmental expenditures were not so large and the tax rates, as we now realize, were low. Even as late as 1916 the Federal income tax on corporations was only 2 per cent and the maximum tax rate on individuals was 15 per cent. We had not then reached the point where such taxation became great enough to have any marked influence on business and investment policies and decisions.

In as complicated a financial and industrial situation as that through which we have been passing, we cannot attempt to define the exact extent to which business has been influenced by taxation. We know it has been affected, because billions of dollars in taxes cannot be taken from the profits of industry without having an oppressive effect. We also know that business managers and large investors are materially influenced as to policy and decisions by the tax situation. This fact, however, has not been understood or appreciated by the popular mind. Political agitators can enthuse their audiences more on a text of "soak the corporations" than economists can in presenting the facts to show that the continually increasing volume of Government expenditures is a burden which falls not alone on the wealth of industry, but which affects everyone concerned with its processes and products. This psychological factor particularly affects the mines, which embody, in popular conception, emblems of great spectacular wealth and therefore easy targets for taxation. The ordinary manufacturing or trading business does not stand out with the glamour which attaches to the successful mine. One of the greatest problems the mines have to solve is how to meet this psychological factor so that a fair hearing and just decision may be accorded their tax problems. These are the conditions which give rise to the common tax on industry, and the mining industry can expect no material reduction in the tax burden which it must carry unless it can do its part in solving these fundamental problems.

TAXATION OF MINES

The various forms of taxes to which the mines are subject each presents its own special feature of the general problem. Each separate mine will also have some problems peculiar to itself. One of the greatest difficulties in the entire tax situation is the question of how the individual mine should handle its affairs so that it will not subject itself to higher taxes than it ought equitably to be required to pay.

If we could set up a tax bill for all the time which has been given, and is today being given, by mining companies to the solving of the problem presented by the Federal tax situation alone, the result would amount to an astounding total. One reason for this has been the frequent changes in our taxing laws. Every change in basis of taxation presents a new problem for solution, and before urging any such change we ought carefully to consider what it is going to cost the business men of the country to solve the new problem which will thus be presented. Considering briefly the principal forms of taxation applied to mines, the following may be mentioned as the main problems presented:

Federal Income Tax—So far as mining corporations are concerned, their principal problems under the Federal income tax laws relate to the past rather than to the present or future. Although the excess profits tax was not officially repealed until 1922, there are only a few mines that have any cause for worry regarding their 1921 taxes.

Those who framed the new Revenue Law have tried to be fair to the mining corporations. They, as other corporations, are subject to only a 12½ per cent income tax. Depletion deductions are allowed on substantially the same basis as in the prior law, although there has been included the relatively minor provision that depletion based on discovery shall not exceed the year's income from the property, and also that depletion based on discovery value is not to give rise to a loss to be carried forward against a subsequent year. No substantial change was made in the provisions regarding depreciation, obsolescence, and inventories. Of course, no law can be drafted and no regulations can be established by the department which will not weigh heavily in some particular applications, but it seems the manifest intention of the law and of the department that mines should receive fair recognition for the wasting of their assets and should not be at a disadvantage on that account as compared with the other industries of the country.

From the standpoint of stockholders, more definite recognition is given in the law to the non-taxable character of distributions which come from the proceeds of depletion, although the law is made even more specific that such distributions can be made only after first distributing any profits accumulated since March 1, 1913; but this is only the same rule which applies to dividends by any corporations. The high surtax rates on individuals will have some detrimental effect on mining, as on other industrial investments, because it is so manifestly to the advantage of individuals with large incomes to place their funds in tax-exempt securities. On the other hand, the provisions for a reduced tax on "capital gains" is a distinct benefit and should generally remedy the situation where the sale of stock ownership of a mining property was prevented because of excessive taxes which the seller would have to pay on profits which he realized.

An important provision in the new law is that which allows losses in one year to be deducted from taxable income of the succeeding year. This is particularly important to mining companies, because mining is a "rich or poor" business. The wording of the law giving this relief is rather complicated and perhaps subject to some criticism of the way in which the matter is worked out, but, after all, the fact of primary importance is that corporations are given this relief, and for mining companies that depletion based on cost or value at March 1, 1913, is definitely recognized as a deduction in computing such a loss, although depletion based on an increased discovery value is excluded. This allowance to the corporation does not give relief to mining stockholders, and they will, therefore, be subject, as in the past, to assuming, perhaps, a high tax rate in years of large dividends, with no compensating factor for those years in which no dividends may be received.

The old problems raised by the 1917 and 1918 laws are not yet settled, and for some time will probably be the largest Federal income tax problems which mining companies have to resolve. Most of the questions which can arise seem, however, to have been well covered by the Treasury Department, and fortunately there is evidence of a definite intention on the part of the department to accord to future cases any rights which have been established in cases already settled. It is needless to say that there can be no fair and just settlement of mining tax issues under the excess profits tax law, because the provisions of invested capital were essentially unfair to the mining industry. Each mine will have its own problems in this regard, but these are problems of the past, which, when once settled, we can believe will never recur.

Federal Capital Stock Tax—The capital stock tax continues in substantially its present form, with a tax of $1 per thousand on "the fair average value of its capital stock for the preceding year." The question of how this "fair average value" is to be determined is one not yet fully clarified. With the capital stock tax thus recognized as a continuing feature of our revenue laws, more definite progress should be made in resolving this question than was made when it appeared that this tax would probably be abolished. In a period of prosperity the capital stock tax is not a particular burden, because it is relatively small as compared with the income tax, but in time of depression it becomes a material burden, because it still has to be paid, even though the corporation is operating at a loss and has no income tax to pay.

Other Federal Taxes—There are various stamp and excise taxes which, directly or indirectly, have to be borne by the mining industry, but only in the same manner in which they must be paid by the other industries of the country. Mines were particularly burdened with the transportation tax, but with its repeal the other items can hardly be classed as a special problem for the mines, although in some particular instances they may be of importance.

State Taxation—It is more difficult to set forth the specific problems which arise in state taxation, because each of our separate states presents its own problem. In all states there is a general demand for increased revenues. The mining industry is in a period of serious depression. For political reasons, the states hesitate to seek additional revenues from the farming communities or from general business. Mines stand out as particular targets; they do not have the voting power which the farmers have, nor the political influence of the retail dealers. There is no fear of their moving their mines out of the state, and, as already mentioned, to the popular mind they represent unlimited wealth. A further popular belief is that the mines are robbing the state of its wealth as they ship out the mineral products.

There has not been sufficient appreciation of the narrow margin between gain or loss which exists in most mining operations and of the vast amounts which the mines spend or cause to be spent locally. The most successful mines in their most successful years stand out as the basis for comparison, although they present an entirely false picture of the average for any one mine, to disregard completely the average for the entire mining industry. A popular belief has been created that mines have had an unmerited prosperity because they have been leniently dealt with by the states, and the fact that the mining states have reached their present stage of prosperity and development only through the vast sums which have been spent on mining development, because the opportunity for large gain to a few mines in certain periods was enough inducement to offset the strong probability of loss, has been ignored. One of the biggest problems which the mines have to face today is to meet a certain adverse public opinion which undoubtedly exists and to give to the public the right appreciation of what the mining industry is and its relations to the general business and public welfare.

Two principal systems of state taxation of mines have been evolved, although these assume many and varied forms. One is the assessment of mining property as realty in the same general manner as other real property of the state. This brings up the problem as to a basis of assessment of mining property which will be comparable with assessments of farming and business properties, because when the assessment is determined the tax burden will be spread according to the assessed valuation.

The other basis is that of a tax based upon volume of output or amount of profits. This, then, raises the question as to what rate of taxation should be applied to the profits or the output, to have the mines stand their fair share of the aggregate total raised by taxation.

In neither of these contingencies is it easy to say what is the right comparative basis. If the basis of valuation as real property is used, we are confronted with the fact that a large part of the value of a mine is represented by ores which cannot be reached for years to come and which have little, if any, effect upon the amount of present income out of which the taxes must be paid, so that mines are radically different from other properties which have only a surface value, which is available for present use. If, on the other hand, mines are taxed on a basis of output, we have the problem of determining what should be the rate of taxation applied thereto. It is a difficult matter to determine whether a tax amounting to a certain percentage of the profits of the mine (or of its net proceeds) or a tax of a stated amount per ton is or is not fair as compared with the basis of assessment and rate of tax applied to other property in the state.

The problem is more complicated because we cannot divorce the mining question from the other features of revenue and taxation in the various states. We may take any one state and determine what would seem a fair and just solution there, but as soon as we turn to another state we find that the whole nature and fabric of the revenue and taxation structure of state, counties, and municipalities is so different that we must start anew to find our right solution. We are also confronted with the practical question that popular ideas and opinions vary in the different states, and a solution which may be adopted in one state might be entirely unacceptable to the people of another. Perhaps some day we may evolve a uniform basis in all states, but we cannot expect this to be possible until we can work out for all the states a more uniform basis of revenue and taxation and create a more uniform popular conception of how government revenues should be raised and spent.

County and Municipal Taxes—County and municipal taxation presents much less of a problem to the mines. Usually, the mining community has mining as its one dominant industry, so that the mine or mines must bear the bulk of local taxation. If a mine has to bear substantially all the local taxes, it makes little difference how they are levied. If the assessment is high, the tax rate should be low, and vice versa. It is only when we proceed to raise revenue jointly from mining and from other property, as we do by state taxation, that the question of valuation of the property and rate of tax becomes a serious problem. The dominant considerations in state and local taxation are, therefore, that the local government expenditures should not be excessive and that the basis used should not be such as would make it appear to those not acquainted with the situation that the mines were not bearing their fair and equitable share of the tax burden imposed upon industry.

This paper summarizes only briefly some of the main features of the situation. Any one division of the subject might be greatly expanded and many other problems discussed with profit. We might also consider those taxes which fall on railroads, power companies, and other activities auxiliary to the mining operations. The main features, however, seem to be those mentioned herein: The reduction of government expenditures, the creation of an accurate popular conception of the status of the mining industry, and the fair apportionment of the tax burden as between the mines and the other industries of the country.

Microscopic Investigation of Tintic Standard Ore

Microscopic work on concentration products of the Chloride, Ariz., ore has been completed at the Intermountain Station of the U. S. Bureau of Mines, with the exception of the work involved in the preparation of photomicrographs.

A preliminary microscopic study on the iron box sludge and other products obtained from chloridizing, roasting and leaching of ore from the Tintic Standard mine indicates that the problem involved in the elimination of the arsenic and other impurities is a strictly chemical one and that microscopic work may help in determining the physical condition of some of the components of the sludge.

Calculation of Anode-Furnace Charges in a Copper Refinery

First Consideration Is To Get the Blister Richest in Precious Metals Through the Operation in Shortest Possible Time—How The Presence of Impurities Governs the Composition of the Charge

By C. M. Brister, Jr.

Written for Engineering and Mining Journal

"GET THE SILVER and gold into the anodes as quickly as possible" is the governing principle for the copper refinery. Every day that the precious metals are locked up in the pig copper means a real loss to the plant in the interest on the money value. Once in the anodes, a start, at least, is made on the road to final shipment as refined metal. Plants doing custom work are required by their contracts to deliver the silver and gold received in pig copper to the owners within a certain specified time—usually about two months after receipt. The refinery must deliver the goods on the specified date or transfer the money equivalent to the owner.

Some one man must keep the bullion moving, therefore, and calculate the anode-furnace charges, to assure that the richer blister copper is given first place in the mixture. The procedure described in this article is that practiced by a large copper refinery in this country.

Equivalent Silver in Various Brands Is Recorded

For quick comparison of the various grades of copper received, a list showing the "equivalent silver" of each brand is kept up to date by use of the latest assays available. The term is simply a figure showing the value of the precious-metal content of the blister, considered as all silver. That is, with gold at $20 per troy oz. and silver at $1 per oz., the equivalent silver for pig copper assaying 0.5 oz. gold per ton, and 25 oz. silver per ton, will be $0.5 \times 20 + 25 \times 1 = \$35$.

ASSAY OF VARIOUS HYPOTHETICAL BRANDS

Brand	Gold, Oz. per Ton	Silver, Oz. per Ton	Equivalent Silver, Value in Dollars per Ton
A	4.50	630	720
B	0.80	400	416
C	1.00	150	170
D	0.65	67	80
E	0.98	55	75
F	1.00	40	60
G	0.85	2	19
H	0.15	13	16

A copy of this list is sent to the anode-furnace superintendent for his guidance. If "G," for example, appearing on his charging instructions, is not available for any one charge, he will consult the table and substitute the brand highest in value and which is not carrying more impurities than "G."

This table is brought up to date once a month, with the aid of the average assays of each brand received during the month. The variation in value and percentage of impurities for any particular blister is usually slight, so that if a high-grade lot comes in and no provision is made for it on the current charge, it can be immediately taken care of by using the analysis and assays of the preceding month. It must be drilled for the sample, but it is not necessary to wait for the assay of the sample. In the treatment of blister which varies widely from month to month, a hurried drill sample is usually taken to check the assumed assay values, whenever a new lot comes in.

The factors other than equivalent silver which affect the choice for the charge are:

1—Impurities. Typical analyses of the ten brands enumerated in the equivalent silver table may be:

Assays, Per Cent

Brand	Lead	Nickel	Arsenic	Antimony	Selenium	Tellurium
A	0.550	0.525	1.425	0.440	0.550	0.046
B	0.330	0.430	0.370	0.230	0.030	0.008
C	1.800	1.140	0.310	0.460	0.032	nil
D	0.025	0.067	0.002	0.070	0.020	0.007
E	0.004	0.058	0.001	0.002	0.035	nil
F	0.010	0.014	0.004	0.005	0.015	0.010
G	0.009	0.030	0.010	0.015	0.030	0.012
H	0.008	0.042	0.020	0.055	0.007	nil

The impurities in a particular brand of pig copper usually run fairly uniformly, and in most operations there are one or two impurities which will limit the amount of that brand to be placed in the anode charge. The copper having the highest equivalent silver is used up to the limit of the amount of impurities the charge will stand.

All reports within the plant show the "Stock on Hand" and other pertinent information of each brand, in tons. It greatly facilitates calculations, therefore, to have the impurities listed as *pounds per ton,* instead of in per cent. A loose-leaf record is kept with a separate sheet for each impurity, as follows:

NICKEL IN PIG COPPER
In Pounds, Per Ton

Brand	Average Aug.-Jan.	January	Average Sept.-Feb.	February	Average Oct.-Mar. 5	Mar. 5	Average Nov.-Apr.
A	10.50		10.50		10.50	10.50	10.50
B	8.00	7.50	7.92	8.20	7.95	8.60	8.06
C	45.00	22.60	26.33		26.33	22.80	25.74
D	1.20	1.20	1.20	1.28	1.21	1.35	1.24
E	1.30	1.44	1.32	1.38	1.33	1.16	1.30
F	0.28		0.28		0.28	0.28	0.28
G	0.60	0.58	0.60	0.62	0.59	0.60	0.60
H	0.98	1.02	0.99	1.02	1.00	0.84	0.98

The average column shows the average value for the last six months. It is a most convenient figure to have when a lot of high-grade copper arrives in the middle of a period, for it can be used in calculations of a new charge until more accurate figures are available.

The allowable limits of impurities in the anodes depend upon the pig copper available for use. The permissible limits may be as listed below:

ALLOWABLE LIMITS OF IMPURITIES IN ANODES

Element	Maximum per Cent	Minimum per Cent
Gold....		0
Silver	225 oz. per ton	0
Lead	0.150	0
Nickel	0.155	0
Arsenic	0.150	0
Antimony	0.120	0.08
Selenium...	0.10	0
Tellurium .	0.05	0

It is not good practice to have the results of the charge calculations show the maximum figure for more than two impurities on the same charge. There are impurities present, of course, other than those listed, but their importance is negligible so far as the average tank house is concerned.

2—*Rate Received and Sampled.* This factor is often of primary importance in the treatment of high-grade pig copper, where every pig is drilled for sample. Obviously, the rate at which it may be used in the furnace is limited by the speed of the drilling. With blister not especially high in precious metals it is generally convenient to use the copper on the charge at a rate that will compensate for receipts, and thus save the expense of handling to storage and back to cars again.

3—*Amount on Hand.* When the receipts exceed the consumption there is an accumulation at the stockpiles. When the receipts fall off or the consumption increases, the amount of each brand designated for the anode charge is proportioned to accommodate the accumulation as well as receipts, in those instances where the equivalent silver so warrants.

4—*Storage Facilities.* It is often necessary to use a brand the equivalent silver of which would not justify its use at the time, simply because of lack of space in which to store receipts. It must go directly from the sample drills to the anode furnaces.

5—*Availability.* Occasionally a large quantity of low-grade copper is received and has to be stored in any available space. This may completely block off some higher-grade blister, which then cannot be used until sufficient of the low-grade material has been removed to free it again.

6—*Physical Character.* The shape, or the "top set," of the pigs may be such that they cannot be piled and transported except with the greatest care, and even then frequent spills may happen. In such circumstances only a certain amount of the blister can be used on the charge without excessive cost or delay in the charging—no matter what the amount of the equivalent silver may be.

Before calculating the charge, the operator must know the "furnace factor." By this term is meant a number which, multiplied by the total weight of any impurity going into the anode charge, will give as a product the weight of the impurity in the anodes cast from the charge. This factor may be calculated by carefully listing the weights of all items entering the furnaces for a period of, say, ten days. The amounts of the impurities are listed in columns, and the totals made, giving the weight of each impurity entering the charge. The average percentage of each is then calculated and compared with the corresponding figures actually found by analysis of the anodes produced from the charges for the same ten-day period. The actual percentage, divided by the calculated percentage, will give the factor desired. The following calculation is an example:

ANALYSIS OF CHARGE

[illegible]	[illegible]	[illegible] Lead	[illegible] Nickel
[illegible]	[illegible]	[illegible]	1,575
[illegible]	250	1,650	2,150
[illegible]	25	[illegible]	570
[illegible]	[illegible]	250	675
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	35
[illegible]	[illegible]	[illegible]	75
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	7,450

[illegible]

[illegible] 0.05 per cent.

[illegible] 0.54

[illegible] 1.03

Factors for arsenic, antimony, and the other impurities are similarly calculated.

CALCULATING THE CHARGE

Suppose, on the first of the month, the stock sheet shows:

Brand	Tons on Hand, 1st	Expected to Arrive 1st to 10th	10th to 20th	20th to 1st
A	200	300	200	0
B	372	250	250	250
C	1,117	250	250	250
D	739	955	300	250
E	188	125	100	100
F	511	0	0	0
G	154	0	0	0
H	8,622	0	0	0
Totals	11,903	1,880	1,100	850

The multiple tank house is operating at 7,000 tons per month. The anode furnaces will make one charge of 250 tons per day for the next ten days. This will mean 25 tons for each per cent of each kind of blister on the charge. The tank-house scrap, which may be assumed to average 25 per cent, must also be treated.

If impurities were all allowed to the maximum percentage, the following amounts could be present:

(1) Element	(2) Allowable	(3) Factor	(2) ÷ (3) Quotient	(4) Lb. per Ton	(4) × 7,000 Total Lb.
Lead	0.15%	0.54	0.28%	5.6	39,200
Nickel	0.155	1.03	0.15	3.0	21,000
Arsenic	0.15	0.92	0.163	3.3	23,100
Antimony	0.12	1.11	0.108	2.1	14,700
Selenium	0.10	0.93	0.107	2.14	14,980
Tellurium	0.05	0.63	0.079	1.5	10,500

Enter the anode scrap on the estimate sheet. With this taken care of, the operator is still allowed:

	Lb.		Lb.
Lead	37,625	Antimony	11,720
Nickel	16,100	Selenium	13,055
Arsenic	19,070	Tellurium	9,975

Considering the brands in the order of their equivalent silver:

"A." The important factor here is *Impurities.* Arsenic and selenium limit the amount to be used, and since there is an allowance of 6,500 lb. more of the former than the latter, the selenium governs. Each per cent of "A" on the charge is equivalent to 70 × 27 = 1,890 lb. of selenium. About 6 per cent, therefore, is all that can be used. With this amount on the charge, there is left an allowance of:

	Lb.		Lb.
Lead	33,005	Antimony	8,020
Nickel	11,690	Selenium	1,735
Arsenic	7,090	Tellurium	5,435

"B." Here again the important factor is *Impurities.* After an examination of the impurity table, it is apparent that arsenic will limit the use of this brand. Each per cent of "B" is equivalent to 70 × 7.4 = 518 lb. of arsenic. About 10 per cent of "B" can be taken care of with safety, leaving an allowance of:

	Lb.		Lb.
Lead	28,385	Antimony	4,800
Nickel	5,670	Selenium	1,315
Arsenic	1,910	Tellurium	5,323

"C." The controlling factors here are *Impurities* and *Availability.* On account of the excessive amount of impurities, this blister is given a preliminary furnace refining before being used on the anode charges. The operator has to consider only the skulls and other scrap resulting from the casting, amounting to about 1 per cent on the anode charge. This leaves an allowance of:

	Lb.		Lb.
Lead	25,865	Antimony	4,166
Nickel	4,074	Selenium	1,271
Arsenic	1,476	Tellurium	5,323

"D." The small remaining allowance of selenium will limit the use of "D." One per cent of "D" is equivalent

ESTIMATE SHEET [illegible] ANODE COMPOSITION

			Gold		Silver		Lead		Nickel		Arsenic		[illegible]		[illegible]		[illegible]	
Brand	Per Cent	Tons	Oz per Ton	Total	Oz per Ton	Total	Lb per Ton	Total	Lb per Ton	Total	Lb per Ton	Total	Lb per Ton	Total	Lb per Ton	Total	Lb per Ton	Total
Scrap	25	1,750	0.87	1,520	100	17[illegible],000	[illegible]	1,57[illegible]	2.8	4,900	2.3	4,030	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
A	6	420	4.5	1,890	630	26[illegible],000	[illegible]	4,620	10.5	4,410	28.5	11,980	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
B	10	700	0.8	560	400	280,000	6.6	4,620	8.6	6,020	7.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
C	1	70	1.0	70	150	10,500	[illegible]	2,520	22.8	1,596	6.2	434	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
D	25	1,750	0.65	1,140	67	117,000	[illegible]	87[illegible]	1.35	2,360	0.05	87	0.14	[illegible]	0.4	[illegible]	0.14	[illegible]
E	6	420	0.98	411	55	23,100	0.08	33	1.1[illegible]	440	0.02	8	0.14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
G	6	420	0.85	357	2	840	0.18	76	0.6	252	0.2	84	0.2[illegible]	[illegible]	0.6	252	0.24	101
H	21	1,470	0.15	220	13	19,100	[illegible]	23[illegible]	0.84	1,230	0.4	588	1	[illegible]	0.14	206	[illegible]	[illegible]
Total	100	7,000		6,168		890,540		14,554		21,258		22,391		[illegible]		[illegible]		[illegible]
Avg. oz. or lb. per ton				0.88		127.2		2.08		3.037		3.199		1.7[illegible]		2.16[illegible]		0.79[illegible]
Per cent								0.104		0.152		0.160		0.08[illegible]		0.108		0.03[illegible]
Furnace factor				1.0		1.0		0.54		1.03		0.92		1.11		0.9[illegible]		0.61
Estimated analysis, oz. per ton or %				0.88		127.2		0.056		0.157		0.147		0.0[illegible]		0.100		0.02[illegible]

to 70 × 0.4 = 28 lb. of selenium. About 25 per cent may be used, leaving an allowance of:

	Lb.		Lb.
Lead	24,990	Antimony	3,921
Nickel	1,714	Selenium	571
Arsenic	1,389	Tellurium	5,078

"E." This is a very pure blister, and ordinarily the *Rate Received* and the *Amount on Hand* would govern, but since there is such a small remaining allowance of selenium, the amount that it is possible to use will be limited to about 6 per cent, leaving an allowance of:

	Lb.		Lb.
Lead	24,957	Antimony	3,204
Nickel	1,224	Selenium	277
Arsenic	1,381	Tellurium	5,078

"F." *Availability* must govern the use of this blister—it is not available because the entire lot is surrounded by "H."

"G." The *Amount on Hand* is the ruling factor. Allowing 6 per cent to use up the entire lot in the next ten days leaves:

	Lb.		Lb.
Lead	24,881	Antimony	3,79[illegible]
Nickel	972	Selenium	25
Arsenic	1,297	Tellurium	4,977

"H." This will complete the charge with 21 per cent. Under other conditions the *Physical Character* might be the limiting factor with this brand. The pieces have rounded bottoms and are, therefore, very hard to pile. The limit for the furnace ordinarily is about 40 per cent. Above this figure, its use will seriously delay the furnace working.

After the calculation is completed, instructions are sent to the foreman of the anode furnaces, giving the name and percentage of each blister for the anode charge and the estimated analysis of the resulting anodes. Copies of these memoranda are sent to the tank-house foreman, the yard foreman, and all others concerned.

The actual work involved in the calculation is not nearly so intricate as it may seem, when the necessary records and other information are kept up to date. Slide-rule calculations are permissible.

Experiments With Fume

At the Intermountain Station of the U. S. Bureau of Mines it has been found that a high temperature (1,000 deg. C.) is needed to form lead bullion from a fume (Yellow Pine ore) high in zinc oxide, although a fusible mass might be obtained at lower temperatures. It was also difficult, even after treating the fume with hydrochloric acid, to get a slag from which the lead collected well, although both metallic lead and slag were obtained at 800 deg. C. when using commercial slag-forming constituents.

Motion Pictures in Mining

The use of motion pictures is an important feature of the educational work of the U. S. Bureau of Mines in promoting safety and health among miners. The motion-picture films in the possession of the Bureau are also lent to individuals or organizations which intend to show them for educational purposes, especially for the promotion of safety, health, welfare, and efficiency in the mining industry. They are not permitted to be shown where an admission fee is charged. Transportation charges are borne by the borrower. This service has proved so popular that requests for the loan of some films can be filled only in the order in which they are received.

M. F. Leopold, of the Washington office of the Bureau, conducts the co-operative work with mining and other companies for the making of films of educational character bearing on the mining industry, and renders technical assistance in the planning of the work of making the pictures. He has also made arrangements with motion-picture companies so that the Bureau receives copies of motion pictures of events of special interest to the mining public.

Flotation Tests at Idaho Experiment Station

At the Moscow, Idaho, field office of the U. S. Bureau of Mines, where investigations relating to the theory of flotation are being conducted in co-operation with the University of Idaho and the Idaho Bureau of Mines and Geology, a special laboratory for the work on surface tension and adsorption has been provided. The following problems have been worked on:

1. Heat and emulsification.
2. Removal of oil in an emulsion by adsorption.
3. Equilibrium of adsorption and oil concentration.
4. Adsorptive capacity of minerals.
5. Treatment of emulsion of eucalyptus.

At the same office tests have been made on the use of sodium dibasic phosphate (Na_2HPO_4) as a differential flotation agent for lead-zinc ores at the Morning Mill of the Federal Mining & Smelting Co.

Iron Ore in Switzerland

It is generally little known that Switzerland possesses an iron ore mine. The mine is situated at the foot of the Gonzen Mountain in the Canton of St. Gall. Exploitation work was started in January, 1921, and the production has grown to about 100 tons per day. The ore is of a good medium quality. The mine is worked by a company which is capitalized at 3,500,000 francs.

By the Way

A Fish Story from the Southwest

Duck-eating fish have been discovered. They swim in the Gulf of California and have been located by Col. John C. Greenway and Dr. L. D. Ricketts, who appear to have had as much success in angling as in mining. While on a fishing trip on the Mexican west coast, they caught a toratava, a sort of bass, this specimen being seven feet in length. After Dr. Ricketts had classified the fish, Col. Greenway found in its mouth a duck, evidently taken while floating on the briny. The party visited Tiburon island, but failed to come in contact with its notorious Seri Indian population. Harry Clark, superintendent of the Calumet & Arizona smelter at Douglas, also has been fishing, this at the Gulf terminal of the railroad proposed from Ajo. He tells that the new port is one of the greatest fishing points imaginable and speaks of capture of bass that weighed 180 pounds.

A Worthy Goal

Senator King recently said that the country would be benefited if the existing United States Senate were dismissed and each place filled with an engineer. Of course it would and it would mean ninety-six less engineers out of work in periods of depression. The idea is a good one and we shall make it our objective for 1922.

Holding at Arms' Length

"I been readin' a lot lately, m'son," said Cap'n Dick, "'bout 'ow h'over in the h'ol country they been makin' some o' these 'ere peers an' puttin' a 'andle in front o' their names. Be h'all right too, I guess, for some o' they that be worthy, but, dam-me, some be they 'oo are too 'igh an' mighty, an' it do turn their 'eads sumthin' h'awful. But, min' you, I don't say as 'ow this sort o' feelin' be peculiar to they chaps, for like as not it's boun' to 'appen mos' h'anyw'eres. I remember in tha h'early days w'en Cap'n Jan 'Oney was made district super, h'afer 'e 'ad been minin' cap'n for many years. Day or so h'afer 'e wuz promoted, one o' tha boys from town stopped 'im on tha street an' sez 'e, 'Cap'n, I congratulate you.' ''Ere, boy,' sez Cap'n Jan. 'Doan thee be cap'n me no more—I 'ires they chaps naow.'"

The Engineer Sans Culotte

The lure of chiclets has proved irresistible to H. T. R., of Nashwauk, Minn., so he rushes into print, to quote his own remarks, offering an explanation of the creation of Mrs. H. P. Whitney, as illustrated in the issue of Nov. 12 (page 777). He says:

> "After several hours of 'crystal gazing' at that cut, some occult power guided me to the following conclusions: That Mrs. Whitney had the same conception of the engineer as did her famous contemporaries Ex-Secretary of War Baker, and General 'Black Jack' Pershing. Ancient history records how the boys flocked to engineering units destined for oversea service. How they pictured themselves with B. P. in hand, a broad-brimmed Stetson overhead, a transit or two in the background (for a close up of this, see most any correspondence school's ad.), and a gallery of French beauties in attendance. How they were rudely awakened from this dream upon being dumped knee-deep into mud and other mud, presented with a R.R. pick and the plebeian No. 2 and told to dig themselves and the Allied armies out. That probably accounts for the hump and agonized expression.
>
> "The lack of shirt, etc., can only be explained on the grounds that this bird had indifferent luck playing strip poker. However, such are the vagaries of Lady Luck, that if Mrs. Whitney had happened along the next day for her inspiration she might have found him fully rigged in his buddy's regalia.
>
> "I do not think Mrs. Whitney's choice of title a happy one, so would suggest that it be changed to 'Innocents Abroad,' with apologies to Mark Twain. Now if you have not consumed all the chiclets mail me one."

Many men many minds. Charles Hendricks, of Gold Bar, Wash., says that he would call the creation "A Stoker," and that if the sculptress will visit a boiler room on some of the large steamships and see a stoker in action she will agree with him.

Samuel H. Dolbear is less inclined to be critical of things in general, now that his war minerals relief claim is settled. He says:

> "The statue is undoubtedly a recent creation, and such engineers who have been fortunate enough to have jobs during the past year have been doing that kind of work. The absence of clothing is due to the fact that the picture was taken prior to pay day. Had Mrs. Whitney waited until after the tenth of the month, her artistry would have been more difficult, for this chap would likely blossom out in a tuxedo. His credit would at any rate have been good for a pair of Can't-Bust-Ems at the company store."

A resident of Silverbell, Ariz., who says he is more anxious to nibble the chiclets than he is to appear in print as an art critic, is nevertheless moved to discuss the subject to the extent of 500 words or so, more than there is space for here. The figure, he says, represents modern woman's idea of the Missing Link. It is probably intended to depict man at a period shortly after the process of evolution had begun to change him from a horizontal quadruped to a vertical biped, and in the act of making his first attempt to stand erect. The hat is an anachronism, of course.

A surprising thing brought out by this nation-wide and even international discussion is that no two individuals have interpreted the statue alike. P. D. Q. thinks it fittingly pictures the mucker who first suggested that mining engineers be licensed.

Calamity Cañon

By Paul H. Keating

Written for Engineering and Mining Journal

There's a place in Colorado that is very little known; its a God-forgotten region in a way. The electric lights are missing with the bath and telephone, and it's not a place where one would care to stay. It's so far from town or city that they get mail-order wives, and the wops and college men are like two peas. There are fugitives and roughnecks who have played with guns and knives, and are hiding from the law and lawyer's fees.

It's so far from habitation and so quiet that you feel (in the evening when its growing cold and dark), you could serve a year in Hades and be glad to make the deal, just to hear a lonesome coyote howl or bark. It's a place where laws and outlaws are on friendly terms at last, and your past is dead and buried. Never tell of the days you wore a dress suit and you lived both high and fast, or of counting off the minutes in a cell.

I have lived in better places and in places that are worse; I can be contented there with half a try. And for all its seeming drawbacks it's the only place on earth where the eagle on a dollar doesn't fly.

CONSULTATION

Centrifugal vs. Reciprocating Pumps

With the thought that his experiences with various types of pumps may be of interest to readers of *Engineering and Mining Journal*, Mr. Edward T. Keenan, mechanical superintendent of the American Cyanamid Co. at Brewster, Fla., has contributed the following remarks on selecting the proper pump:

"With reference to 'Centrifugal vs. Reciprocating Pumps,' under the head of 'Consultation,' in your issue of Jan. 14, perhaps my experience with pumps may be of value to the party asking for the information. As you state, your correspondent fails to explain the cause of the failure of the centrifugal pump. However, he may feel at liberty to communicate with me if he desires.

"I have had experience with reciprocating and centrifugal pumps, both pressure and mining, and in the hydraulic mining industry. I appreciate the service demanded of a pump. It has been my experience that the manufacturer's recommendations are not always of sufficient accuracy to enable one to select and purchase the proper pump for the service demanded. In relying upon the manufacturers one must be governed by the fact that the manufacturing company has a standard line of pumps, and unless the company is specifically charged with quoting on a certain pump, it confines its quotations to its standard line. So a purchaser, as a rule, should not order a pump of any description without consulting a proper authority. This I learned by experience. I will endeavor to explain why, in a few words.

"Taking centrifugal pumps for example, inasmuch as the correspondent stated he had had unsatisfactory results with this type of pump, I will venture to say there are few operations, if any, where a properly selected centrifugal pump, properly installed, will fail to give satisfaction.

"It is comparatively simple to determine the simpler features demanded and required in a centrifugal pump, such as the number of stages, method of drive, and the rotative speed. Almost any manufacturer's recommendations may be accepted, but the matter of vane angles, the number of vanes, balancing device, composition of the impeller, ratio of the width of the impeller to its diameter, and the peripheral speed of the impeller, are salient features that should be predetermined and specified, to the manufacturer.

"It would be decidedly improper to select a pump with a rising characteristic, when a flat characteristic is demanded; that is, if the head against which the pump is obliged to work is subject to variation, the characteristic should be such that the electric motor (if the pump is driven by a motor) will not be damaged by overload, due to too low a head and an increase in capacity. Again, perhaps the motor is of sufficient size to permit of a considerable increase in load without damage, which may be taken advantage of in the design of the pump. At any rate, the area of the highest efficiency of the pump should extend over the range of variable head as completely as possible.

"Again, the quantity of water which the pump is to deliver may be variable and the head may remain nearly constant. In this circumstance, the characteristic should be such that the point of highest efficiency should cover the range of capacity, as nearly as possible. In any event, the point of highest efficiency of both pump and prime mover should occur together.

"As to the matter of balancing, both mechanical and hydraulic balancing devices are made which give good results in practice. However, there are instances where neither one alone should be relied upon, and in selecting a pump with a hydraulic balancing device, care must be taken to choose one in which gritty water will have the least effect."

Uses of Finely Ground Silica

"In your columns of current price quotations for various minerals, I note that a recent quotation for fine silica between 250 and 500 mesh is given as $16 to $30 per ton, considerably more than silica is worth in any other form. I should be greatly interested to know of the purposes for which this fine silica is used."

Silica (SiO_2), finely ground and referred to in our market reports, is extensively used as a paint pigment. In the Middle West tripoli, the siliceous residue of decomposed limestone, is used to produce an excellent grade of ground silica, which is utilized for the same purpose as the other varieties obtained by grinding massive crystalline quartz or sand and sandstones. One producer informs us that his product, the amorphous or decomposed variety, will analyze 99½ per cent silica and contains only slight traces of iron and alumina. As it is inert, has no tinting properties, and is not affected by any vehicle used for paint manufacture, it is an ideal pigment. It also has absorbing powers that make it suitable for that purpose. This variety can be pulverized to impalpable fineness, but the average grades run from 250 to 400 mesh, the standard meshes most used being 250 and 350. Ninety-eight per cent of the silica passes through 250 or 350 mesh screens in order to be classed as extremely fine material. Wood-fillers commonly contain fine silica, for which use it is excellently adapted.

Silica is also used in the manufacture of scouring soaps, as polishers, in pottery manufacture and in chemical processes. It must be exceptionally pure for use in the pottery trade, and should contain less than 0.5 per cent of impurities such as iron-bearing minerals. Silica gives a glaze and is employed in the body of the ware to decrease shrinkage.

When used in paint manufacture, it is desirable that the silica grains should have pronounced angularity to make them adhere more firmly to the surface coated. The same characteristic is desirable in wood-fillers and polishes. Varying proportions of silica are used in paints but may run as high as one-third of the total pigment used. Some dental preparations also contain fine silica.

No Gold-Locating Instruments Developed

"Can you advise me where to obtain an apparatus or how to make one for the location of buried gold? I have a chart giving location of two places and am just crazy enough to try, provided I can get the necessary instrument. My chart is thirty years old."

There does not exist, so far as we know, any instrument that will locate buried gold. We certainly advise you not to give the matter any further thought. All kinds of extravagant claims, hoaxes, and swindles concerning reported wonderful ore-finding instruments have been made. Scientific experimentation now going on may gradually enable a certain detection of underground conditions, but nothing has yet come to our attention that is worthy of your experimentation or even of serious consideration.

HANDY KNOWLEDGE

Uses of Compressed Air in Mining

By W. R. Wade

Written for Engineering and Mining Journal

The air lift as an auxiliary aid in mine pumping is not as generally applied as it should be. An experimental lift was installed in a mine at Edwards, N. Y., to be used in case of the failure of one of the pumps. This mine makes a large flow of water. Pumping is done in stages by electrically driven centrifugal pumps. The water does not all come from the lowest levels, but much of it originates several hundred feet above the lowest workings. Before the installation a drift on the 700 level was making 200 gal. per minute, which was carried down the shaft to the 840 level to the nearest pumping station. By a system of valves it was arranged to discharge this water either into the sump or to pump it to the next relay station above with compressed air. For the discharge column one of the pump columns was used. Fig. 1 shows the arrangement. This handled all the water from the 700 level. It was only about four days after the installation that one of the centrifugal pumps had to be shut down for repairs. The other pump with the assistance of the lift was able to handle the water. As 540 gal. per minute is handled at this station, one 300-gal. pump alone cannot do the work, and two pumps running practically all the time are required. As a standby the air lift takes the place of a third pump. A centrifugal of the type used costs $4,000 installed. As there is ample compressor capacity the lift saves this investment. A recent test showed the centrifugals to have an over-all efficiency of 48 per cent. This included transformer losses, transmission losses, motor losses, and pump and pipe friction losses. The efficiency was the water horsepower against the electric power paid for. Calculated on the same basis—that is, considering the electric power purchased to drive the compressors—this lift shows 31 per cent efficiency.

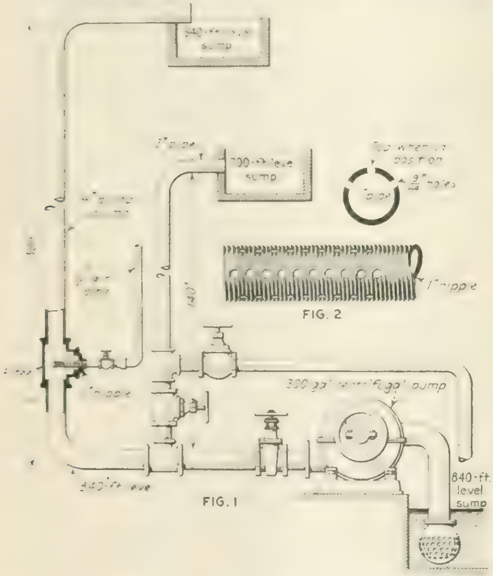

FIG. 1. SHOWING AIR LIFT AS AUXILIARY TO PUMPING SYSTEM. FIG. 2. PERFORATED NIPPLE

The air is admitted into the pump column through a 1-in. nipple with 4 in. of thread cut on it. This permits the nipple to be screwed nearly to the back side of the tee. The end of the nipple is plugged and its top surface is bored with $\frac{9}{64}$-in. holes, in three rows. Fig. 2 makes this clear. The water is brought down from the 700 level in a 3-in. pipe. This gives 140 ft. for the submergence. The delivery column is 4 in. and the air is introduced at the 840 level, as shown in Fig. 1.

The specific gravity of the water and air mixture in column *B* in Fig. 3 is lower than that in column *A*, which is plain water. The weight of the water in column *A* is greater than the weight in column *B*. Therefore the water in *A* forces the aerated water in *B* upward until the weights of the two columns balance. If the discharge of *B* is below this point the water will flow. The higher the lift in relation to the submergence, the more air demanded. To illustrate, suppose *A* is 50 ft. and *B* is 150 ft. Then if the mixture in *B* is one-third water and two-thirds air it will have to rise to the top of *B* to balance the clear water in A. If *B* is 200 ft., the mixture will have to be one-fourth water and three-fourths air. In practice, as the mixture is never perfect and as a strong flow is desired, it takes considerably more air than the theoretical amount.

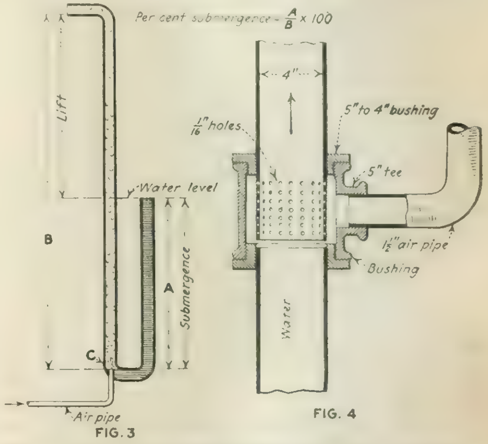

FIG. 3. DIAGRAM ILLUSTRATING AIR LIFT PRINCIPLE. FIG. 4. FOOT PIECE FOR AIR LIFT MADE OF PIPE FITTINGS AND GIVING GOOD RESULTS

I would like to call attention to the percentage of submergence. This is used in all tables on air lifts. It is the length of pipe *A* divided by *B* times 100. The air pressure must be greater than the hydrostatic pressure at point *C* or no air will flow into the lift. The hydrostatic pressure is that caused by the water in column *A*. It will be .434 lb. per ft. of submergence. As mine compressors are generally limited to 100 lb. the practical limit of submergence in mining is 200 ft. This requires 87 lb. at their air nozzle, and the pressure should be at least 2 lb. more to allow for friction at this point. Many writers on air lifts state that they will not work on less than 33 per cent submergence. As 66 per cent is recommended for low lifts and 41 per cent for lifts around 500 ft., it would not appear possible to get the necessary submergence around a mine. S. F. Shaw at the Tiro General mine[1] operated a lift with only 1.8 per cent submergence, raising the water 1,000 ft. The submergence was 18 ft. The claim is not made here that such low submergences are efficient but that they will pump water if the lift is properly designed. I have operated lifts pumping only to moderate heights with less than 10 per cent submergence.

The accompanying table will be found convenient in figuring on air lifts around the mine. It is based on an air consumption of four times the theoretical amount.

FREE AIR CONSUMED PER GALLON OF WATER DELIVERED ASSUMING 25 PER CENT EFFICIENCY

Feet of Lift	Submergence in Feet 50 ft.	100 ft.	150 ft.	200 ft.
50	0.84	0.52	0.48	0.40
100	1.72	1.08	0.92	0.80
150	2.60	1.60	1.41	1.20
200	3.44	2.12	1.88	1.62
250	4.36	2.68	2.36	2.08
300	5.20	3.20	2.80	2.44
350	6.08	3.72	3.28	2.84
400	6.88	4.28	3.76	3.21

Theoretical air required would be one-quarter the number of cubic feet shown in this table.

APPROXIMATE STAND PIPE CAPACITY-GALLONS PER MINUTE AT 200 FEET SUBMERGENCE

Feet of Lift	Size of Pipe in Inches 3	4	5	6	8
50	175	350	500	750	1,200
100	125	275	400	650	1,150
200	50	225	325	550	1,100
300	20	150	275	450	1,000
400	.	50	200	350	900

Less submergence gives less capacity.

This is a low efficiency, but for crude lifts is about right. Anyway it is on the safe side. The figures given for the different depths of submergence represent the quantity of free air consumed per gallon of water delivered, assuming 25 per cent efficiency. Calculations were made from S. F. Shaw's formula

$$X = \left(\frac{L}{255 \operatorname{Log} \dfrac{S+34}{34}} \right) \times \frac{25}{100}.$$

In Fig. 5 is shown a simple method of unwatering a winze. The water can be lowered to within a few feet of the bottom. The final wind-up will require a pump and the air lift water column will make the pump column. In the meantime the water has been lowered most of the way without any of the bother of repeatedly lowering a sinking pump.

Recently it became necessary to pump water with a pump that would not lift it as high as required. The job was accomplished with complete satisfaction by turning live air into the water column where it left the pump. As the column full of water set up a greater pressure than the air pressure it was necessary to turn the air on before starting the pump. The pump then acted as a submergence for the air lift.

The exhaust from direct-acting air pumps comes out with considerable force, and this energy can be utilized by piping it into the pump column. It also prevents freezing at the exhaust. The pump will elevate the water slightly higher than it will with the exhaust discharged in the open, as is generally practiced. A check valve must be placed between the pump and the water column to prevent the water working back into the air cylinder. Also a by-pass should be provided to the open, for use in starting the pump. The exhaust should be turned into the column as soon as the pump gets under way. Once the exhaust air gets started in the column it ascends with the water, making the column lighter. This exhaust air acts as an air lift, while the pump furnishes the submergence. As the exhaust air is colder than the water when it first enters the column, this air absorbs heat from the water, which in turn expands the air, so that some energy is obtained from the water itself. It is our practice to pipe all air-pump exhausts into their water columns. We have air pumps raising water 300 ft. vertically, operating on 80-lb. air pressure at the pump, which discharge their air directly into the pump column. When not so discharging, these pumps give constant trouble with freezing, and though we have no definite figures, they seem to consume considerably more air for the same water delivery. The water column should always be large enough to handle the mixture of air and water. If it is ½ in. larger than the proper column for the pump with open exhaust, it will be satisfactory. In fact, we have had pumps working this way where the column was really smaller than it should be for just the plain water. However, this is very inefficient and should be avoided. Fig. 6 shows the proper arrangement.

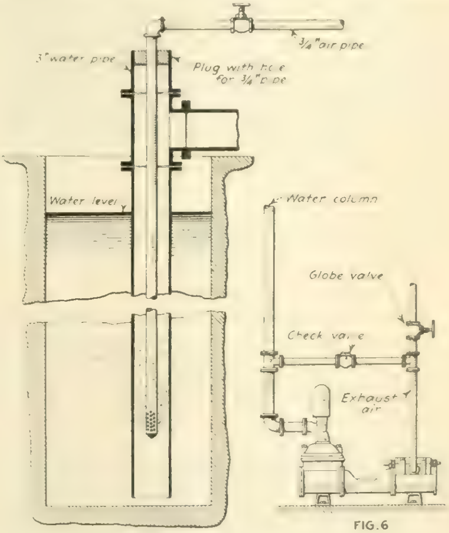

FIG. 6

FIG. 5

FIG. 5. METHOD OF UNWATERING WINZE. FIG. 6. SHOWING PUMP DISCHARGING EXHAUST AIR INTO WATER COLUMN

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[1] "Unwatering the Tiro General Mine by Air Lift," S. F. Shaw. *Trans.* A.I.M.E., 1920.

THE PETROLEUM INDUSTRY

The White Point Gas Field

BY ALBERT G. WOLF
Written for Engineering and Mining Journal

THE RECENT DEVELOPMENT of the old Mexia gas field into one of the largest producing oil fields of Texas lends new interest to other old gas fields of this state in which sufficient drilling has not been done definitely to prove their mineral content. The White Point gas field comes under this classification, and the following article is presented not as a geological report but as a general description that may be of interest to many who are unacquainted with this little-known but promising field.

White Point is in San Patricio County, Tex., about six miles northeast of Corpus Christi and on the opposite side of Nueces Bay. As its name implies, it is a tongue of land projecting into the bay. Around the bay shore is a low, gently sloping belt, some of it a tidal flat, and back of this belt is a bluff 40 or 50 ft. high, which extends around the bay itself and on south of Corpus Christi. Back from the bluff the land is practically level.

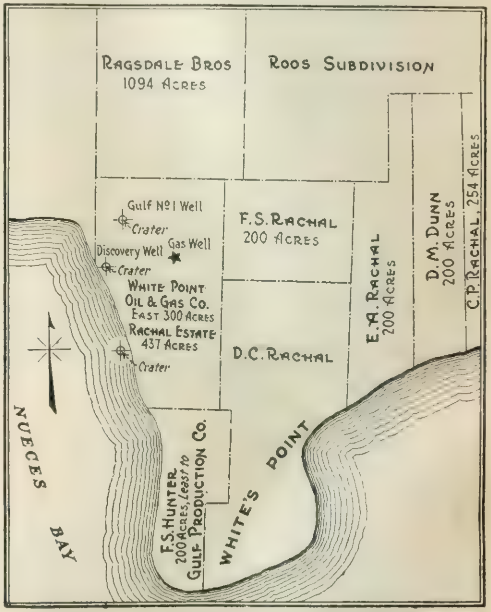
LIMESTONE PROMINENT FORMATION

The surface is covered everywhere by sand or a black, heavy, sticky (when wet) soil known as "black land." The most conspicuous formation exposed on the face of the bluff is a white limestone that outcrops on the western side of the point. This is a fine-grained rock similar to the so-called "calichi" that covers so much of Southwest Texas farther to the west. A large percentage of this rock is soluble in acid, leaving a residue of rounded, white silica grains. Some geologists consider the rock a phase of the Reynosa, the lower beds of the Pleistocene in the western part of the Gulf Coastal Plain. If this be true, the upper beds of the Pleistocene, unlike the entire Texas coast northward from this section, are almost entirely absent as the limestone crops near the top of the bluff, and its apparent dip is not great.

No opportunity to examine samples from wells drilled in this field has presented itself, but it is probably reasonable to assume that the entire series of strata passed through in drilling belong to the Pleistocene and upper Tertiary. The log of one well drilled to a depth of 1,910 ft. shows ninety-eight changes of formation in that depth, including two gas-bearing strata. Most of the beds were gumbo, shale, sand, and rock, with sandy variations of gumbo and shale, and the rock strata, in most formations, were quite thin. This compares with most of the other wells of this depth in the Gulf Coast region.

Claims have been made that White Point is a salt dome, but they are entirely without foundation in fact. To date no formations proving the existence of a salt dome, such as a rock-salt core or the overlying cap rock of anhydrite and porous crystalline limestone, have been found. It is true that salt water and saline water charged with hydrogen sulphide occur here, but these are found in areas other than salt-dome oil fields and prove nothing. It is my belief that the structure of this field is an anticline. This opinion has been previously expressed by Alexander Deussen.[1]

Drilling at White Point began in 1914. It was induced by the discovery of a gas seep on the west side of the present field. The discovery well, No. 2 of the White Point Oil & Gas Co., came in suddenly on Nov. 11, 1914, as a tremendous gasser at a depth of 2,260 ft. The casing was blown from the hole, the derrick dashed to pieces, and the top of the well soon became a yawning crater in which the drilling rig was swallowed. The collection of mud and water in the crater eventually plugged the well, but not until a great loss of gas had occurred. The gas flow was roughly estimated to be 50,000,000 cu.ft. per day. The crater is now about 200 ft. in diameter, with nearly vertical walls 50 ft. deep to the level of the water that has collected in it. Some gas is still bubbling up through this water.



SKETCH MAP OF WHITE POINT GAS FIELD, TEXAS

Later the Gulf Production Co. obtained a lease on this ground and drilled a well about 800 ft. north of the discovery well. This work was begun in September, 1915, and in December the gas sand was struck at

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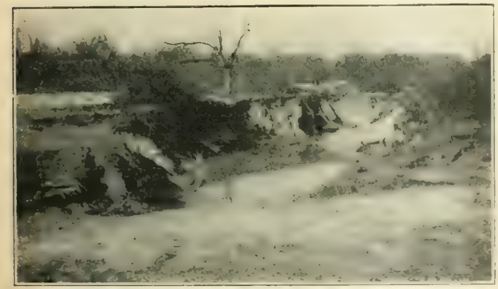
[1] "Review of Developments in the Gulf Coast Country in 1917," by Alexander Deussen, Bulletin of the American Association of Petroleum Geologists, Vol. 2, 1918, pp. 35-36.

2,200 ft. Eight-inch casing was set, extra heavy fittings were attached, and several tons of cement poured around the connections. Bailing was then started, but the mud was lowered only part way when the well came in with such force as to blow the derrick to pieces. During the first week in January, 1916, the well was capped.

To quote from an account of this well published in the *Fuel Oil Journal* (the forerunner of the *Oil Trade Journal*) of February, 1916: "The massive fittings, weighted down with tons of cement, held until Wednesday, Jan. 12, when, under the constant pressure, they gave way, stripping the threads from the irons buckled into the cement and throwing off the gate-valve connections. The hole soon began spouting sand, mud, and water along with the gas. The friction of the solid particles cut through the casing, part of which was lifted out of the hole, the remainder dropping out of sight."

As a matter of fact, everything about the rig, including the boiler, was lost in the crater of this well. Sand fell in the streets of Corpus Christi, six miles away, and later, when the gas became ignited, flames leaped over 200 ft. into the air. The flow from the well was estimated to have been in excess of 100,000,000 cu.ft. daily, and the pressure, from experiments with a pitot tube, to be 1,100 lb. This well, like the discovery well, eventually became sealed off, and only a little gas is now escaping from the well, visible where it bubbles up through the water in the bottom of the crater. This crater is between 300 and 400 ft. across and 75 to 100 ft. down to the water.



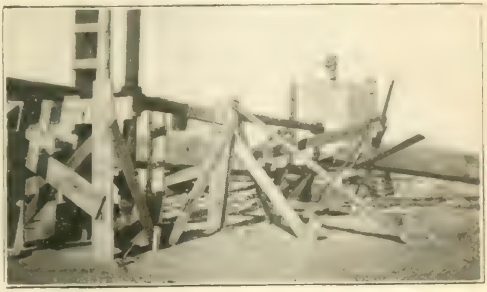
HOLE MADE BY BLOWING GAS FROM WELL

Other wells were drilled in which gas-bearing strata were found at 450 ft., 1,900 ft., 2,260 ft., and 3,400 ft. The Gulf Production Co.'s No. 5 well was abandoned at 4,500 ft. after passing through the gas sands at 2,200 and 3,500 ft. No oil was encountered in this well. A strong flow of hot salt water was struck at 3,600 ft., and this water is being used in an improvised bath house. Another well, on the bay shore, also blew a considerable crater at the surface, but left the casing. This casing has evidently collapsed, and a flow of salt water highly charged with hydrogen sulphide is still issuing from the casing.

Finally a third big well was drilled to the 2,200-ft. gas stratum, in which the casing held. After blowing wild for a couple of years, and wasting billions of cubic feet of natural gas, this well was ordered closed in by the Oil and Gas Division of the Railway Commission.

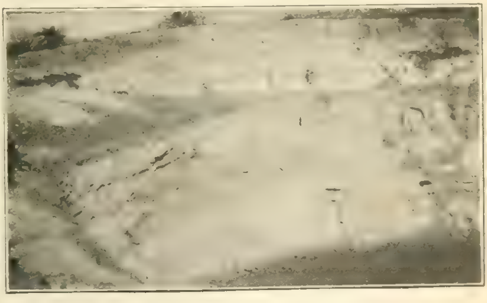
A cross connection was placed on top the casing, and a valve on each of the three arms. Then a concrete monolith was built around the casing, completely surrounding the valves. The block is about 6 ft. square above ground, 8 ft. square below the surface, and 20 or 30 ft. deep. Pipes leading to the valve stems are cemented in so that the valves can be turned by long wrenches. Other valves were placed on the pipes outside the cement. A horizontal blow-off pipe was laid from the well, and the force of the blowing gas alone was sufficient to dig a large hole in the ground.

For some time this well has been supplying gas for all the industries and dwelling houses at Taft. Only recently the meter on this well showed a pressure of 520 lb., even with the supply going to Taft and with a considerable escape from the blow-off pipe from the water separators. If the well were closed in the pressure would go up to 700 lb. per sq.in. The gas is free from sulphur and tests about 900 B.t.u. It is almost dry, but a little light, slightly pinkish tinted oil collects in the valves at the well.



CONCRETE ANCHOR USED TO CLOSE GAS WELL

In September, 1921, an association of capitalists of north Texas, headed by S. J. Campbell and L. D. Prewitt, of Dallas, and called the Campbell-Prewitt interests, secured a lease on 1,480 acres from the White Point Oil & Gas Co., agreeing to drill within a certain time limit. These interests also secured a franchise from the city of Corpus Christi to supply natural gas within its limits. This project will necessitate the construction of a pipe line across Nueces Bay. The White Point Oil & Gas Co. will receive a royalty based on cubic footage of gas at the wells. Further drilling in this field, to be undertaken soon, will be watched with great interest, not only because of the almost certainty of developing a large supply of natural gas, but because of the possibility of opening a new oil field in an unproductive portion of the Texas Gulf Coast.



CRATER OF NO. 2 WELL OF WHITE POINT OIL & GAS CO.

Book Reviews

Must the Critique Always Be Favorable?

WE WERE SOMEWHAT AMUSED to read in a local newspaper the other day that a Cuban journalist fought a duel with an outraged author over an unfavorable book review. The book in question described conditions in Mexico, which did not make the duel quite so inappropriate an event as it might otherwise have been. Fancy a duel over "Pollyanna," for instance. Sr Ossorio, the reviewer, sustained a slight wound, it was said, whereas Sr. Ballesteros received a sword thrust through the shoulder which sent him to the hospital. Let this be a lesson to the authors of books: they should not become unduly exercised over criticism. So far, we have escaped and we hope that we shall continue to do so. One of the reasons why we never really hankered for a training in a German technical school was that we feared we might have to fight a duel, for we preferred to retain both of our ears and not have a place where we had to be careful in shaving.

Seriously speaking, this brings up the question of unfavorable criticism. One well-known technical editor in this country tells us that it is a rule in his office to avoid reviewing books about which he cannot speak in a friendly way; that is, a book will not be reviewed unless he can speak of it favorably and helpfully. We do not agree with this point of view. If the title and prospectus of a book is likely to attract our readers, we feel that they are entitled to know our honest opinion of it. We try to give an idea of what the book contains, of its good and bad points as we see them. If a book is a poor one in our estimation we say so, whether it is published by McGraw-Hill or someone else. Of course, the opinion is only ours, and higher authorities may disagree, but this is about all that can reasonably be expected of us.

IN AN EARLY ISSUE we hope to review "Within the Atom," by John Mills. This is said to "admit the non-scientific reader to the mysteries which science is penetrating." Of course, we, being scientific men, will find nothing that we do not already know, but it may be a good book to buy for our sweethearts or wives.

A Manual of Flotation Processes. By Arthur F. Taggart. Cloth; 6 x 9; pp. 181. John Wiley & Sons, Inc., New York; 1921. Price, $3.

A book on flotation in the index of which no such words as "litigation," "patents," "royalties," and "history" can be found is somewhat of a novelty, and we think will be a welcome one to the average flotation operator. No conflicting theories are offered to puzzle the reader. In the first chapter, of twenty-two pages, the author states clearly and concisely his own opinions, based on experience and experimental research, as to why and how flotation works, and the governing conditions, from the practical standpoint. Then come about seventy-five pages on testing equipment and methods; forty pages descriptive of the leading makes of commercial flotation machines; and thirty pages devoted to the flow sheets, and reasons therefor, at representative flotation plants. A large number of detailed drawings and charts supplement the text. Several valuable tables are also appended.

Mr. Taggart is professor of ore dressing at Columbia University. Under his direction, in 1919 and 1920, research work was carried on which indicated an essential difference in principle between the operation of machines in which the froth is caused by violent agitation and those in which the froth is made by the admission of air at or near the bottom of the cell, as in the so-called pneumatic machines. In those machines which depend on beating the pulp into a froth (the Minerals Separation and the Janney, for example) Professor Taggart believes the phenomena to be as follows: The rapidly moving impellers throw the pulp to the periphery of the agitation chamber, thereby depressing the surface at the center and creating a vortex. When the vortical cone above the pulp level reaches the impellers, air is entrained and is immediately broken up into many small bubbles. As the pressure in front of the rapidly moving blades is considerably greater than at other points, a portion of these small bubbles passes into solution. Away from the impellers, however, the pressure is normal, and behind the impellers, subnormal, so that the pulp, except directly in front of the blades, becomes supersaturated with air. Bubbles of air therefore re-form, and do so on the oiled sulphide particles present in the pulp. The bubbles of air rising through the pulp in this type of machine have been found to be coated with sulphide particles—the concentration having been made in the body of the pulp as the bubbles form. Professor Taggart therefore calls the process "pulp-body concentration," which would seem to be a fitting term.

In distinction to the phenomena already outlined is the "bubble-column process," in which the bubbles are larger and more numerous than in the pulp-body process and therefore rise through the pulp more rapidly. They have been found to carry sulphide and gangue particles in the same ratio as they are found in the pulp through which they pass, no concentration taking place until the level of the pulp (the bottom of the bubble column) is reached. But in the layer of bubbles at the surface of the pulp, study shows that "there is a differential draining of the gangue and sulphide particles; that the average downward velocity of the sulphide particles is less than the average upward velocity of the bubbles; that the average downward velocity of the gangue is greater than the average upward velocity of the bubbles; and that, as a result, the sulphides are lifted up and away from the gangue. It is apparent, also, from such study, that the sulphide particles in the bubble column are nowhere firmly adherent to bubbles, as they are in the pulp-body processes."

Besides the Callow cell, bubble-column concentration is said to take place in the Ruth, Groch, Hebbard, Rork, and K. & K. machines. One would think the last two mentioned would not come in this class, but Professor Taggart has found that the "pulp is displaced so rapidly through the zone of the moving parts into the quiet zone, that the time is insufficient to effect pulp-body concentration."

Not being familiar with the experimental work upon which Professor Taggart's assertions are based, we are not qualified to offer intelligent comment thereon. A full explanation and discussion is promised in a later book; until this is published we can only admit the reasonableness of the author's views, at the same time rather holding aloof from the idea that there is in all instances a sharp dividing line between the two processes. It is interesting to observe that Professor Taggart believes that any ore amenable to froth flotation can be treated with equally good metallurgical results by either process.

The theory of supersaturation in the agitation compartment, on which Professor Taggart's views are based, seems to have been advanced privately as early as 1907 by Sulman and Picard, but to have been carefully avoided in Sulman's paper published by the Institution of Mining and Metallurgy in 1919. This may have been done advisedly, for, as we all know, flotation is a legal as well as a metallurgical process. We expect that Professor Taggart's work will have a wide airing in the courts.

Certainly the first chapter of this book is the most interesting, but the remainder is no less valuable to the flotation test man and operator. The author does not hesitate to state his opinions of procedure, processes, and machines, and with his ideas we generally agree. He devotes a page to a comparison of flotation machines which we think might well have been amplified, giving more of the details as to why some types of machines have been thrown out of certain plants. Mr. Callow and others of his school should feel encouraged by the prophecy that "ten years' time will see the agitation-type machine almost completely displaced by machines of the pneumatic type."

This small volume is well written, well edited, and well printed, and on the subjects which it covers we consider it easily the best book available today.

E. H. R.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

New York Section, A. I. M. E., Opposes Licensing of Engineers

Among a majority of those present at the meeting of the New York Section of the American Institute of Mining and Metallurgical Engineers, held at the Machinery Club, on Jan. 11, the bill for the compulsory licensing of engineers seemed to be as popular as a bow-legged girl in her own home town. The subject of the evening was open for discussion immediately following the usual dinner. W. Y. Westervelt, as chairman, introduced P. E. Barbour, assistant secretary of the Institute, and also vice-chairman of the present Engineers' Licensing Board of New York State. Mr. Barbour outlined the history and purport of the Engineers' Licensing Bill, which passed the Legislature, was signed by the Governor, and becomes compulsory in May, 1923. Mr. Barbour refrained from any comment either for or against licensing, but simply stated conditions as actually specified by the measure.

B. B. Gottsberger, the next speaker, gave a résumé of the legislation with regard to the licensing of engineers, now in effect in nineteen states. He stated that, in his opinion, there was considerable opportunity for study, as engineers in general, and particularly mining engineers, did not feel that there was justification for such measures. A serious objection to such laws was that the effect would be not to rule out the unfit, but that there was a danger that engineers would be forbidden to develop. The arguments thus far given by the supporters of the licensing bill are without real justification, particularly as applied to mining engineers.

W. R. Ingalls, in a letter to the chairman, stated he believed that all efforts should be made to check and repeal the movement and also said that one great difficulty lay in the fact that no satisfactory definition of engineers had yet been reached. This opinion was also held by a number of those present.

J. M. Goodell, the next speaker, said that civil engineers had had licensing thrust on them, and he outlined the early work which had been done in furthering the licensing movement. He believed that the civil engineers, as well as others, should help to administer the laws as they now exist until they can find out the general effect, and make such corrections as seem necessary.

D. M. Liddell, in a letter to the chairman, stated that engineers were not to be considered in a class with doctors and lawyers, as their practice was often not a local one, but covered professional work in numerous states, and that the securing of licenses in every state would work an unnecessary hardship on them. F. T. Rubidge told of the work done by the licensing committee appointed by Engineering Council in 1918, of which he was a member. This committee spent considerable time investigating, and attempted to secure as many opinions as possible. At the time the report was made, there had been no opportunity for extensive expression of opinion.

R. A. Parker, chairman of the Colorado Section, stated in a letter that the licensing bill as passed in Colorado was an underhanded piece of legislation, and one with which none of the mining engineers were in sympathy or expected to receive benefit from. Col. A. S. Dwight outlined the more recent work of Engineering Council with respect to engineer licensing. He said that the committee had done all that it could do and that there still existed a radical division of opinion.

Allen H. Rogers then proposed a resolution, but at this point D. M. Oltarsh, one of the originators of the Engineers' Licensing Bill in New York State, attempted to explain the measure. His attempts were more antagonistic than explanatory, and resulted in considerable discussion on the floor. The resolution, which was seconded and passed with but one dissenting vote, is as follows:

"Whereas the legislature of this state has passed a law requiring that engineers be licensed for the practice of their profession; and,

Whereas it is our belief that this law or any other law for the licensing of engineers does nothing to improve the status of the engineer and is not required for the protection of the public; and,

Whereas this law imposes an unjust and burdensome restriction on engineers in the practice of their profession;

Resolved, That the members of the New York Section of the American Institute of Mining and Metallurgical Engineers present in meeting assembled pledge themselves jointly and severally to work for the repeal of this law and to oppose any similar legislation; and

Resolved, That a copy of these resolutions be transmitted to the Board of Directors of the A.I.M.E., with the request that the appointment of a committee of five by the chairman of the section be approved, said committee to plan and carry out measures for the repeal of the New York licensing law, and to this end authorized to receive and disburse funds and to co-operate with other engineering organizations."

An attempt on the part of Mr. Oltarsh to have the resolution held over until a later meeting was stopped for lack of a second. Directly preceding the closing of the meeting, Dr. H. M. Payne stated that he regarded the entire engineering license movement as selfish legislation, and considered that it had been fostered by labor-union propaganda and agitation, pure and simple.

Mine Law Revision Opposed in Colorado

The annual meeting of the Colorado Metal Mining Association and the Colorado Chapter of the American Mining Congress met in joint session at Denver on Jan. 16 and 17. Operators from the principal mining camps reported a revival of mining interest throughout the various districts. Several of the large operators stated that they were preparing for enlarged operations and a considerable number of new mining enterprises were announced by members present.

George A. Stahl, general manager of the Vindicator Consolidated Gold Mining Co., at Cripple Creek, was elected president of the Colorado Metal Mining Association, and George E. Collins, of Denver, was elected governor of the Colorado chapter of the American Mining Congress. M. B. Tomblin was elected secretary of both organizations and A. M. Collins, treasurer.

The meeting went on record as opposed to the revision of Federal mining laws as proposed in H. R. 7736, and a resolution was adopted favoring the transfer of the Forestry Department from the Agricultural to the Interior Department.

University of Illinois Offers Research Assistantships

To assist in the conduct of engineering research and to extend and strengthen the field of its graduate work in engineering, the University of Illinois maintains fourteen research graduate assistantships in the Engineering Experiment Station. Two other such assistantships have been established under the patronage of the Illinois Gas Association. These assistantships, for each of which there is an annual stipend of $600 and freedom from all fees except the matriculation and diploma fees, are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering physics, or applied chemistry. Information may be obtained by addressing The Director, Engineering Experiment Station, University of Illinois, Urbana, Ill.

Special Entertainments Planned for Institute's February Meeting

In addition to the general program of technical sessions to be held at the [illegible] meeting of the American Institute of Mining and Metallurgical Engineers in New York, the Committee on Arrangements has made the following announcement concerning special entertainments:

On Feb. 20, at 8:15, a smoker will be held in the Engineering Societies Building.

On Tuesday evening, Feb. 21, two moving pictures, "Mexico and Its Oil" and "Through India With the Duke of Connaught, Including a Visit to the Tata Iron and Steel Works," will be shown.

For the accommodation of members, arrangements have been made whereby tickets for several of the principal theatres may be purchased through the Entertainment Committee. Details regarding these tickets may be obtained from A. C. Ludlum, 2 Rector St., New York City.

On Wednesday afternoon, Feb. 22, Senator William A. Clark will open his art galleries to members and guests.

Wednesday evening will be devoted to the banquet.

Those planning to participate in the excursions on Thursday, Feb. 23, will assemble at the ferry house of the Central R.R. of New Jersey at the foot of West 23d St. (Hudson River), a little before 9 o'clock, the boat leaving 8:55 a.m. sharp. The party will be divided into groups: those interested in steel, in oil and in copper.

At Jersey City, a special train will take the steel group to the plant of the Crucible Steel Co. of America, at Harrison, N. J.; the oil group to the Bayway plant of the Standard Oil Co. of New Jersey, and the copper group to the Chrome plant of the U. S. Metals Refining Co. At Perth Amboy the different groups will be entertained at luncheon by the industries of Perth Amboy.

After lunch the steel group will visit the Pardee Steel and Pardee Tile Works; the oil group the Chesebrough Manufacturing Co. or the Barber Asphalt Co., and the copper group the Standard Underground Cable Co. or the Raritan Copper Works. The ladies of the party will be entertained at cards and tea during the afternoon. Groups will reassemble at the Perth Amboy station about 4:30 p.m., for return by special train, which will bring them back to New York about 5:30 p.m.

The committee finds that it will be necessary to secure definite registration for the excursions. This registration Tuesday evening, Feb. 21.

Partly to defray the expenses of the excursion, members residing in the territory covered by the New York Section will be required to pay a nominal fee for themselves and each guest when registering for the excursion. Visiting members and guests will not be required to pay this fee.

MEN YOU SHOULD KNOW ABOUT

G. A. Joslin has returned to Salt Lake City from Bayhorse, Idaho.

H. S. Rose, president of Level Crystal Gold Mines, Kirkland Lake, is visiting New York.

C. K. Leith, of the University of Wisconsin, sailed for Chile on Jan. 7, to make geological examinations.

O. E. Meinzer, of the staff of the U. S. Geological Survey, is making a Western trip on extended business.

E. A. Julian, of San Francisco, consulting engineer for the Goldfield Consolidated Mining Co., was recently in Reno.

J. R. Thoenen has been made general manager of the Spar Mountain Mining Co., with headquarters at Cave-in-Rock, Ill.

Maurice Clark has been put in charge of a special mining department recently established by the Douglas, Ariz. Chamber of Commerce and Mines.

George A. Morrison, formerly superintendent of the Creighton Mine, Ontario, has accepted a position with the Keene Mica Co., Gilsum, N. H.

J. D. Bower, formerly shop foreman for the Miami Copper Co., has been placed in charge of the mechanical department at Nacozari, Mexico.

Frank M. Estes returned to New York from Central America last week and left for Madera, Chihuahua, Mexico, to take charge of the Dolores mines.

Arthur W. Jenks returned to San Francisco last week after examining properties in the Porcupine and Kirkland Lake districts of northern Ontario.

William Loeb, Jr., vice-president of the American Smelting & Refining Co., has been in Salt Lake City and vicinity on a trip of inspection of the company's plants.

Bulkeley Wells has been elected chairman of the mining bureau of the Civic and Commercial Association at Denver. He succeeds **Richard A. Parker.**

Stanly A. Easton, of Kellogg, Idaho, manager of the Bunker Hill & Sullivan Mining & Concentrating Co., accompanied by his family, is spending a few weeks in California.

Martin Trewhella, superintendent of the Agnew mine, a property of the International Harvester Co., near Hibbing, Minn., has resigned his position and will move to Los Angeles, Cal.

John T. Reed, who has recently been in San Francisco on business, will soon leave his office in Lovelock, Nev., for an extended visit to New York City in connection with his mining interests.

John C. Semple has severed his connections with the firm of Armstrong & Semple, Spokane, Wash., and has opened offices for the practice of mining engineering in the Shoshone Building, Wallace, Idaho.

A. J. Beaudette, of Los Angeles, will leave on Feb. 1 to establish an office at Istmina, Colombia, S. A. He will remain there about three years, making a geological investigation of the occurrence of platinum in the San Juan River.

W. Earl Greenough, mining engineer of Wallace, Idaho, and Spokane, has returned from the oil fields of Wyoming, where he had been for several months giving his attention to the development of a large oil tract near Lander.

W. L. Cummings, chief mining engineer for the Bethlehem Steel Co., has been visiting the iron-ore districts of the Lake Superior region. He was accompanied by **Mr. Salter**, who is in charge of mining operations for the company at Cornwall, Pa.

Frederick Bradshaw, was elected president at a meeting of the Nevada Mine Operators' Association, held in Reno Jan. 9. Other officers were as follows: **John G. Kirchen**, first vice-president; **W. S. Larsh**, second vice-preident, and **H. M. Rives**, secretary.

W. P. Chinn, assistant general manager of mines, and **W. A. Rose**, chief mining engineer, of Pickands, Mather & Co., have been promoted to the respective positions of general manager and assistant general manager. Mr. Chinn fills the vacancy caused by the removal of **C. H. Munger**, secretary of the company, from Duluth to Cleveland.

Mining and metallurgical engineers visiting New York City last week included: W. W. Taylor, New Haven, Conn.; **C. W. Goodale**, Butte, Mont.; **E. W. Bullard**, San Francisco, Cal.; **W. J. Pentland**, Mexico; **Sherwin F. Kelly**, Lawrence, Kan.; **J. F. Callbreath**, Washington, D. C.; **A. E. Perkins**, Salt Lake City; **W. B. Campbell**, Baxter Springs, Kan.; **Harold A. Titcomb**, Farmington, Me.; **W. R. Van Slyke**, Eveleth, Minn.; **H. L. Rau**, Milwaukee; **W. B. Donoghue**, Ontario; **T. J. Mateer**, Fredericktown, Mo.; **E. F. Buchard**, Washington, D. C.; **Charles W. Henderson**, Denver; **H. R. Robbins**, Fierro, N. M.; **Julius H. Gillis**, Sudbury, Ont., and **G. R. Mansfield**, Washington, D. C.

OBITUARY

G. G. Hartley died at his home in Duluth, Minn. on Jan. 17, at the age of sixty-eight. Mr. Hartley was one of the pioneers in mining on the Mesabi iron range, where his greatest achievement was the successful washing and concentration of low-grade iron ores on the western end of the district.

Captain James Rosewall died recently at his home in Hibbing, Minn., after an illness of many months. Mr. Rosewall, who was fifty-five years old, had been chief underground mining captain for the Oliver Iron Mining Co. in the Hibbing district for the last twenty years. He was born in St. Ives, Cornwall, England.

THE MINING NEWS

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Leading Events

Other copper companies are now looking forward to a resumption of operations on a more or less limited scale. Among these are the United Verde Extension and the Iron Cap, in Arizona, which plan to resume next month, and the Calumet & Hecla and three of its subsidiaries, in northern Michigan. The International smelter in Arizona is now running two furnaces on Miami concentrates. The Davis Daly company is negotiating with Anaconda for the treatment of its ore at the latter's Washoe plant.

Butte & Superior's crosscut on the 2,600 level of the Black Rock mine is in nearly 10 ft. of ore running 9 per cent copper and high in silver.

The Hollinger Consolidated Gold Mines, Ltd., of Porcupine, Ont., has started suit against the Northern Canada Power Co., alleging that it has grounds for action through the latter's failure to conform to the terms of its contract.

Flotation litigation between the Minerals Separation and the Miami Copper companies progressed another very short step recently when the Court of Appeals at Philadelphia refused to shorten the case by excluding the consideration of certain processes, Miami thereby losing the point.

Mergers of various independent steel companies are the subject of much discussion. The situation as it stands is given in this issue.

Freight rates on ores from the Pioche district, Nevada, to the Salt Lake Valley smelters have been reduced, effective next month.

Hearings in the Star-Hecla injunction suit were recently resumed in Spokane.

Hollinger Sues Power Company for Breaking Contract

Operations Greatly Hampered by Power Shortage—Amount Claimed Said To Be Over $2,000,000

The Hollinger Consolidated Gold Mines, Ltd., of Porcupine, Ont., has begun one of the most important legal actions in the history of mining in northern Ontario in its suit against the Northern Canada Power Co., Ltd., for the failure of the latter to comply with its contract to supply the full needs of the mine during the winter months of 1920-1921. It is understood that the amount claimed is $2,150,000, which includes loss in revenue from tonnage which might have been treated had the power been available for extensions, and also includes the New York exchange on such estimated production.

The primary cause of the action dates back to the early days in the history of the Porcupine field. At that time two power plants were being built on the Mattagami River, one at Sandy Falls, which was being financed by Hollinger interests, and the other at Wawaitin Falls, in which the Dome company was interested. These two plants were amalgamated under the name of the Northern Canada Power Co., Ltd., and it is stated that as one of the considerations for turning over the plant the Hollinger company obtained first call on all the power needed for its requirements. At that time neither the power company or the mining companies had any conception of the magnitude to which these mining operations would extend, and when the shortage of water occurred last winter the power output was somewhat curtailed. The Hollinger made application for the right to develop power on the Abitibi River, but as the Abitibi Power & Paper Co. had certain rights to be safeguarded in this connection, the government did not grant the Hollinger's application. Hollinger officials have also stated that they could develop their own power with the use of Diesel engines for less than the power company charges. All these factors have resulted in a serious power shortage in the Porcupine camp, as the power company does not want to go ahead with expenditures without assurance that if additional power is developed it will be consumed. The power situation in the camp has held up its development for at least a year.

Suit To Test Tonnage Tax Law of Minnesota

Oliver Iron and Thirty Independents Claim Statute Is Unconstitutional —Action Forced on Operators

By Wire

Duluth—Suit to test the constitutionality of the Minnesota state tonnage tax on the mining industry was filed in the U. S. Court in Duluth on Jan. 25 by the Oliver Iron Mining Co., and thirty independent mining corporations. Issuance of a temporary restraining order was asked to enjoin officials of the state from proceeding with the collection of the tax. Should that be granted, application for a permanent injunction may be heard before a court of three judges. Suit was forced at this time through the action of the State Tax Commission in serving notice on the mining companies to supply certain information on which the tax could be assessed. The companies would have been liable to penalties had they refused to comply.

Merger of Independent Steel Companies Pending

Negotiations in Advanced Stage—Names of Eleven Companies Mentioned

It is now a well-established fact that negotiations for an important merger of independent iron and steel companies have reached an advanced stage, and that unless a break occurs over the relative valuations of the properties involved the merger will be an accomplished fact by early spring. The plans, if effected, will mean a combine of the Youngstown Sheet & Tube Co., Youngstown, Ohio, and the Inland Steel Co. and Steel & Tube Co. of America, both of Chicago.

Other independent concerns which have been prominently mentioned as entering into the preliminary merger negotiations are the Midvale Steel & Ordnance Co., Pickands, Mather & Co., Lackawanna Steel Co., Brier Hill Steel Co., Pittsburgh Steel Co., Cleveland-Cliffs Iron Co., Donner Steel Co., Otis Steel Co. and Trumbull Steel Co. It is not now expected that these companies will enter into the proposed merger at this time, but it seems probable that one or two combinations may be effected of these concerns, with the ultimate view of forming a large merger of the independent combines later. Pickands, Mather & Co. will in any event be affected by the merger plans, as this company owns important interests in the Youngstown Sheet & Tube Co. and in the Steel & Tube Co. of America. Cleveland-Cliffs has denied that it will enter the merger.

Representatives of the three independents mentioned have been rounding out the details of the merger at meetings held in Chicago, Cleveland,

and New York. A valuation committee composed of the vice presidents of these companies has appointed umpire engineers who are now engaged in examining and appraising the iron-ore properties on the Gogebic Range in Michigan and the Cuyuna Range in Minnesota, which will be involved in the deal.

The proposed merger will have important steel-manufacturing facilities, a large iron-ore reserve, and a fleet of Lake ships. It is expected that the new consolidation will make its iron-ore and vessel headquarters in Duluth.

The Youngstown Sheet & Tube Co. produces forging ingots, blooms, billets, bars, wire, steel and iron pipe, tubes and sheets; the Inland Steel Co., pig iron, ingots, blooms, bars, structural shapes, plates, and sheets; and the products of the Steel & Tube Co. of America include pig iron, ferrosilicon, ferromanganese, plates, steel pipe, and tubes.

The Youngstown Sheet & Tube Co., though not actively engaged in the mining of iron ore, is reported to own interests in several mine leases. The other concerns in the consolidation are important iron-ore producers in the Lake Superior district. The Steel & Tube Company of America owns and operates the Palms-Anvil group and the Newport mine on the Gogebic Range of Michigan, the last named being the largest and deepest underground iron mine in the world. It also controls, through the Rogers-Brown Ore Co., the Kennedy and Meacham mines, on the Cuyuna Range, with an estimated reserve of about 2,000,000 tons, and the Susquehanna mine, on the Mesabi, with a reserve now estimated at 18,000,000 tons.

The Inland Steel Co. owns and operates the Armour group and the State Lease on the Cuyuna, and the Laura mines, on the Mesabi Range, with a total estimated reserve of 5,700,000 tons, and is interested in the lease of the Dunwoody mine, on the Mesabi, an 11,000,000-ton reserve operated by the Tod-Stambaugh Co.

The financial details of this independent merger of steel interests are being handled by Dillon, Read & Co., of New York. James A. Campbell, president of the Youngstown Sheet & Tube Co., has been mentioned as the probable president of the new corporation.

Katanga To Use Powdered Coal in Blast Furnaces

An agreement has been made whereby the Garred-Cavers pulverized-coal firing process will be applied to the blast furnaces of the Union Minière du Haut Katanga, in the Belgian Congo, Africa, for the smelting of copper ores. U. A. Garred, president of the Garred-Cavers Corporation, left New York on Jan. 17 for the Belgian Congo to superintend the installation of the process. The pulverized-coal equipment was purchased several months ago in America and is now installed at the Katanga smelter.

Calumet & Hecla To Resume Production April 1

Three Subsidiaries Likewise—Output at Start To Be About Half Normal

The Calumet & Hecla and three of its subsidiaries, the Ahmeek, Allouez, and the Isle Royale copper companies, in northern Michigan, will resume production April 1. Men will be taken on from time to time before that date as they may be needed to repair the shafts and plants and to overhaul the equipment. Production at the start will probably not be more than half normal and will be gradually increased as the market warrants. Calumet and Hecla's copper surplus should be back to normal by midsummer.

Navigation will have opened before operations are resumed in the Calumet & Hecla mines, according to present prospects. This will assure a plentiful supply of coal. Though considerable work must be done in the conglomerate shafts before production can get back to normal in this department, it is expected that the amygdaloid shafts will be ready to resume hoisting without great delay. The restoration of underground equipment and the repair of surface plants will not take more than six to eight weeks. No great difficulty is expected in recruiting sufficient labor to reopen the mines. It is estimated there are fully 3,000 men available in the district, and there is no intention of speeding up production at the start.

Freight Rates on Pioche Ores Reduced

New Schedule Affecting Shipments To Salt Lake Valley Smelters Effective Feb. 7

Reduced freight rates on ore shipped from the Pioche district, Nevada, to the Salt Lake Valley smelters will become effective Feb. 7. The new schedule is a result of the hearing recently held at Carson City. A comparison of the new rates with those now in effect is given in the following table:

Ore Not Exceeding in Value	Rate After Last Increase	Plus War Tax	New Rates
$6.50	$2.75	$2.83	$2.20
7.50	2.75	2.83	2.75
8.50	3.50	3.60	2.80
10.00	3.50	3.60	3.50
15.00	4.25	4.38	3.75
20.00	5.50	5.66	4.50
30.00	7.00	7.21	5.50
40.00	8.25	8.50	6.25
50.00	9.38	9.65	7.00
60.00	10.12	10.42	7.50
70.00	10.50	10.82	7.50
80.00	11.00	11.33	8.00
90.00	11.37	11.71	8.50
100.00	11.75	12.10	8.50
[illegible]	14.13	14.55	10.00

The value of the ore is computed by dividing the amount derived from the smelter settlement by the wet tons contained in car after smelter has deducted its own charges.

Ore shipments from the Pioche district for the week ended Jan. 13 were confined to ore from the mines of the Bristol section, where the Bristol Silver shipped 315 tons and the Black Metals 315 tons. All other ores are being held pending the application of the new rates.

Mineral Discoveries Made in Silesia

By Cable From Reuters to Engineering and Mining Journal

Prague, Jan. 16—According to the *Narodni Listy* discoveries of gold have been made in Czechoslovak-Silesia. Two analyses revealed 36 and 52 grams of gold respectively per ton of ore. Ore containing copper and iron has been found near Durrseifen. Pyrites has been discovered near Zuckmantl, and magnesite near Vidnava. Several foreign groups are already interested.

U. V. Extension Will Resume Next Month

James S. Douglas Seeking Lower Rate on Bullion to Pacific Coast

James S. Douglas, president of the United Verde Extension Mining Co., Jerome, Ariz., has announced that his company expects to resume production within thirty days, with an output of 1,500 tons of bullion a month and with an operating force of 500 men. He is working on a new plan, which is expected to secure a material reduction in transportation costs, with incidental transfers of freights to San Pedro harbor, on the Pacific Coast, instead of direct rail shipment to New Jersey for refining. He has enlisted the support of the Los Angeles Chamber of Commerce in his efforts to secure a rail rate of $5 a ton for domestic and $4 for export copper bullion from Jerome to Pacific tidewater, 570 miles. He considers this fair in view of the present Salt Lake-Los Angeles rate of $6.50. The Arizona-New Jersey rate is $16.50. Before the war the Atlantic rate was $12.50. Los Angeles already is making plans for a refinery at her harbor, to manufacture Arizona copper into such forms that it can be exported directly to the Orient, with possibility of attached wire and other manufacturing plants.

Court Refuses To Curtail Miami Flotation Suit

On Jan. 18 the U. S. Circuit Court of Appeals, in Philadelphia, heard and denied a petition for a writ of mandamus, which, had it been granted, would have instructed the master who is making the accounting in the Miami Copper Co. flotation suit to exclude from the accounting proceedings further consideration of those flotation processes of the Miami company which have been employed subsequent to those which the Circuit Court of Appeals had found to be infringement. This unusual petition resulted from an equally unusual situation. In 1920 Minerals Separation, Ltd., appealed to the U. S. District Court seeking to have the Miami Copper Co. found in contempt of court for its continued use of these subsequent processes. But the Minerals Separation, Ltd., having failed in its efforts before the District Court, in this respect, because that court did not find these subsequent processes to be "mere colorable departures" from the declared infringing processes, made further effort to bring the matter to the higher court upon appeal. The Circuit Court of Appeals decided, however, that such an action was not appealable, but wrote an opinion in which it sustained the District Court's opinion to the effect that the Miami company's operations were not such as to make them in contempt.

Upon the apparent contention that that which could not be found in contempt could not be found to infringe, the Miami sought the aid of the court to eliminate from the hearings before the master further testimony as to these subsequent processes. The Circuit Court of Appeals, however, decided that the record was already so voluminous that it was better that the defendant make its reply before the master, rather than through the medium of a new trial.

Star Injunction Hearings Resumed

Hearing of injunction proceedings brought by Eugene R. Day and Sarah E. Smith, minority stockholders in the Hecla Mining Co., Wallace, Idaho, to restrain Hecla company from joining with Bunker Hill & Sullivan Mining & Concentrating Co. in acquiring a joint interest in property of Star Mining Co. at Mullan, Idaho, was resumed at Spokane, Wash. on Jan. 16. The original plaintiffs have been joined in the action by Frank Murphy, Frank Radovich, and A. L. Hutton, Hecla stockholders to the extent of about 11,000 shares. Indications are that examination and argument will take a week or ten days, with an appeal to higher courts, without regard to the side favored by the decision.

Only half of the plaintiff's witnesses had been heard up to Jan. 24. Among the technical witnesses for that side were F. E. Berg and Roy Wethered, of Wallace, of the Day companies' engineering staffs; A. L. Bruce, of Butte, manager of the Davis-Daly Copper Co.; and Sidney L. Shonts, of the Internal Revenue Department, Washington, D. C. The technical evidence has been confined largely to the refractory nature of the Star ores and the impossibility of profitable mining operations under the arrangement proposed by the Hecla and the Bunker Hill & Sullivan companies.

Many important technical witnesses are lined up for the defendant, including Albert Burch, of San Francisco; W. H. Wiley, of Los Angeles; F. W. Callaway, of Kellogg, Idaho; Rush J. White, of Wallace; W. G. Woolf who is in charge of the Bunker Hill electrolytic operations; D. W. Buckby, superintendent of the Timber Butte mill, Butte; Gus Hellstrand, metallurgist at the Timber Butte mill; A. J. Miller, of Salt Lake City; and J. B. Parker, of Kellogg. Important evidence is likely to be given by Fred W. Bradley, president of the Bunker Hill & Sullivan company.

To Reopen Cornish Radium Mine

By Cable From Reuters to Engineering and Mining Journal

London, Jan. 21—Great interest has been aroused in Cornwall by the announcement that an English financial group has decided to reopen the Tolgarrick radium mine, near Truro. The property is known to possess two rich lodes of uranium ores, and it is hoped to establish a new industry in Cornwall by treating the ore on the spot.

Another Option on Middlemines on Comstock Taken

As announced recently, an option on the Middlemines group of the Comstock lode has been granted to Dr. M. R. Ward and associates, of Philadelphia. The sum of $150,000, to defray expense of examination and necessary development work, has been raised, and work started through the Hale & Norcross tunnel under direction of Alex Wise. The properties included in the option are credited with a production of over $100,000,000 in high-grade ore. Present plans are to develop and prove the commercial low-grade portion of the lode, with the possibility of later driving haulage tunnels and erecting a mill of at least 2,000 tons' daily capacity.

Archibald-Osborn Case Settled

In the matter of the suit of Ralph S. Archibald, of Negaunee, Mich., against Chase S. Osborn, of Sault Ste. Marie, and others conducting the sale of lands of the Michigan Land & Iron Co. to the Ford Motor Co., for service rendered in connection with that sale, the issue has been settled out of court and to the complete satisfaction of Mr. Archibald. Berg, Clancey and Randall were attorneys for the plaintiff. Mr. Archibald is a geologist and mining engineer representing regularly several large mining interests in the Lake Superior country.

"Pittsburgh Plus" Case To Open

Tenative arrangements have been made by the Federal Trade Commission to begin the trail of the Pittsburgh basing point case against the U. S. Steel Corporation at Milwaukee on Jan. 30. This case is based on a complaint issued by the commission against the corporation for alleged prejudice against competitors in the use of the "Pittsburgh Plus" method of fixing the price of steel.

McDougall Patent Case Appealed to Supreme Court

The case against the Oliver Iron Mining Co. instituted by Alexander McDougall has been taken to the U. S. Court of Appeals. The plaintiff alleges infringement of patents granted himself on ore washing equipment and seeks damages alleged to have been sustained for over $1,000,000. At the first trial in the United States District Court, about a year ago, the decision rendered was in favor of the Oliver Company.

Operations Along Kuskokwim Progressing

Gold Stampede to Tributary of Nixon's Fork—Guarding Gold Shipments

By [illegible]

Aniak, Alaska, Nov. 1—The season of 1921 closed on the Central Kuskokwim River without any sensational rich strikes, but nevertheless with steady improvements. Drilling with a gasoline-driven drill was begun on Ophir Creek, testing for placer gold. The work was abandoned before the close of the season, because of the poor showing made. A hydraulic outfit that has been in process of installation for the past two years was worked on Spruce Creek. Good results were obtained.

During the spring and early summer New York capital acquired a group of fifty-two placer claims of twenty acres each on California Creek and the Upper Tuluksak River for dredging. A steam-driven drill will be installed to test the ground during the coming summer.

BRINGING GOLD SHIPMENTS DOWN KUSKOKWIM RIVER, ALASKA, WITHOUT GUARDS

Several small outfits continued to mine on Bear Creek during the season with the pick and shovel. Shaft sinking continued during summer and fall on the quartz prospect in the Russian Mission Mountain, fourteen miles from Kolmakoff. Those concerned claim they are developing a big orebody carrying values of $90 per ton in tin. A small crew worked with an hydraulic outfit on Marvel Creek, in the Aniak region, the last summer.

The new quicksilver mine twenty-two miles from the mouth of Crooked Creek was operated during summer and fall with only three retorts, due to the freezing in of the river boat the fall before and to the impossibility of sledding in the complete plant until snow came. The ore runs high in mercury and the mine promises to become a heavy producer soon.

A rich placer strike was made on Crooked Creek last summer, going $2 per sq. ft. of bed rock, and preparations were started for installing a hydraulic plant next season. Lumber is now being hauled on the ground from Iditarod.

Rich ground was found on Willow Creek, a tributary of the George River, and a new hydraulic outfit is being landed on the ground this winter for work next season. The largest nugget to be found on this part of the Kuskokwim River, weighing 16½ oz., was found on a George River tributary.

A small crew have been at work the past season at the Parks cinnabar properties, fifteen miles above Georgetown, but shut down at the freeze-up.

Development work was continued during the summer on the Holitna River, and resulted in a stampede up the river. Some good pay is reported to have been struck there. No mining has yet been done.

A very rich strike of placer gold was reported on a tributary of Nixon's Fork late in the summer, and has resulted in a great stampede since the freeze-up, hardly an extra man being left in any of the camps on the Central River. Good prospects have been found along six miles of the benches. The Treadwell's quartz mine shipped several barges of rich ore last summer to the outside. The company has received and installed larger air compressors, and expects to increase the output of ore next summer. About half a dozen new placer camps are getting ready to work the summer of 1922, in the vicinity of the Treadwell property.

The first dredge on the Kuskokwim River made a half-million-dollar shipment of gold bricks this fall by the last boat for the outside. The ground is dredging much better than was shown by some of the drill reports.

Four new dredges are enroute to the Kuskokwim. Some are being shipped by way of the mouth of the Kuskokwim; one around from Nome by way of the mouth; another over the snow to Ruby, on the Yukon, and will come around by water, next summer; and one is being hauled over land to the head of the river. Another dredge is ready to be shipped from San Francisco as soon as space can be reserved on the boats.

GUARDING GOLD SHIPMENTS

Many different plans have been adopted in the past by captains of river boats to safeguard large and valuable shipments of gold, generally by placing the treasure in iron boxes secured by two or more padlocks, the whole then being chained and locked to the mast or some part of the machinery, and watched by several guards. But it has remained for the captains of the steamers on the Kuskokwim River to evolve a plan that is original and appears to be wholly safe for the treasure. The gold is put in strong wooden, iron-clad boxes and delivered under strong guard to the steamers. The boxes are laid along the floor, and 4-ft. steamboat wood, used as fuel, corded on top. Thus the gold makes its 600-mile journey down river to the ocean boat. The steamers use many hundreds of cords of wood, and it would be utterly impossible for hold-up men to get the gold without removing the greater part of the cord wood. As the crews of these boats are composed of Esquimo, the highwaymen would need to speak the native tongue to secure help from them, and if he tried to force them with a gun, they would either jump overboard or faint. It has been estimated that it would take two highway robbers fifteen hours to unload the wood so they could get at the gold, and as working is a violation of the Highwaymen's Union rules, they would be fined more than they got if attempted that way. The express companies might profit thus.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Hearing on Mining Law Revision Expected Next Month

Chairman Rhodes Opposed to Introduction of Modified Bill—Many Complain of So-Called Arentz Measure

Though it has been necessary to delay somewhat the opening of hearings on the bill providing for extensive revision of the mining laws and for their codification, Representative Rhodes, the chairman of the House Committee on Mines and Mining, is fully determined that the committee proceed with these hearings at the earliest possible date. In all probability, the hearings will begin early in February.

Of the communications being received by the committee in regard to the bill, fully 90 per cent, Mr. Rhodes says, are protests against some feature of the measure. In view of the widespread complaint which has been registered against the bill now before the committee, it has been suggested that a modified bill be introduced and made the basis of the hearings. Mr. Rhodes sees nothing to be gained by such a course and insists that the bill introduced by Representative Arentz, of Nevada, be made the basis of the hearings. He believes any other course would tend toward confusion.

The Arentz bill has been widely circulated, and all correspondence and discussion have been directed at that measure. In addition, Mr. Rhodes personally made an extended trip through the mining states and has listened to first-hand testimony of representatives of the industry who reflected opinion typical of that prevailing in various districts. At these hearings and at all other times Mr. Rhodes has refrained from stating any conclusion that he may have reached himself. He believes, however, that the Committe on Mines and Mining will be able to reach a decision promptly.

It has been suggested to Mr. Rhodes that, in view of the opposition, it may be better to undertake to secure legislation at this time in the matter of extralateral rights only. Were the committee to report out a bill providing for vertical side lines, making it clear that the change is in no way retroactive, it is believed that it could be passed. Mr. Rhodes states that this proposal will be emphasized during the hearings, and should it develop that this course is regarded as being best, he sees no reason why a less controverted feature of the bill could not be handled as a separate measure, leaving the more disputed provisions for further discussion. He points out that the committee can report out the type of bill that it agrees upon as being best and is not limited by, or committed to, the bill on which the hearing is based.

Tariff on Cyanide Favored by Senate Committee

Expected To Recommend Rate Lower Than That Asked—Chemical Company Said To Control Field

Unquestionably the controlling sentiment within the Senate Finance Committee favors a duty on cyanides. It is probable that a rate lower than the 33⅓ per cent duty requested will be prescribed in the bill which will be reported to the Senate next month. It may be predicted, however, with considerable certainty that cyanides will be removed from the free list.

Though the Homestake Mining Co. has been most active in opposing a duty on cyanides, its position is generally understood to be that of the gold-mining industry in general. The principal point made before the committee was that the gold-mining industry is in no position to add to the expense of producing its fixed-valued product. It was pointed out that though there were twelve regular gold producers in the Black Hills four years ago, only two, the Homestake and the Trojan, have survived the war period. Under those conditions, the committee was urged to do as the Ways and Means Committee had done with the bill in the House and insist upon cyanides remaining on the free list.

Senator Smoot, of Utah, called attention to the fact that only two-tenths of a pound of cyanide is used in treating a ton of ore at the Homestake mine. As the price of cyanide for the last eight years never has exceeded 25c. a lb. to those using it in quantity, he expressed the opinion that it is not going to add greatly to the cost of production of gold, when the cyanide used would not cost to exceed 5c. per ton of ore treated.

Senator Sterling, of South Carolina, referred to the committee a letter in which it was charged that there is an agreement between the Roessler & Hasslacher Chemical Co. and the German and English manufacturers of sodium cyanide. It was suggested that they are dividing the world markets.

P. S. Rigney, appearing for the Roessler & Hasslacher company, suggested that the letter probably came from a disgruntled former employee and declared that there has been no division of territory with English and German producers. He stated that the majority of the stock of this company and its subsidiaries is American owned. He characterized as "absolutely and unqualifiedly untrue" statements to the effect that the Alien Property Custodian took over the Roessler & Hasslacher company during the war. He said that the company is an American institution, employing American labor, and paying taxes to the United States. He pointed out that cyanide always had been dutiable, prior to the Underwood tariff. The Payne-Aldrich rate was 25 per cent. If cyanide is put on the free list, he said, it would be necessary to close the company's plants and scrap $5,000,000 worth of property. Mr. Rigney said that his company is importing cyanide to supply many of its customers and laying it down at New York 6c. cheaper than it can be manufactured for in this country. Such cyanide as is being manufactured is produced at a loss, he said, and its production is justified only by the advantages of holding the organization together.

J. O. Hammitt, of the American Cyanamid Co., expressed the opinion that it would be greatly in the interest of the American consumer to permit a continuance of competition between cyanide producers. He pointed out that his company is an American enterprise that was unable, in 1907, to obtain the cheap water power necessary for the manufacture of cyanamid and for that reason had established a plant across the river in Canada. After declaring that chemical manufacturing companies generally recognize that Roessler & Hasslacher has definite control of the field and constitutes an American monopoly, Mr. Hammitt stated that customers had told him that they had been handed unreasonable contracts and were required to enter into them as the only basis upon which they could obtain cyanide. He quoted President Seaman of the Trojan Mining Co. as authority for the statement that a representative of Roessler & Hasslacher had laid on his desk a contract for his full requirements for three years and stated that he could get no cyanide until he signed the contract. In 1917, the American Cyanamid Co. entered the American market, and Mr. Hammitt said it is now in a position to offer real competition and to break up the character of exploitation which he alleges existed previously.

Plan Hearing on Nicholson Bill Before Senate Committee

Thought Likely Joint Commission on Federal Reorganization Will Not Propose Department of Mines

Immediately following the report of the joint commission which has been studying the matter of Federal reorganization, it is planned to call a preliminary hearing before the Senate Committee on Mines and Mining on the bill of Senator Nicholson, of Colorado, which provides for the establishment of a Federal Department of Mines. Though no announcement has been made as to the recommendations which the commission will make, it is assumed that the plan proposed will not include a department of mines. The submission of the report will bring the whole subject prominently to the attention of members of Congress.

The subject is now receiving the active attention of legislators, and Senator Nicholson is of the opinion that this would be a propitious time to bring up his bill. His plan is to have a preliminary hearing before a subcommittee of the Mines and Mining Committee, at which a record could be made of the thought on this subject of outstanding men in the mining industry. This concise testimony could be made immediately available in printed form and could be distributed widely. After an opportunity has been given the public to acquaint itself with the advantages to be gained from such a department, it is planned to conduct more formal hearings, at which all interested in the proposition could be heard, as well as those who are opposed to it.

NEWS BY MINING DISTRICTS

London Letter

Report Made on East Pool-South Crofty Pumping Dispute — Gaika Gold Directorate Changed — Russo-Asiatic Approached by Soviet

BY W. A. DOMAN

London, Jan. 10 — Forster Brown, mining engineer, who was appointed by the Board of Trade to hold a public inquiry in Cornwall into the dispute between the East Pool and South Crofty companies in regard to pumping, has now issued his report. As I mentioned at the time, the closing of a part of the East Pool mine threatened to flood the South Crofty, and the question in dispute is as to which party is responsible for keeping down the water. According to Forster Brown, a sum of £42,000 would be necessary for pumping machinery, and annual pumping charges would run into about £17,000, and his recommendation is that 62 per cent of the cost should be borne by South Crofty, and 38 per cent by East Pool. South Crofty management welcomes the idea, but East Pool raises objections. The position is not easy to understand, for East Pool would not be unwatered below the 180-fathom level, though it would appear that the company has already abandoned this part of the workings. If the plan as recommended by Forster Brown could be carried through, the South Crofty might be able to resume mining operations in about twelve months.

As I recently reported, trouble has arisen in connection with the management of the Gaika Gold Mining Co., in Rhodesia. Stanley J. Edwards, a Colonial, and a substantial following that he has secured, have taken such action that three of the directors, one of them the chairman, have resigned. Mr. Edwards' allegation is that the mine could have been operated to better advantage so far as the shareholders are concerned. The directors, in a long circular, met all his points, and it looked like a fight. At the last minute resignations were handed in, and Mr. Edwards has a board of his own appointing. His intention now is to send an independent engineer to the mine to report and reorganize. The movement seems to be a reflection upon the management of engineers supplied by the Gold Fields Rhodesian Development Co.

The Russo-Asiatic Consolidated has received a message from its Moscow agent to the effect that the Soviet government desires to resume negotiations for the return of the company's properties. Further encouraging news has come to hand from the company's Villemagne concession in France, borehole No. 18 indicating at a depth of 300 ft. a width of 6 ft. of ore assaying 8 per cent lead, 10 per cent zinc, and 3 oz. silver per ton. The management is testing this property by the drill in the same way as it proved Irtysh, Kyshtim, and Tanalyk.

Apart from the gold premium, the

Cam & Motor Gold Mining Co. has not yet earned much profit. For instance, the October net profit was £4,520, including £4,500 from premium reserve; for November, the net profit was £4,502, including £4,000 from premium reserve. The crux of the position is the tonnage that can be crushed monthly. The company uses ball mills and the cost is nearly 5s. per ton milled. It did not select these mills; they were on the spot, and, being less expensive than a new gravity plant, were made use of.

There are several new mining flotations on the tapis. Two well-known engineers have reached this country from Australia. One has tin properties for sale, and the other has in his pocket copper properties in North Queensland. From a study of inland Queensland and New South Wales, the latter has come to the conclusion that some fine properties are awaiting development. The trouble at present is to raise capital.

Johannesburg Letter

Strike Over at Crown Mines—Rand Refinery Holds First Meeting

By John Watson

Johannesburg, Dec. 6—The strike of workers at the Crown Mines has been settled and the miners returned to work Dec. 5. The stamp-mills were to be restarted as soon as there was enough ore.

The first annual meeting of the Rand Refinery, Ltd., was held on Dec. 5, when H. O. Buckle, president of the Chamber of Mines, traced its history, showing that as a result of researches by Dr. Caldecott and Samuel Evans it was decided to erect and equip a gold refinery on the Rand. The union government, conjointly, has decided to reopen the Pretoria mint. The new refinery is situated near Germiston, on ground purchased from the Simmer & Jack Proprietary Mines, Ltd. The refining plant and buildings, erected under the supervision of Messrs. R. R. Kahan and R. C. Atkinson, will form one of the largest and most up-to-date refineries in the world.

MEXICO

Sonora

Cananea Consolidated Working 700 Men

Cananea — Seven hundred men are employed at the several mining properties, smelter, and mill of the Cananea Consolidated Copper Co., on which, according to E. T. Koons, chief clerk of the general office, about $1,000,000 is being spent on improvements. Mr. Koons has a force of ten men engaged in figuring transportation costs, with a view to determining the possibility of making a saving in utilizing the proposed rail route from Ajo to the Gulf of California, with connection with deep-water vessels that would reach New York via the Panama Canal.

It is reported that the Southern Pacific of Mexico will resume service into Tepic, in the state of Nayarit, Mexico, on Feb. 4 after suspension of about ten years due to revolutionary conditions.

CANADA

Ontario

McKinley-Darragh To Resume This Spring—Canadian Associated Goldfields Meeting Stormy

Cobalt—It is understood that the McKinley-Darragh will start operations in the spring, as soon as the heavy expense for heating is over. It is believed that total costs of at least 60c. an ounce can be obtained.

The Right-of-Way is proposing to open up the south end of its property, where there is supposed to be a considerable tonnage of milling ore.

Porcupine—It is understood that the Dome is making arrangements to make such changes in the company's charter as will permit repayment of capital. It is expected that a meeting of the shareholders will be called within the next two months to ratify changes necessary to permit the company to do this. The company has about $2,000,000 available. A capital repayment of $1 per share would call for $447,000.

The recent discovery of spectacular gold samples on the claims of the Lightning River company will probably result in great interest being taken in that region as soon as the snow is off the ground.

Negotiations are under way for the refinancing of the Clifton Porcupine Mines. This company has a small vein of fairly high-grade ore.

Kirkland Lake — A meeting of the shareholders of the Canadian Associated Goldfields, Ltd., was held in Toronto recently, at which the officials of the company were subjected to much criticism. Some of the shareholders claimed that there was a discrepancy of over $50,000 which was not shown among the expenditures. They also criticised the fact that the company's manager was not there and that no report was available from him. The president took the stand that there was no reason why the manager should be there, but finally agreed to present a report from him within the next three months. The company is capitalized at $30,000,000.

Underground development at the Tough-Oakes continues. Mining is being centralized at the No. 3 shaft of the Burnside, which has been sunk to the 400 level. Surface equipment is being overhauled, and it is expected that milling will be resumed this spring.

British Columbia

Smelter Smoke Damage Cases Before Arbiter at Trail—Activity in Cariboo Expected

Quesnel—Renewed activity in the Cariboo gold fields is looked for early this year. A road to the gold fields of the Whitewater district has been surveyed and will be built in from Hanceville. For the present interest is chiefly centered in Cedar Creek, where new locations have been made.

Trail—Twenty-five cases of farmers of the Trail Creek Valley who are claiming damages from the Consolidated Mining & Smelting Co. for alleged loss by smelter fumes are being heard by the arbiter, Judge Ferin. It is believed the hearing will not be concluded until near the end of the month. Over half of those who had claims reached an agreement and satisfactory settlement with the Consolidated company.

Trail—Ore shipments received at the Consolidated smelter from Jan. 8 to Jan. 14 inclusive totaled 8,703 tons, of which 8,306 came from the company's mines. The other shippers were as follows: Josie, Rossland, 91 tons; Knobhill, Republic, Wash., 106; Millie Mac, Burton, 15; Paradise, Lake Windermere, 80; Rambler (lead), Rambler, 25; Rambler (zinc), Rambler, 79, and Wind Pass, Chu Chua, 1.

Sandon — Silversmith Mines, Ltd., which has just started milling operations at its rebuilt 150-ton plant here, will be in a position to maintain regular dividend disbursements to shareholders about the middle of 1922, according to an official report of the board of directors, just issued. The mine and mill are in condition to continue steady production, and it is announced that an output of 500 tons of concentrates per month will be maintained. Ore reserves are conservatively estimated as sufficient for five years.

Nelson—Prospects of improved marketing arrangements for shippers of Slocan and Ainsworth district silver-lead ores are apparent to many Kootenay mining men as a result of action taken by United States Senator Poindexter in urging upon the United States Government the advisability of making some arrangement with the government of the Dominion of Canada whereby the ores of either country may be shipped across the line to smelters for treatment in bond, thus providing for the return and marketing of the metallic contents in the country of their origin without a duty. This is particularly the case with lead, which has to pay a duty of 1c. per lb. when returned after smelting. Such an arrangement would prove particularly beneficial to many British Columbia silver-lead operators and to such mines as the Electric Point and Gladstone Mountain, in Washington.

Vancouver—The existing regulations for the disposal of mining claims on dominion lands provide that all grants or leases are subject to the provision that all ores mined from such locations shall be treated in Canada so as to yield refined metal. An Order-in-Council has been issued by the Canadian government permitting the treatment outside Canada for a period of one year from Dec. 1, 1921, which may be extended by the Minister of the Interior to five years, of the silver-lead ores of the Mayo district of Yukon Territory. The reason assigned is that the only Canadian smelters on the Pacific Coast at which this ore could be economically treated are at Trail and Anyox, B. C., neither of which is prepared to accept the Yukon ore for treatment.

ARIZONA

United Verde To Resume Steam Shoveling Capping—Iron Cap To Start Feb. 1

By JAMES H. McCLINTOCK

Phoenix—The Jerome-Superior row at Jerome has reached a stage of criminal prosecution. In Los Angeles, under a grand jury indictment, George Mitchell, one of the best known of Southwestern mine and smelter men and former general manager of the Jerome corporation, has been arrested, also Melville Frasier, former president of the company. It is charged that, by evidence of a fraudulent diamond-drill core, showing very rich ore, they sold stock of par value of $1,300,000. It is alleged that the ore did not come from Jerome-Superior ground and that the ground had not been drilled. Assumption was involved that the cores had been secured by drilling operations in the United Verde that had extended over into the Jerome-Superior. The Mitchell management of Jerome-Superior was deposed by court order after a couple of conflicting meetings of stockholders, reviewed by judges in Los Angeles and Prescott. The holdings are among the largest in Jerome district, including 113 claims. They now are under charge of Bert Campbell. Only assessment work has been done for the last year.

Federal Judge Sawtelle at Tucson has refused permission for issuance of any more receiver's certificates and has set Feb. 16 for the sale of the property of the Consolidated Arizona Smelting Co., at Humboldt. It is understood that on the sale date the Southwest Metals Co. management expects to have available $500,000, with which to buy in the property and pay off debts.

The application of the Arizona Swansea R.R. Co. for permission to abandon its line of twenty-one miles between Bouse and Swansea again is before the Arizona Corporation Commission, with keen opposition from the Swansea mine interests. With exception of one year, the road, since its construction thirteen years ago, has never paid its expense, and it is delinquent in taxes for three years on an assessment of $7,000 a mile. Opponents of the proposed plan of discontinuing operations declare the road essential to operation of the Swansea mine, which is under bond to the Consolidated Arizona Smelting Co.

Douglas—J. S. Williams, Jr., who is manager of the Moctezuma Copper Co., states that renewal of milling operations at Nacozari hardly can be possible before July of this year, when the work of building a new concentrator and of remodeling the old plant will be completed.

Globe—A second reverberatory is in operation at the works of the International Smelting Co. at Miami, with enough Miami concentrates stored to keep the two furnaces busy till May 1, with a monthly output of 16,000,000 lb. of blister copper. Two carloads of sulphide, for flux, are being brought in daily from the Calumet & Arizona mines at Warren, this made necessary by the idleness of the Old Dominion mine in Globe. The smelter company purchased the Miami concentrates several months ago, exchanging copper bullion. About 250 men are employed.

Soon after Feb. 1, nearly a year from the date of suspension, there is to be renewal of operations at the Iron Cap. Mill operations may be delayed, awaiting receipt of roller bearings from Sweden. The concentrates are to go to the International smelter, under a contract still in force.

Globe now has an Asbestos Clearing House Association, for the benefit of small producers, who thus will be able to assemble their outputs for grading and shipment. The first asbestos claims here patented are those of the Arizona Asbestos Association, twenty-one in number, the notice just filed with county recorder.

Morenci — Captain J. P. Hodgson, general manager of the local Phelps Dodge property, announces that no early operations are planned, except reconstruction and additions to equipment. No. 6 concentrator is to be enlarged to 5,000 tons capacity, with changes expected to give a larger percentage of extraction.

Superior—At Superior a 40 per cent force is employed in the Magma, concreting the main shaft and guniting the stations, work that will take until some time in March. It is reported that the Magma management has plans for broad-gaging its rather temporary narrow gage from Magma station on the Arizona Eastern line and for installation of a reverberatory furnace near the mine.

Jerome—Steam-shovel work is to be resumed soon on the United Verde capping ores, which in the meantime are to be loosened by blasting. Original plans for clearing off the whole top of the orebody have been modified. There is to be deep channeling through to the old Glory Hole, exposing the top of the smoldering sulphide stopes section, this first work involving removal of 100,000 cu.yd. of material. The ore is to be handled through the mine and the Hopewell tunnel, as are the mine ores. In all, above the 400 level, 3,000,000 cu.yd. of ore and 4,500,000 cu.yd. of waste are to be removed. The ore will be largely oxide, some of which carries good values in gold and silver, but hardly over 1 per cent in copper. Two shifts are to be employed, with about 125 men. No intimation is given of any plans to resume production at the Clarkdale smelter.

Verde Central is believed to have demonstrated its position as a mine. Excavations for station and sump at the 600 level of the main shaft are in ore, bornite and chalchopyrite in Yavapai schist, with copper value up to 5 per cent. The stock has jumped several dollars, but little is to be had. Much of it was taken in by Calumet & Arizona interests when treasury stock was sold for development needs.

MONTANA

Butte & Superior Cuts Copper Vein on 2,600 Level—Anaconda To Open Fifth Mine Soon

By A. B. KEITH

Butte—The Butte & Superior company has cut its copper vein on the 2,600 level of the Black Rock mine. The crosscut heading is in nearly 10 ft. of ore that runs 9 per cent in copper and high in silver. The ore is 11 to 15 ft. wide on the 2,200 level. It will be necessary to drift about 200 ft. to reach a point under the 2,200 level where the copper ore is being found at its best. It is considered probable that the company will give consideration to the matter of sinking its main working shaft to the 3,000 level and crosscutting the copper vein again at this depth, in addition to the development of the Rainbow fissure, which is the company's big zinc-silver producer.

Anaconda has resumed mining operations at the Leonard, Mountain View, Badger State, and Steward mines and as soon as heavier rails can be laid at the Mountain Consolidated operations will be started there. A change from mule to electrical power is being made at the last-named property, and it will be necessary to lay about seven miles of track. The decision to reopen the Mountain Consolidated indicates that the Anaconda has enlarged upon its original plans to resume the production of copper at four mines. Ore is now going to the Washoe smelter at Anaconda. Increased activity is noticeable at the Great Falls plant of the company, particularly in speeding up the output of zinc. The electrolytic plant had been producing about 2,000,000 lb. of zinc monthly, but under the Anaconda's contract with the Butte & Superior this will be increased immediately to 4,000,000 lb. monthly and will be further increased to 7,000,000 lb. as soon as milling operations of the Butte & Superior are resumed. Repair work is being pushed at the Black Rock concentrator of the latter company. Shipments of concentrates are being made from the company's stockpile. The upper levels of the Black Rock mine are also being cleaned up preparatory to resuming the mining of zinc ore when the concentrator is ready.

The Davis-Daly Copper Co. is changing its surface haulage system from gasoline to electricity, which will be more economical. The company will probably ship its ores to Anaconda's Washoe plant as soon as the latter is ready to take custom ores.

Libby—The Lukens-Hazel mine, near Libby, has resumed production, the new concentrator, which was completed only a year and a half ago, only to remain inactive, having started on Jan. 1.

More than 51 per cent of the stock of the American Brass Co. has been deposited by the stockholders under the agreement between the Anaconda Copper Mining Co. and the committee.

MICHIGAN

Marquette Range

Cleveland-Cliffs Will Not Enter Merger—Pumping of North Lake Delayed—Ford's Mine Producing—Furnaces Preparing To Resume

By W. H. Newett

Ishpeming—Officers of the Cleveland Cliffs Iron Co. deny that they are considering entering any of the steel mergers that are being discussed in the newspapers. The management takes great pride in operating its various properties in the Lake Superior region and does not care to do anything to lose its identity.

The Imperial mine, now owned and operated by the Ford motor interests, has stopped all surface construction work until spring, when weather conditions will be more favorable, and is now confining its efforts to mining, the ore being stocked at the mouth of the shaft. The Ford scale of $6 a day is paid to all employees, whether engaged on surface or underground.

The unwatering of North Lake by the Cleveland-Cliffs Iron Co. was hampered recently by the giving way of the ice on which an electric pumping plant was being operated, which let the pump go to the lake bottom, 30 ft. below the surface of the water. The pump is now being recovered.

The installation of the new pumping plant is under way at the Lake Superior mine of the Oliver Iron Mining Co., at Ishpeming.

The Pioneer blast furnace, at Marquette, is undergoing repairs preparatory to blowing in. Several hundred men have also recently been engaged for the wood-cutting forces to supply the kilns with wood for charcoal.

Menominee Range

Iron Montain—The West Chapin Mining Co. held its annual meeting on Jan. 9, selecting officers and directors for the present year. Construction work on the new stack is delayed for lack of materials. Foundations for the stack and stove are ready, and the hoisting machinery and castings are on the ground.

In the Crystal Falls district mines, surface wages are now based on a scale of 21c. an hour for a ten-hour day. Wages underground have been fixed at $3 a day of eight hours where men are working in wet places, and at $2.88 a day where work is conducted in dry places.

Gogebic Range

Mikado Mine Shut Down—Fire in East Norrie Mine

Ironwood—The shaft at the Mikado mine has been closed for an indefinite period, and the small force of men employed there are removing pumps, pipes and rails. At present all stripping and mining operations have ceased in the Wakefield district and many men are idle.

A fire occurred recently on the 18th level of "D" shaft of the East Norrie mine. It was near the transfer shaft and threatened to spread through the Norrie mine, but was got under control twelve hours after being discovered. It started in an old drift used for storing pipe, where some men had been working. Bursting of air lines when filled with water caused a long delay in getting water on the fire. Oxygen breathing apparatus was used in the work.

MINNESOTA

Only Seventeen Seek Prospecting Permits

St. Paul—On the opening of applications for permits for prospecting on mining properties in the State of Minnesota, it was found that there were only seventeen applications. The small number can be attributed to the general depression in the iron and steel business at present and to the unfavorable taxation laws. The stipulations as to the granting of the permits called for payment of $50 for the permit and a minimum royalty of $1,250 for the first year and $5,000 a year thereafter.

Mesabi Range

Lincoln Mine Being Reopened—Butler Bros. Increase Force

Virginia—The Lincoln mine, a property of the Inter-State Iron Co., is being reopened and placed on an operating basis as rapidly as circumstances will permit. The mine was flooded about a year ago. This is the second property to reopen in this vicinity in the last month.

Nashwauk—The stripping work at the Butler Bros. Co.'s Patrick and North Harrison mines, has been increased by the addition of a night shift. This work has employed an additional 200 men. Practically all the old employees of the company are back at work.

Cuyuna Range

Hillcrest Mine Sinking New Drainage Shaft—Croft Mine Resumes

Ironton—At the Hillcrest mine (Coates & Tweed) work has been started on the sinking of a new drainage shaft for the open pit. The shaft, which will be 8 x 6 ft. inside, is at the foot of the approach, and will be carried to a depth of 160 ft.

The Croft mine (John A. Savage & Co.) resumed underground mining on Jan. 1 after a ten months' shut down. Production will be on a moderate scale for the present, with only a small crew, and much of the work will be confined to development tributary to the new 333 level. The operators state that they have resumed earlier than anticipated, in an effort to assist in relieving the present unemployment situation.

Riverton—A one-mile railroad spur has been completed to connect the new drying plant of the Sagamore mine with the main line, and trestles are being constructed for a lean-ore dump and a new stripping dump in the area northwest of the open pit.

ALABAMA

Iron-Ore Output in 1921 About Half That of Preceding Year — Great Southern Steel Co. May Build New Plant

By George Huntington Clark

Birmingham—The close of 1921 found thirteen furnaces in blast in Alabama; seven on merchant iron, four on basic, and two on charcoal iron; eight of the thirteen having been blown in between July and the year's end. The recovery over the low point was 75 per cent. The July output was the lowest noted for many years. The output for December, 114,296 tons, was the third largest month's production, being exceeded only by February, with 121,122 tons, and January, with 141,426 tons, the total output for 1921 being 1,195,576 tons. Alabama's pig-iron production in 1912 was 1,862,000; 1913, 2,025,000; 1914, 1,826,000; 1915, 2,049,000; 1916, 2,702,000; 1917, 2,953,000; 1918, 2,587,000; 1919, 2,130,000; and 1920, 2,392,000.

The iron makers enter the 1922 iron market on a base of $16.50, f.o.b. Birmingham district furnaces, a drop of $21.50, or 57 per cent, from the ruling price per ton Jan. 1, 1921.

The decrease in production of iron ore necessarily kept pace with iron making, being in 1921 2,875,000 tons, valued at $6,095,000, as against 5,833,317 tons shipped in 1920 and valued at $15,993,987; representing a decrease in the average value of the ore mined from $2.88 to $2.15 per ton. Of this 1921 production, 78 per cent was red hematite, 21 per cent brown, and 1 per cent magnetic iron ore.

Coal production declined to a low point, reaching its minimum output at 131,354, as against a normal weekly average of 305,000 tons.

It is said that the Great Southern Steel Co. recently announced as the new owners of about 100,000 acres of mineral lands mainly situated in Etowah County, is preparing to build a $500,000 steel-product plant somewhere in Alabama as the initial step toward development of these lands.

SOUTH DAKOTA

Cutting Workings Unwatered

Deadwood—The unwatering of the Cutting workings has been completed and the driving of laterals on the 350 level started. A new pump has been installed and the 500 level is being put in condition for active development.

Galena—Work at the New Silver Queen property is being continued. Shipments of lead-silver ore were made late in the last year. A compressor plant was installed during the year, and production will be increased.

UTAH

Park City Wage Reductions Deferred

Park City—The Silver King Coalition has announced that it will continue the old wage scale, thereby compelling the other operators to defer making the proposed cut. Bingham and Tintic districts have cut wages 50 cents.

THE MARKET REPORT

Daily Prices of Metals

Jan.	Copper, N. Y., net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
19	13.50	31.75	32.375	4.70	4.40	4.70
20	13.50	31.50	32.125	4.70	4.40	4.65@4.70
21	13.50	31.50	32.00	4.70	4.40	4.65
23	13.50	30.75	31.375	4.70	4.375@4.40	4.65
24	13.375@13.50	30.75	31.375	4.70	4.375@4.40	4.60@4.625
25	13.375@13.50	30.25	30.875	4.70	4.375	4.60

*These prices correspond to the following quotations for copper delivered: Jan. 19 to 23 inc. 13.75c.; Jan. 24 and 25, 13.625@13.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Jan.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
19	65¼	66⅛	72	163¾	165½	23⅛	23⅛	26¼	26⅝
20	65	65¾	72	162⅝	164¼	23¼	23⅛	26⅛	26½
21	...	...	..	....	...	...	..	...	...
23	65	65¾	71	158¾	160¼	23	22⅞	26	26⅜
24	64⅞	65⅝	71¼	158½	160	23⅛	23	25⅞	26¼
25	65	65¾	71¼	156	157¾	23⅛	23	25½	25⅞

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Jan.	Sterling Exchange "Checks"	Silver			Jan.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
19	421⅞	99⅝	65⅜	34⅞	23	420	99⅝	64⅞	34¾
20	420⅜	99⅝	65	34⅞	24	421½	99⅝	65½	35
21	420¼	99⅝	64¾	34¾	25	422	99⅝	65⅜	35

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Metal Markets

New York, Jan. 25, 1922

The local metal markets remain in a state of stagnation, and no improvement can be perceived in the immediate future. The improvement in general business conditions is coming very slowly, and it is likely to be two or three years before prosperity becomes at all general. European affairs remain in a pitiful condition. It is not probable that the metals will experience marked price recessions in the next few months, but it would seem that the gradual improvement which took place during the closing months of 1921 is at an end for the time being, although some improvement in demand is likely, for present sales do not equal consumption.

Copper

Most of the large producers continue to quote prices above the market, up to 14c. delivered, but they are doing practically no business. Those willing to sell at 13.75c. have had no little trouble in getting orders, even for delivery as late as the second quarter, and in some transactions they have been obliged to shade that price. Odd lots of spot copper could have been obtained all week at an equivalent of 13.375c. refinery. The copper market is definitely weaker, and the metal can be obtained at the prices which we quote, for delivery as far ahead as the third quarter. In the closing months of 1921 many consumers bought beyond their immediate requirements on the rising market, and so do not find it necessary to buy more at present. The announced reopening of some of the copper mines, and the expected early resumption of others, have also caused consumers to wait, in the hope that depressed prices will result.

Export business has also been quiet. The Copper Export Association is still keeping around the 14@14.125c. level for European ports, but others are cutting these prices considerably, without attracting much business however.

Lead

The American Smelting & Refining Co.'s official contract price remains at 4.70c. Practically all producers have had an unusually quiet week, though occasional sales have been made. Business in St. Louis was so quiet that over the week-end the price again broke to 4.375c., after going to 4.40c. last Thursday, and by today that price could have been done in at least three directions. Corroding grades continue scarce, however, and several orders were placed during the week at the equivalent of 4.55c. St. Louis.

The London price has declined recently, owing to increased shipments from Australia and probably to the danger from imports of United States lead. A good business can still be done in Mexican lead abroad, but should the London price decline £2 further, Mexican lead might again be sold in this country, provided the duty on it had not been raised by that time.

Zinc

The market continued its decline, but sales have been smaller than for several weeks. Small transactions are setting the market. As is usually the rule in a declining market, consumers are holding off. Galvanizing business has fallen off in the Pittsburgh district, which also accounts for the drop in prices. A few weeks ago there was a prospect of shipping zinc abroad, but that probability has vanished with the decrease in the London zinc market. Although earlier in the week metal was sold for 4.70c., the price today has dropped to 4.60c., and offerings have been made below that level. Some inquiries have been made for forward zinc. High-grade metal continues to be sold for 6c., with freight allowed, with business more active than in the common grades.

New York quotations are 35 points above the St. Louis level, this corresponding to the freight rate.

Tin

The tin market has been further depressed owing to selling pressure in the Far East, and sales are small. Spot metal continues at an appreciable premium owing to the disinclination of manufacturing interests to buy forward supplies.

Tin for future (April) delivery was quoted as follows: Jan. 19th, 31.875@32c.; 20th, 31.25@31.50c.; 21st, 31c.;

23d, 30.75@31c.; 24th, 30.75@31c.; 25th, 30.25@30.50c.

Arrivals of tin, in long tons: Jan. 20th, London, 150; Straits, 375; 23d, Straits, 10; 24th, Australia, 110.

Gold

Gold in London, Jan. 19th, 98s.; 20th, 97s. 6d.; 23d, 97s. 9d.; 24th, 97s. 7d.; 25th, 97s. 6d.

General stock of money in the United States, Jan. 1, 1922: Gold coin and bullion, $3,656,988,551; standard silver dollars, $357,581,851; subsidiary silver, $272,552,485; United States notes, $346,681,016; Federal Reserve notes, $2,781,791,260; Federal Reserve Bank notes, $116,670,400; National Bank notes, $750,167,924; total, $8,282,433,487. Circulation per capita, $53.03. Stocks of gold have increased $112,000,000 in the last month; of silver dollars, $[illegible],000,000; and of notes, $82,000,000.

Foreign Exchange

The foreign exchange market for the week was colorless, with narrow price changes. On Tuesday, Jan. 24th, francs were 8.1325c.; lire, 4.3725c.; and marks, 0.4725c. New York funds in Montreal declined again to 5 13/16 per cent premium.

Silver

China has continued to sell in the London market, and any purchases made in New York or San Francisco for China account have been at a price below the London parity. This year the Chinese New Year holidays extend from Jan. 28 to Feb. 1, and China's lack of interest in silver at this time is therefore normal, but as the silver market is fundamentally based on China demand, the present dullness is likely to continue for a time at least.

Mexican Dollars—Jan. 19th, 49¾; 20th, 49¾; 21st, 49¾; 23d, 49¾; 24th, 49¾; 25th, 49¾.

Other Metals

Quotations cover wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony—Chinese and Japanese brands, 4.45c.; W. C. C. brand, 5.25@5.75c. per lb. Cookson's "C" grade, spot, 9c. per lb. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—7½c. per lb.

Bismuth—The London price increased on Jan. 17 from 7s. 6d. to 9s., which has occasioned an advance in the New York market to $1.85@$1.95 per lb.

Cadmium—$1@$1.10 per lb. in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Nickel—Standard market, ingot and shot, 41c.; electrolytic, 44c. Small tonnages of spot metal have been offered as low as [illegible]. Practically no [illegible]

Platinum—$105 per oz.

Palladium—$60@$65 per oz.

Iridium—$170@$200 per oz.

Quicksilver—$48@$50 per 75-lb. flask. San Francisco wires $46.70.

The prices of the following metals remain unchanged from the figures published in these columns on Jan. 7: Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten.

Metallic Ores

The market is generally exceedingly quiet, and prices on the following ores remain unchanged from the figures published in the Market Report in the Jan. 7 issue: Chrome, Iron, Magnetite, Manganese, Molybdenum, Tantalum, Titanium, Tungsten, Uranium, Vanadium, Zircon, and Zirkite ores.

Zinc and Lead Ore Markets

Joplin, Mo., Jan. 22—Zinc blende, per ton, high, $30; Basis 60 per cent zinc, premium, $27; Prime Western, $26; fines and slimes, $24@$23; average settling price, all grades of blende, $28.81.

Lead, high, $64.45; basis 80 per cent lead, $60; average settling price, all grades of blende, $61 per ton.

Shipments for the week: Blende, 6,775; lead, 1,746 tons. Value, all ores the week, $303,500.

Last week sellers would let but 5,600 tons go on the market at $27 basis, but this week over 10,000 tons was released on $26 basis. Production is generally estimated at 7,000 tons per week. For the three weeks of the year purchases have exceeded production. This, in addition to lowering the reserve stock about 30,000 tons at the close of last year, puts the ore situation in an enviable position with regard to the metal market.

Platteville, Wis., Jan. 21 — Blende, basis 60 per cent zinc, $30. Lead ore, basis 80 per cent lead, $60 per ton. Shipments for the week: Blende, 455; lead, 50 tons. Shipments for the year: Blende, 1,201; lead, 50 tons. Shipped during the week to separating plants, 775 tons blende.

Non-Metallic Minerals

Generally dull markets exist for the non-metallic minerals, and there is no quotable change in the following from the prices published in our Jan. 7 issue: Asbestos, Barytes, Bauxite, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Kaolin, Limestone, Magnesite, Mica, Monazite, Phosphate Rock, Pumice Stone, Pyrites, Silica, Sulphur and Talc.

Mineral Products

Sodium Sulphate — For 95 per cent material, $12.50 per ton, f.o.b. in bulk, Western mines, spot and six months' contract; $18@$21 per ton, New York.

Prices of Copper Sulphate, Potassium Sulphate and Sodium Nitrate are unchanged from the quotations published Jan. 7.

Ferro-Alloys

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 11¾c. per lb. of chromium contained; 4 to 6 per cent carbon, 12c., f.o.b. works.

No quotable changes have taken place in the following ferro-alloys from the prices quoted in the Jan. 7 issue: Ferrotitanium, Ferrocerium, Ferromanganese, Ferromolybdenum, Ferrosilicon, Ferrotungsten, Ferro-Uranium and Ferrovanadium.

Metal Products

Nickel Silver—27.75c. per lb. for 18 per cent nickel, grade "A" sheets.

Zinc Sheets—$8 per 100 lb., less 8 per cent on carload lots, f.o.b. works.

Prices of Copper Sheets, Lead Sheets and Yellow Metal, are unchanged from the quotations published on Jan. 7.

Refractories

Chrome Brick—$41@$44 per net ton.

Silica Brick—9-in., per 1,000, $30@$40 in carload lots, f.o.b. shipping points.

Prices on the following are unchanged from the figures published in the Jan. 7 issue: Bauxite Brick, Chrome Cement, Firebrick and Magnesite Brick.

The Iron Trade

Pittsburgh, Jan. 24, 1922.

Demand for steel products has not increased materially from the rate shown in the latter part of December. As the mills had little forward business, all the buying for a long time past having been for relatively prompt shipment, operating rates reflect the light rate of buying. Production of steel ingots thus far this year has probably been at an average rate of about 18,000,000 gross tons a year, this comparing with an average of 20,000,000 tons in December and 23,000,000 tons in October and November. The higher rate was expected to be regained early in the new year, but scarcely any progress toward that mark has been made.

In most of the finished-steel lines competition between the mills has become much keener in the last week or two. Regular prices, for small lots, are not materially changed, but concessions are now given on much smaller orders than formerly, so that the average selling price is lower. Sheets, however, are absolutely firm, there being no concessions. In tin plate, concessions for large lots are no more common than before the war. Improvement in steel demand is to be expected as spring approaches, but nothing like a fair demand for steel, in proportion to productive capacity, before next fall.

Pig Iron—The market continues inactive, with prices quotable as formerly: Bessemer, $19.50; basic, $18.25; foundry, $19.50, f.o.b. Valley furnaces, freight to Pittsburgh being $1.96.

Coke

Connellsville — Furnace, $2.75@$3; foundry, $3.75@$4.50.

Five Dividend-Paying Gold Mines

By Edward H. Robie

[illegible] *Engineering and Mining Journal*

INVESTORS in the securities of gold-mining companies have one less variable to consider than those who put their money in other mining industries. The price of the product is fixed; at least it is so in the United States and approximately so in Canada, the only two countries here to be considered. Profits will depend upon the amount and grade of ore mined and treated, and the cost of doing the work. The gold produced will, as long as our present financial system endures, be worth $20.67 per oz. in this country, and slightly more in Canada, depending upon the depreciation of the Canadian paper dollar (at present about 5 per cent, but likely gradually to revert to par). Therefore increasing prosperity of gold-mining companies as a class is sure to result with a reduction in the cost of labor and supplies. That such a reduction was sure to come in the period following the war has been universally admitted, so that the securities of gold-mining companies of proved worth have been and are now considered in the front rank of mining investments and speculations.

Five companies will be considered here: Hollinger, McIntyre, Dome, Homestake, and United Eastern. These have been selected because they are the only strictly gold-mining companies of any size which paid dividends during 1920 and 1921 and continue on a dividend basis at the present time. The first three are Canadian companies operating in the Porcupine district of Ontario. Homestake is in South Dakota, and the United Eastern in Arizona. Data as to the operation and character of each of these companies will be mentioned briefly. More information can be obtained from the annual reports of each company, for all except the Homestake issue exceedingly informative and valuable statements.

Hollinger Consolidated Gold Mines, Ltd.—The officers and directors are all residents of Canada, and the principal market for the shares is on the Standard Stock and Mining Exchange of Toronto. The authorized capital is $25,000,000 in 5,000,000 shares of $5 each, 4,920,000 of which are outstanding. The first dividend was paid in November, 1912. The dividend record follows:

1912..............	$270,000	1917	$738,000
1913..............	1,170,000	1918	1,230,000
1914..............	1,170,000	1919	1,722,000
1915..............	1,560,000	1920	2,214,000
1916..............	2,160,000	1921	3,198,000

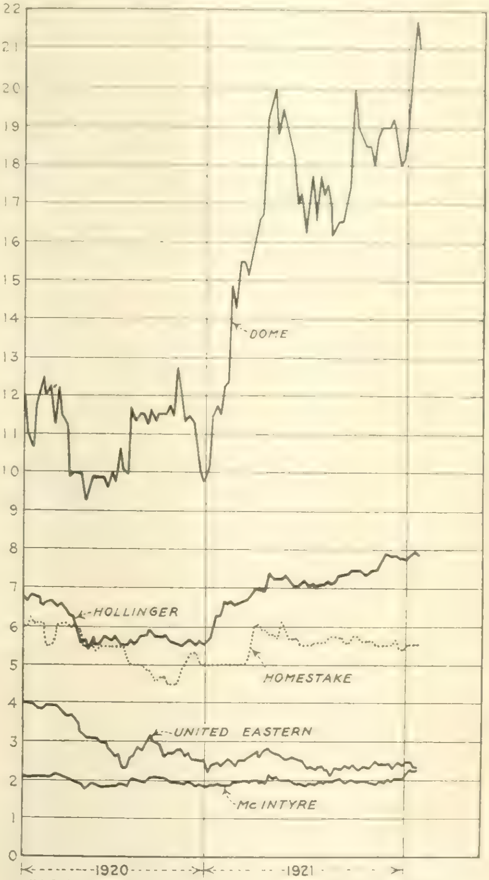
Total to date, $16,558,000

The tonnage treated in 1920 was 650,205, averaging $9.93 per ton, of which about 96.2 per cent was recovered. The operating cost, including general, mining, and milling charges, was $4.83 per ton. The operating profit was $4,018,282, of which taxes and depreciation (but with no allowance for mineral exhaustion) took $1,343,007, leaving a net profit of $2,675,275 available for dividends. The net profit per ton treated was $4.10. Total developed ore reserves on Dec. 31, 1920, were 3,294,000 tons at $11 per ton, or $35,596,000. At the present rate of production this is but little more than two years' supply. However, there is little doubt that vast quantities of ore have not yet been developed. The mine seems of undiminished richness at depth.

In the last year or two Hollinger has been hampered by lack of labor and power. Plenty of men are now available, as well as power for the present mill. If arrangements can be made for more, the mill capacity may be extended to a maximum of 7,000 tons per day. It has already been raised to 4,000. Some criticism has been voiced that, in the effort to mine a large tonnage, ore running under $5 per ton is being passed by which will not again be available, and that this is not conducive to conservation of the mine's resources.

There is little doubt that Hollinger is destined within the next year or two to be the world's leading gold mine in point of current production. Its past cannot of course compare with that of Homestake and some others. Its future prospects appear brilliant. It is, without doubt, the best property in an excellent district.

The fluctuations of the stock appear reasonable and do not indicate manipulation. A regular dividend of 5c. is paid every four weeks, so that, at present prices of close to $8 per share, the stock yields about 8.2 per cent.



FLUCTUATIONS IN FIVE GOLD-MINING STOCKS
Based on Weekly Closing Quotations, Jan. 31, 1920, to Jan. 21, 1922
The price of Homestake is divided by ten.

McIntyre Porcupine Mines, Ltd.—Like the Hollinger, the McIntyre is a Canadian company, only one of the five directors living in the United States. The principal market for the shares has always been on the Standard Exchange in Toronto, but they have recently been listed on the New York Stock Exchange. The authorized capital is $4,000,000 in shares of $1 each, $3,640,283 of which is issued. Dividends date from February, 1917, and are as follows:

1917..	$541,542	1920	$546,042
1918..	543,042	1921	546,042
1919	364,028		
		Total .	$2,540,696

The tonnage treated in the fiscal year ended June 30, 1921, was 171,916, averaging $11.67 per ton, of which about 95 per cent was recovered, the bullion containing 91,750 oz. of gold and 19,806 oz. of silver. The operating cost (excluding development, as was done in the Hollinger summary) was $5.16 per ton. Including development the cost was [illegible]. The operating profit, after providing for development, was $815,563. Of this amount, $272,984 went for taxes and plant depreciation, but $272,951 was received in interest and exchange, largely on investments in coal companies, so the net profit for the year, available for dividends, was $815,530. The net profit per ton treated was $4.75. Total estimated ore reserves are 624,422 tons at $10.25 per ton, or $6,392,000. This is a little over three years' supply for the present mill, which is now handling about 550 tons per day.

Some difficulty has resulted from the presence of carbonaceous ore in certain parts of the mine, but this has been solved in the laboratory and a separate 250-ton unit will be completed in the spring to handle this ore. This will bring the total mill tonnage to about 800 tons per day. Power shortage has hindered operations as with Hollinger, but troubles from this source are unlikely in the future. The extremely dry spring of 1921 was held accountable.

The McIntyre properties adjoin those of the Hollinger, but the ore found is at much deeper levels, and is therefore more problematical. Development, however, is reported extremely favorable at depth, and a long life is expected. These companies are alike in many respects, and are excellent representatives of sound mining enterprises as contrasted with wildcats. Shares in the McIntyre have held closely to the $2 level for the last two years, but have recently advanced slightly on the news of increased mill capacity soon to come into being, and owing to the fact that the shares were to be quoted on the New York Stock Exchange. McIntyre has been paying 5c. every four months recently, so that at present market prices the yield is about 6.7 per cent.

The Dome Mines Co., Ltd.—Dome is an American company formerly connected with the International Nickel interests and under the control of the late J. R. De Lamar. Since the death of Captain De Lamar, J. S. Bache, a New York financier, has been president. Shares have for some years been quoted on the New York Stock Exchange, where most of the transactions are made. The authorized capital is $5,000,000 in 500,000 shares of $10 each, 470,611 of which are issued, and 6,056 more are allotted. The dividend record follows:

1915	$400,000	1919	None
1916	800,000	1920	$419,167
1917	300,000	1921	476,667
1918	....		
		Total	$2,395,834

The tonnage treated in the fiscal year ended March 31, 1921, was 273,700, averaging $7.51 per ton, of which 94.7 per cent, or $7.11, was recovered. The operating cost was $3.56 per ton, not including development. Including development, it was $4.55. The operating profit was $706,894, of which depreciation of plant, and taxes, took $283,251. An allowance of $368,519 was also made for mineral depletion, a factor not provided for by the Hollinger and McIntyre companies. Non-operating revenue amounted to $247,356. The net profit available for dividends was therefore $302,480, or $1.10 per ton treated, although if no allowance had been made for mineral depletion, the profit would have been $2.46 per ton. Ore reserves are not estimated, for the reason that the deposits are extremely erratic, being in the form of large irregular masses entirely without walls and not at all uniform in the distribution of gold. Recent developments at depth are said to indicate somewhat richer ore than has so far been found. In December, 1921, recovery from ore mined was said to be about $8 per ton, which, with operating costs of $4.30, showed a profit of $3.70 per ton.

The costs at the Dome in the spring of 1921 were greatly increased because the power had to be generated from high-priced coal.

About 1,000 tons per day is now being treated, and no arrangements have yet been announced for increasing this figure. It will be noticed that dividends were allowed to lapse during 1918 and 1919; at that time the mill was closed down owing to labor scarcity and high costs.

The Dome mine lies in a different part of the Porcupine district from the first two mines mentioned, and does not have the well-developed vein system of the others. This feature makes the mine more uncertain, although there is apparently yet no sign of failure of ore supply in the large area on which operations are conducted.

The shares of the company have always exhibited wide fluctuations and have evidently received a large amount of attention from speculative interests. This fact, combined with the more uncertain conditions underground, does not make the stock so attractive an investment as Hollinger or McIntyre, though the mine has great possibilities.

Quarterly dividends of 25c. are paid, and a capital distribution of $1 has recently been made in addition to the regular dividends. Including this, the yield, based on the present selling price of $22, is about 9.1 per cent. It is understood that the capital return of $1 is to be made an annual event.

Homestake Mining Co.—Most of the officers and directors of this company are Western men. The stock is quoted on the New York Stock Exchange, but is rarely traded in. The authorized capital of $25,116,000 consists of 251,160 shares of $100 par value each. The dividend record is a long and honorable one, dating from January, 1879, monthly payments being made. They were suspended from May, 1907, to January, 1908, owing to a bad fire, and from December, 1909, to March, 1910, owing to labor troubles. To date they total $41,417,704, a remarkable showing.

The tonnage treated in 1920 was 1,274,944, from which was realized an average of $3.46 a ton. Costs for that year are virtually meaningless, for the reason that owing to a flooded mine and labor scarcity operations were suspended or curtailed for a considerable time. The fire which began in September, 1919, and which necessitated flooding the mine, cost the company $1,000,000. Recently the mill has been treating about 4,000 tons per day, but this amount will be increased soon as a result of added equipment. Costs are understood to be about $2.60 per ton. No estimates of ore reserves are made by the management, but the mine is considered still to be far from exhausted.

Possibly in no mining company is more of an effort made to divorce operations at the property from the stock market. No information is given out which would tend to influence the price of shares, and intending investors must depend on the long dividend record of the company and its excellent management. W. H. Weed, in the 1920 edition of "The Mines Handbook," says: "The Homestake is the greatest gold mine in the world, judging by its past performance, present condition, and possibilities. Management says little but produces the gold and dividends."

At present, dividends of 25c. monthly are paid, which yield about 5.5 per cent at present prices (about $55 per share). The somewhat irregular stock price curve is accounted for by the infrequency of sales.

United Eastern Mining Co.—This company operates in the Oatman district of Arizona. It is capitalized at $1,500,000, of which there are 1,360,000 shares of $1 each outstanding. It is marketed chiefly on the New York Curb Exchange. The dividend record follows:

1917	$408,900	1920	$981,360
1918	845,060	1921	817,800
1919	899,580		
		Total	$3,952,700

Costs at the United Eastern are not of great interest to the investor, because the Tom Reed Extension Mine, which has so far supplied the ore, is expected to be exhausted in about one more year. The company will gradually develop an adjoining mine, the Big Jim, but it is yet too early to say how long a life this property will have. Shares are evidently considered a speculation, for the price has declined to $2.25, thus yielding between 26 and 27 per cent on the investment at the current rate of dividend of 15c. per quarter. The United Eastern has been a good property and may be a profitable enterprise for a few years yet, but is not likely to develop into anything to be compared with the other four mines discussed.

COMPANY REPORTS

The Cape Copper Co.

A report of operations of the Cape Copper Co. for the year ending April 30, 1921, in South Africa, and August 31, 1921, in London and India states that a deficit for the year of £184,534 17s. 10d. was incurred.

Profit and loss account follows:

Dr.	£	s	d	£	s	d
Costs at Rakha Hills Mines	85,977	12	[illegible]			
Costs in South Africa, including depreciation..	13,248	13				
Costs in Newfoundland	179	1	7			
Transport and shipping including depreciation	6,199	8	4			
				105,604	6	3
Losses on realizations and revaluations of stocks of copper.				70,382	12	4
Management in London .				2,835	13	2
Bank Commission and Exchange				888	12	2
Interest and Discount. .				22,243	16	9
Interest on Debentures paid and accrued				6,213	5	11
Miscellaneous .. .				1,079	15	10
Depreciation (India)				5,632	15	3
				£224,146	5	8
Cr.				£	s	d
Copper ores and metal .				38,416	19	5
Rent and stores account				1,194	8	5
Balance carried down...				184,534	17	10
				£224,146	5	8
Dr.						
Balance brought down				184,534	17	10
Balance from Profit and Loss Account 1919-20				189,670	19	1
Taxes outside the United Kingdom ..				370	8	2
				£374,576	5	1
Cr.						
Income Tax Refund				600	15	2
Balance .				373,975	9	11
				£374,576	5	1

Deficit shown in accounts is attributable to serious losses on realizations and revaluations of copper stocks, to heavy charges for interest, to maintenance expenses connected with the company's establishments in South Africa and Briton Ferry, and to the unfavorable conditions which have prevailed in India, resulting in a loss in the working of the Rakha Hills Mines.

The additional plant for which provision was made in the debenture issue in November, 1920, has been erected at Rakha, but the company's operations there have been severely affected by numerous difficulties, chiefly those connected with transport, supplies of coal, coke and fluxes for the smelter, labor trouble and breakdowns of plant. The company being at present entirely dependent on the Rakha Mines for revenue, the effect of the disturbed state of India on its affairs is very serious.

Mining operations in South Africa have remained suspended during the year. The O'okiep Mine was kept unwatered until March last, when an exceptionally severe thunderstorm occurred, resulting in the flooding of the lower workings of the mine.

The estimated reserves at the Nababeep Mine remain at the same total as at the close of the previous year, viz., 90,000 tons of 5 per cent copper, wet assay.

In India from the No. 1 shaft of the Rakha Hills Mines 19,941 tons of ore assaying 4.07 per cent copper were sent to the treatment plant.

The ore reserves at the Nos. 1 and 4 shaft workings, including ore broken at surface, but without any deduction for ore in shaft pillars, are estimated at 329,151 short tons of an average assay value of 3.60 per cent copper, compared with 354,688 short tons of 3.66 per cent ore at the close of the previous year, both estimates being over an average lode width of 42 inches.

Of the reserves 297,575 tons of 3.74 per cent is developed ore, and 31,576 tons of 2.34 per cent is probable ore.

Capitalization: 400,000 shares £2 each, of which 360,000 are issued; 75,000, 6 per cent cumulative preference shares of £2 each, of which 45,000 have been issued; 1,200 first mortgage 8 per cent debentures of £100 each.

Superior & Boston Copper Co.

A report of operations of the Superior & Boston Copper Co. for the year ending Sept. 30, 1921, states that 5,835 ft. of development work, and, in addition, 1,036 ft. of diamond drilling was done. This compares with 8,397 ft. of development work the previous year. The decrease is due to the curtailment in operations, which, instituted in November, has become more and more drastic from time to time, as conditions dictated, until at the present time operations underground in the McGaw shaft have been suspended, except for pumping and a nominal amount of repair work, necessary to keep the workings open.

The copper smelters of the Southwest closed in April, stopping for the time the production of copper ore. Until then, there had been shipped since the beginning of the fiscal year, 11,107 (dry) tons of ore, assaying 4.37 per cent copper, 5.88 oz. silver, containing 970,653 lb. of copper and 65,352 oz. of silver, for which was received $95,022.74, after deducting freight and smelting charges.

RECEIPTS AND DISBURSEMENTS FOR YEAR ENDED SEPT. 30, 1921

Receipts		
Ore sales....................................	$103,501.06	
Ore in transit................................	6,231.68	
Royalties .	123.61	
		$109,856.35
Profit and Loss		
Interest on deposits	$3,659.32	
Interest on calls of capital stock	1,268.77	
Interest on employees insurance fund	230.69	
		5,158.78
		$115,015.13
Account calls No. 9 collected		15,557.00
Account calls No. 10 collected		113,449.50
		$244,021.63
Disbursements		
General development..........................		$244,830.74
General expense.		21,960.50
General equipment...........................		2,563.40
Mining patents ..		1,883.50
Mining claims .		6,250.00
Call No. 10 on account treasury stock (included in receipts above)..:.....................		2,598.50
		$280,086.64

Capital stock listed is 297,827 shares at $9 each.

Portland Gold Mining Co.

A report of operations of the Portland Gold Mining Co. for the year 1920 shows a loss of $442,094.72, exclusive of a dividend of $195,000 paid during the year, as the following profit-and-loss account shows:

Gross value of ore mined and shipped. .	$887,533.04
Values recovered by mills (a)................................	663,107.62
	$1,550,640.66
Net cost of mining and milling................................	1,474,100.35
Net profit from operation of mines and mills ..	$76,540.31

(a) Includes 14,794 tons Portland shipping ore and 2,496 tons custom ore.

DETAILED STATEMENT OF PROFIT AND LOSS FOR THE YEAR 1920

Net profit from operation...........			$76,540.31
Interest on bank balances.			1,354.09
Interest on corporation bonds owned			300.00
Interest on bills receivable... ..			2,380.00
Interest on open accounts.			1,493.38
Interest on Liberty Bonds....		....	942.04
Discount.............. . .		....	998.46
Registration fees....			25.10
Interest on notes payable....		$187.50	
Discount on Liberty Bonds sold ..		1,629.33	
Depreciation:			
Permanent equipment............	$27,648.64		
Independence mill...............	92,390.73		
Furniture and fixtures	333.78		
		120,373.15	
Depletion....................................		199,059.10	
Loss on sale of Colorado Springs mill		119,362.86	
Loss on sale of Victor mill		85,516.16	
Net loss to surplus .. .			442,094.72
		$526,128.10	$526,128.10
SURPLUS			
Balance, Jan. 1, 1920			$819,531.97
Net loss for 1920....		$442,094.72	
Dividends		195,000.00	637,094.72
Balance, Jan. 1, 1921			$182,437.25

MINING STOCKS

Weeks Ended January 14 and 21, 1922

Stock	Jan. 14 High	Jan. 14 Low	Jan. 14 Last	Jan. 21 High	Jan. 21 Low	Jan. 21 Last	Last Div.	
COPPER								
[illegible]	[illegible]	[illegible]	[illegible]	64	[illegible]	[illegible]	[illegible] '20, Q	$0 [illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	24	[illegible]	[illegible] '19	1 00
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] '20, Q	1 00
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] '18, Q	50
[illegible]	27	[illegible]	26	29	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	14	[illegible]	[illegible]	[illegible] '19, Q	25
[illegible]	[illegible]	[illegible]	37	[illegible]	[illegible]	[illegible]	[illegible] '21, Q	50
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] '20, Q	5 00
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] '18, SA	1 00
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] '21, Q	50
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	27	[illegible]	27	[illegible]	[illegible]	[illegible]	[illegible] '20, Q	.37½
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible] '18, Q	.05
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	42	44	[illegible] '20, Q	.50
[illegible]	[illegible]	57	[illegible]	62	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	7	[illegible]	[illegible]	Mar '20, Q	25
[illegible]	11	[illegible]	[illegible]	12	11	12	[illegible] '19, A	.50
[illegible]	75	69	[illegible]	80	[illegible]	[illegible]	Feb. '19, SA	15
[illegible]	2	1	[illegible]	2	[illegible]	[illegible]		
[illegible]	†*50	†*40	[illegible]	*45	[illegible]	[illegible]		
[illegible]			[illegible]	[illegible]	27	30½	May '19, Q	1 25
[illegible]	26	26	26			[illegible]	[illegible] '20, Q	.50
[illegible]	2	2	2	[illegible]	2	[illegible]		
[illegible]	2	2	2	[illegible]	2	[illegible]	[illegible] '21, Q	05
[illegible]	[illegible]	38	40	[illegible]	[illegible]	[illegible]	[illegible] '20, Q	1 00
[illegible]	7	7	7	7	[illegible]	7	Sept '20, K	25
[illegible]	24	22	24	25	[illegible]	[illegible]	Sept. '19, SA	50
[illegible]	26	[illegible]	[illegible]	[illegible]	[illegible]	30	Dec. '20, Q	.50
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	....	
[illegible]	[illegible]	2	2	2	2	[illegible]		
[illegible]	[illegible]	[illegible]	1	2	1	2		
[illegible]	[illegible]	27	28	[illegible]	[illegible]	[illegible]	Jan. '19, Q	50
[illegible]	[illegible]	†*4	*4	[illegible]	[illegible]	4		
[illegible]	1	1	1	1	1	1		
[illegible]	2	2	2	2	2	2	Nov '17, Q	1 00
[illegible]	27	26	27	27	27	27	Nov '21, Q	50
[illegible]	2	2	2	2	1	2		
[illegible]	[illegible]	53½	55	57	[illegible]	[illegible]	Nov. '20, Q	1 00
[illegible]	7	7	7	9½	7	[illegible]		
[illegible]	[illegible]	14½	15	15½	14	15	Sept '20, Q	25
[illegible]	[illegible]	17	17	[illegible]	[illegible]	[illegible]	[illegible] '20, K	.25
[illegible]	[illegible]	12	13½	[illegible]	[illegible]	14	[illegible] '18, Q	.25
[illegible]	[illegible]	25	*25	[illegible]	[illegible]	[illegible]		
[illegible] Copper	[illegible]	[illegible]	*8	[illegible]	[illegible]	[illegible]		
[illegible]	25½	[illegible]	25	[illegible]	[illegible]	[illegible]	Dec '18, Q	1.00
[illegible]	[illegible]	[illegible]	32½	34	[illegible]	34½	June '20, Q	.50
[illegible]	†175	†160		†175	[illegible]		Jan. '22, Q	1.00
[illegible]	42	41	42	45	[illegible]	45	Mar '20, Q	1 00
[illegible]	15	14	14	15	14	15	Dec. '20, Q	.25
[illegible] Hercules	*7	*4	*4	4	3	4	....	...
[illegible] M. L.	45	41	45	46	44	45	Dec. '21, K	1.00
[illegible] Copper			24	17	17	17		
[illegible]	1	1	1	1	1	1	Nov '17, Q	25
[illegible] Ariz	8	8	8	9	8	[illegible]	Jan. '20, Q	25
[illegible]	†1.00	*55	60	60	60	[illegible]		
[illegible] & Boston	1	*2	1	1	1	1		
[illegible] C. & C.	[illegible]	[illegible]	10	10	9	[illegible]	May '18, I	1 00
[illegible]	[illegible]	52	74	77	70	70	May '13	10
[illegible]	[illegible]	27	28	30⅝	28	[illegible]	[illegible] '21, Q	25
[illegible]	1	1	1	2	1	1	Sept '18,	25
[illegible] Copper	64	[illegible]	63½	65	63	64	Dec '21, Q	50
[illegible] M. & T	1	1	1	1	1	[illegible]	Dec '17	30
[illegible]	[illegible]	[illegible]	1	2	2	2	....	
[illegible]	40	40	40	40	[illegible]	[illegible]	....	
[illegible]	10	10	10	11	10	11	....	
NICKEL-COPPER								
[illegible]	12	11	12	12	11	12	Mar '19,	50
[illegible], pfd.	67	62	67	[illegible]	[illegible]	[illegible]	Nov. '21, Q	1 50
LEAD								
[illegible] Lead	92	85	92	91	88	[illegible]	Dec '21, Q	1 50
[illegible] Lead, pfd.	110	118	110	111	111	111	Dec '21, Q	1 75
[illegible] Lead	13	12	13	13	13	13	Dec. '21, Q	.25
QUICKSILVER								
[illegible]	†1	†*75	1	1	1	1	...	
ZINC								
[illegible]	15	13	13	14	13	14½	May '20,	1 00
[illegible]	38	37	37	39	36	37	Nov '20, Q	1 50
[illegible] & Z	[illegible]	5	5	6	5	6	June '18,	50
[illegible]	23	20	23	27	22	26	Sept '20,	1 25
[illegible] Z. I	[illegible]	5	5	6	5	6	Dec. '20, Q	50
[illegible] Z	[illegible]	125	126	133	127	131	Nov '21, Q	2 00
[illegible]	50	50	*50			*50	Sept '20, Q	03

[illegible] †Bid or asked. Q, Quarterly. SA, Semi-annually. [illegible] K, Irregular. I, Initial. X, Includes extra.

Stock	Jan. 14 High	Jan. 14 Low	Jan. 14 Last	Jan. 21 High	Jan. 21 Low	Jan. 21 Last	Last Div.	
GOLD								
Alaska Gold	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	....	
Alaska Juneau	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	....	
Carson Hill	12½	11⅞	12	13½	12½	13¼	....	
Cresson Consol.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Jan. '22, Q	$0 10
Dome Ex.	*75	73	75	78	*75	75		
Dome Mines	21¼	20¾	21¼	23	21	21	Jan. '22, Q	25
[illegible] Goldfield	*26	20	21	*23	20	23		
Golden Cycle	*70	69	70	*71	*71	71	June '21, Q	02
Goldfield Con.	*5	*3	3			3	Dec. '19,	.05
Hollinger Con.	8 00	7 88	7 98	8 10	7 90	7 98	Dec. '21, 4 wks.	05
Homestake	55	55	55			55	Dec '21, M	25
Kirkland Lake	[illegible]	28	30	35	*31	*35		
Lake Shore	1 40	1 32	1 35	1 39	1 28	1.30	Nov. '21, K	.02
McIntyre-Por.	2 27	2 18	2 20	2 28	2 22	2 26	Jan. '22, K	.05
Porcupine Cr.	18	12	*12	17	*14	15½	July '17,	.03
Porcupine V. N. T.	*21	*19½	*20	22	*19	*20	....	....
Portland	†*42	†*32	39½	†*42	†*30	*39½	Oct. '20, Q	.01
Schumacher	35	*32½	34	36	*34	35½	....	
Silver Pick	*6	*6	6	6	2	6	....	
Teck Hughes	*23½	*22	23	30	27	*29¾	....	
Tom Reed	*45	*39	44	*55	46	*50	Dec. '19,	.02
United Eastern	2⅜	2¼	2¼	2⅜	2⅜	2¼	Oct. '21, Q	.15
Vindicator Con.	*23	*21	23	23	23	*23	Jan. '20, Q	.01
White Caps	...	...	5	*4	*4	*4	....	....
Yukon Gold	1¼	1⅛	1⅛	1 3/16	1 1/16	1⅛	June '18,	.02½
SILVER								
Batopilas Mining	[illegible]	½	[illegible]	[illegible]	[illegible]	⅝	Dec. '07, I	.12½
Beaver Con.	*24	*21	*23	*23	21	*22	May '20, K	.03
Coniagas	1 50	.	1 50	1 50	1 30	1 50	May '21, Q	12½
Crown Reserve	*17	*15	*15	15	*13½	*14	Jan. '17,	05
Kerr Lake	3¾	3¼	3¼	†3½	†3⅞	3¼	Jan. '22, Q	12½
La Rose	*33½	33	*33½	*34	*33	30	Apr '18,	02
Mclt. Dar-Sav.	*17	*15	16			*16	Oct. '20, Q	03
Mining Corp.	1 10	1 00	1 05	1 00		1 00	Sept. '20, Q	12½
Nipissing	6⅞	6⅛	6⅞	6⅝	6⅛	6¾	Jan. '22, Q	15
Ontario Silver			4	5⅜	4⅞	5¼	Jan. '19, Q	50
Ophir Silver			*12			*12	Jan. '12,	.10
Temiskaming	*32	*28	*31¼	*35	*29	*34	Jan. '20, K	.04
Trethewey	*7½	6¼	*7	*9	*7	*7¼	Jan. '19,	.05
GOLD AND SILVER								
Bost. & Mont.	*87	*71	*74	*75	*62	*63	....	
Cashboy	..	.	*5	*5	*5	*5	....	
Dol Esperanza	..		*90	...	...	*90	....	
El Salvador	*5	*4	*4	*5	*4	*4	....	
Jim Butler			*6			*6	Aug. '18, SA	.07
Jumbo Exten.		.	*4	*2	*2	*2	June '16,	.05
MacNamara M.	*10	*5	*7	*9	*6	*7	May '10,	02½
Tonopah-Bel.	1 7/16	1⅜	1 7/16	1 [illegible]/16	1 5/16	1 7/16	Jan. '22, Q	05
Tonopah	*65	*61	*61	74	62	*74		
Tonopah Ex.	1 9/16	1½	1 9/16	1⅝	1 9/16	1⅝	Jan. '22, Q	05
Tonopah Min.	1 9/16	1 7/16	1½	1 9/16	1 7/16	1½	Oct. '21, SA	05
West End Con.	*78	*75	*75	78	*74	*77	Dec. '19, SA	.05
SILVER-LEAD								
Caledonia	....		*7	*6	*6	*6	Jan. '21, M	.01
Cardiff M. & M.	1.05	1 00	1.05	1 00	1 00	1.00	Dec. '20,	.15
Chief Consol.	3⅛	3⅛	3⅛	3 1/16	3	3	Aug. '21, Q	.05
Consol M. & S.	20¼	19	20½	20¼	20½	20½	Oct '20, Q	.62½
Daly Mining	†3.00	†1 00		†3 50	†1 00		July '20, Q	.10
Daly-West	2	1¾	2	2	2	2	Dec. '20, Q	.25
Eagle & B. B.	†3	†2¼	2¼	2¼	2¼	2¼	Apr. '21, K	05
Electric Point	*4½	*4	*4	*4½	*4	*4	May '20, SA	.03
Fed. M. & S.	10	10	10			10	Jan. '09,	1.50
Fed. M. & S. pf.	38	37	37	40½	38	40	Dec. '21, Q	1 00
Florence Silver	*18	*18	*18	*18	*18	*18	Apr. '19,	.01½
Grand Central	†*63	†*36½	*41	*45	45	*45	Jan. '21, K	.01
Hecla Mining	4¼	4⅝	4⅝	4 11/16	4¼	4⅝	Dec. '21, Q	.17
Iron Blossom	*21	*19	*21	22	*22	*22	Dec. '21, Q	.02½
Judge M. & S.	†3 00	†2.00	2 50	†3 00	†2 00	2 50	Sept. '20, Q	12½
Marsh Mines	*6	*5	*5	*6	*4	*4	June '21, I	.02
Prince Consol	*14½	*10	*10	*10	*8½	*8½	Nov. '17,	.02½
Rambler-Carib	*4	*4	*4	*4½	*3½	*4	Feb. '19,	.01
Rex Con	*7	*6	*6	*7	*6	*7	....	
South Hecla		†*12½			†*12½	.	Sept. '19, K	.15
Stand. S. L.	*11	*11	*11			*11	Oct. '17,	.05
Stewart Mines		.	*2	*4	*2	*4	Dec. '15,	.05
Tam.-Custer	2.20	2.15	2.20	2 15	2 10	2 10	Jan. '21, K	.04
Tintic Stand.	2.00	1.95	2.00	2 00	1.95	2.00	Dec. '21, Q	.05
Utah Apex	2¾	2⅝	2⅝	2¼	2½	2¾	Nov. '20, K	.25
Wilbert Min.	....	....	2	....	....	2	Nov. '17,	.01
VANADIUM								
Vanadium C.	31⅞	30¼	31	37⅞	31¼	34	Jan. '21, Q	1.00
ASBESTOS								
Asbestos C.	48⅜	48¼	48¼	....	....	48	Jan. '22, Q	1.50
Asbestos Cp., pfd	....	....	76	....	....	76	Jan. '22, Q	1.75
SULPHUR								
Freeport, Texas	13	12⅝	12¾	13	12¼	12⅜	Nov. '19, Q	1.00
Texas Gulf	42⅛	40	41¼	42⅛	40⅝	41¾	Dec. '21, Q	1.00
MINING, SMELTING AND REFINING								
Am. S. & R.	45½	43⅝	45½	48	45½	47½	Mar. '21, Q	1.00
Am. S. & R. pf.	88	86½	88	91½	89⅝	90⅞	Dec. '21, Q	1.75
Am. Sm. S. pf. A.	.	.	87½	89	89	89	Jan. '22, Q	1.50
U. S. S. R. & M.	36	34½	36	37¼	36	37¼	Jan. '21, Q	50
U. S. S. R. & M., pf.	44	43⅛	44	43¾	43¼	43¾	Jan. '22, Q	87

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Consulting Editors

Volume 113 New York, February 4, 1922 Number 5

The Need for Organization Among Miners

WE HAVE before called attention to the farmers' bloc in the Senate as an example of the mass action of the agricultural industries, and compared the corresponding need for concerted action for protection and better conditions on the part of that other great basic raw-material industry, the mining industry. Recently, Secretary Wallace of the Department of Agriculture has summoned a farmers' conference; and before that conference in Washington President Harding has pointed out the fact that the nation cannot be prosperous unless the farmer is prosperous, and, what is more significant, declared himself in favor of organized and centralized marketing as one of the remedies to be applied to the present serious agricultural situation.

Good enough: and this reminds us again of the analogous plight of the mining industry. There is a growing tendency toward solidarity in the Senate of a group composed mostly of Senators from the Western states, which group is entirely in sympathy with any just and broad plan for the advancement of the rights and prosperity of the mining industry. There is no reason why this should be confined to the West: nearly every one of our states are great mining states, Pennsylvania, by virtue of its coal mines, the greatest of them all.

But who is going to summon the representatives of the mining industry to a conference in Washington over the mining situation, as Secretary Wallace did for the farmers, or Secretary Hoover did for the farmers? There we see our poverty of representation. Whatever responsibility for the mining industry there may be in the Cabinet, theoretically, we suppose resides with the Secretary of the Interior; but speaking from an intimate knowledge of the facts, this has practically amounted to no special representation at all, and this applies all down the line, and includes the present incumbent, Secretary Fall. It is plain, therefore, that we need a Department of Mines at once, and a Secretary of Mines, as Representative Rhodes, of Missouri, Secretary of the Committee on Mines and Mining, in his article in our Annual Progress Number, pleads. And in the Senate an ever-increasing number of Senators whose constituencies have a prime interest in mining have been privately pledging their support to the bill for the establishment of a Department of Mines.

Our continued survey of the situation reveals that the mining industry has great need of being mothered: not coddled, but given a fair chance with the rest. If marketing is the chief problem of the agricultural industries—and it is—it is no less true that marketing is the chief problem of the mining industries. And we are as far from any efficient system or even any knowledge of the principles of the subject as the farmers are.

What can you do? Support vigorously a Department of Mines, as a starter. The Nicholson bill provides for the establishment of a Bureau of Mineral Markets within this department, which Bureau of Mineral Markets is very much to the point of this discussion. The Department of Agriculture has a Bureau of Markets. The American Mining Congress, the directors of the Bureau of Mines and the U. S. Geological Survey, the chairman of the Committee on Mines and Mining of the House of Representatives, and *Engineering and Mining Journal* are among the representative factors in the mining industry that are unequivocally in favor of a Department of Mines. Push for this and make it a fact; and then we shall be ready for the next most necessary step, following the excellent example of the farmers.

Mining Engineer Insurance

THE MINING ENGINEER is a soldier of industry and even a soldier of fortune. He is a soldier, often, without a regiment or a protecting organization behind him. Combining as he does all the fresh and manly qualities of the intrepid adventurer with the conscientiousness of the technically and scientifically trained man and the caution of the business man, he is unquestionably the finest type of man that we have ever rubbed up against.

But his life, though adventurous and free, is not an easy one. Especially when—as he does—he attaches unto himself a wife and a few children—does his problem become increasingly difficult. Should he play in bad luck—should he drown in a tropical river, or be stricken with fever in Africa, or be slain by the hill men in Asia, it may be that his family become stranded under unusually trying circumstances. If not death but hard times—depression in mining, due to a mad world war brought on by fools in Europe—come upon him, he is unusually liable to be caught without sufficient funds or other sheet anchors to windward against the parting of the main hawser. A mining engineer may be careful, successful, and broke at thirty or forty, which combination is not so easy to find elsewhere.

And during his career he, of all professions, has often been least able to put out roots and form ties which will aid him or his family in time of unexpected stress. He has drifted from one part of the world to the other, from camp to camp, served one business group after another, and his social tentacles have not taken deep hold anywhere. Friends are widely scattered, and not intimate, though cordial. He does not belong, as a rule, to the various fraternal societies which lend a hand in case of need and which usually include in their program some form of emergency insurance. His case, or that of his surviving family in adversity, is apt to be a particularly trying one, as we happen to know from many instances. Who cares? asks a recent correspondent. He belongs to the American Institute of Mining and Metallurgical Engineers, but that is a technical society, and is a connection no more personal than his relation as a subscriber to *Engineering and Mining Journal*.

The principle of insurance and that of the helping brotherly hand are pretty good things. They are the sound justification for the existence of labor unions. This insurance, the miners—the manual workers—have. The mine owners have their own forms of insurance in the shape of reserve budgets. Can the men who furnish the technical brains of the mining combination who stand between the two and are the guides and the only safeguard of both—likewise insure themselves against sudden drops in their curve of work and prosperity? It is worth pondering over.

The principle of group insurance has become more and more widely recognized as a sound safeguard, and many companies, having in certain cases thousands of employees each, see to it that each employee is protected by a certain sum, to be paid to his family in the case of his death. Would it be practicable for such a group insurance plan to be conducted by the American Institute of Mining and Metallurgical Engineers? The argument to the contrary will be that the Institute is a technical society. And this argument will call for a definition of the position, field, and aims of the Institute, for which the time has otherwise come. The organization, besides its original technical function, has branched into the civic field, through the Federated American Engineering Societies, and into the social field, as especially instanced by its Women's Auxiliary; and it has even ventured into the field of technical journalism.

As to fraternal insurance of mining engineers as a group, besides the evidently practicable suggestion which we made above, there remains the highly debatable thought concerning unemployment insurance. We were recently surprised and confounded when Mr. Seebohm Rowntree, an English cocoa manufacturer, showed that his company had successfully maintained unemployment insurance for its thousands of employees: and afterward we privately found out that at least two large companies in Massachusetts, one of them the well-known Dennison Manufacturing Co., had also been successfully carrying this on for some time. Having thus been convinced against our own judgment, it occurs to us to inquire how much more difficult it would be to provide unemployment insurance for a group like the mining engineers than for a corresponding number of industrial employees grouped around a single great company.

A Community Development Project in Leadville

A RATHER NOVEL METHOD of organizing and financing a mining enterprise is that initiated by the Leadville Chamber of Commerce, which chose a committee to select the most favorable area in the Leadville district for development, this committee consisting of mine operators and mining engineers. A place on Canterbury Hill, where the geologic features were considered very favorable, in the light of past experience, was selected, and a company was incorporated for $150,000, of which over 100 Leadville men subscribed $50,000, and the remaining $100,000 was sought outside of Leadville. The circular states "Revival in mine production insures increased prosperity to all. Unison of effort only will revive the game, and Leadville points the way." The officers of the company are subscribers and serve without salary.

This is a plan which interests us and brings forth our best wishes of success. Those behind the plan—the citizens of Leadville—have put their own money into it; and whatever they get will be out of the ground, not out of stock sales or salaries. The ordinary citizen is more attracted by remote ventures for his surplus capital than by opportunities at home; and for all of us the Leadville people are setting a good example, and one that invites respect and sympathy. If the enthusiasm of the supporters has anywhere been excessive, it has been in that part of the letter inviting outside co-operation, where it is stated that the enterprise is "designed as a safe investment as well as to generate revival of mining interest so essential to all other industry." The framers of this evidently conservative and worthy project could not have carefully considered the word "safe." Few mining enterprises are "safe" as investors understand the term, which means a practical lack of risk; and no exploration or prospecting enterprises deserve that term. They are business ventures, and are to be looked upon as such; and if successful, the rewards are commensurate; but the investor must be ready to philosophically kiss his money good-by, if need be. It is a business man's venture, not a place for the funds of needy widows.

Those who would claim that the mineral resources of Leadville are exhausted—if there be any such—would be far bolder than we. We look forward to discoveries other than those already made. Concerning Canterbury Hill, we are not sufficiently informed; but there are places in the district which have come under our notice, even like Fryer Hill, in the Down Town district, where we anticipate the ultimate discovery of new orebodies, in spite of unsuccessful attempts that were made in the past.

In Darkest Brooklyn

THE UNTUTORED OBSERVATIONS, ruminations, and conclusions of prospectors and others who come into contact with rocks and ores is proof that everyone is, to the best of his ability, a geologist. Only the lack of training and sound experience leads such observers, young in science, though old in years, afar. Witness the article on "How Granite Is Formed," published in *The Golden Age*, which is printed in Brooklyn:

> "I have traveled over the waste places of the earth, and from both observation and inquiries have come to the conclusion that granite is formed from a sticky mud called gumbo. This mud is found in great quantities on the prairies of Northwest Canada; and in the Rocky Mountains is sometimes cut into when a new railway is being made. I have seen it myself, and have also been told by men in charge of the work in railway cuts that it was granite in the formation. One may ask how it came there. The answer is that it was deposited by water countless ages ago. The crystalline appearance of granite is due to the salinity of the moisture it once contained.
>
> "On the coast of Alaska rises a huge granite cliff out of the water with a 4-ft. seam of coal running across the upper face. If this mass of granite had been formed from lava, there would have been no seam of coal in it."

The author (Mr. Truzzell) adds some observations concerning the shifting of the poles:

> "The equator was in another part of the earth when the present mountains were made, and is now moving imperceptibly each year north or south, probably south. One cannot guess the age of the earth with correctness; it is certainly thousands of millions of years old. We have

trees 6,000 years old here in California. There has been no change of the earth in their locality since they first started to grow."

But the sapient editors of *The Golden Age* will not let Mr. Truzzell's statements go unchallenged and uncorrected. In an editorial note they observe:

> "*The Golden Age* believes that Mr. Truzzell is in error in thinking that the equator is moving appreciably or has ever moved appreciably. The location of coal deposits in the Arctic Zone is not to be explained in that way, but by the fact that prior to the Flood the whole earth was enveloped in a canopy of moisture which made it a vast hot-house. Prior to the Flood we read: 'The Lord God had not caused it to rain upon the earth, but there went up a mist from the earth, and watered the whole face of the ground.' We think it quite possible that some of the sequoias of California, and possibly a few of the deep-sea monsters, are the only living things on the planet that have survived the days of Noah."

Paleontological Society of America please take note: also Don Marquis, author of the ballad, "Noah and Jonah, and Captain John Smith."

How far Brooklyn is from New York! We had never realized it before. Evidently the proper way to count the distance is to go due west from New York till you reach Long Island.

The Bursting of the Fisher Bubble

AS EXCLUSIVELY ANNOUNCED in our editorial columns in our issue of Dec. 31, the sensational discovery of Professor Irving Fisher, of Yale, that Germany was about to produce artificial gold in such quantities as to make gold no longer practicable as a medium of exchange, has been found to be an error. Only Professor Fisher did not know it till Jan. 24, when a reporter found the Yale savant in Berlin and was told by him that he had that day discovered the claim to be without foundation. His methods of discovering his error are much in line with his method of making his original great discovery. He says, "I saw a distinguished German scientist this morning, and he told me the man is a fraud and has a prison record." All very well until someone else gives him an earful day after tomorrow.

Professor Fisher would not make an understudy for Sherlock Holmes. But he has some weak justification of his hopes for worthless gold. He says that the German government has made serious attempts to produce gold from sea water. Wrong again, professor: ask anybody. Besides, the Yankees are still ahead. It was a Maine man, and a clergyman at that, who worked the gold-from-sea-water game on the American public. The Yankees score once more over the Dutch.

Also, Professor Fisher says that it has been found that all the rivers of Germany, such as the Rhine, carry a little gold in solution. If Professor Fisher would come home—and we really wish he would—he would find that all the rivers of New England carry a little gold in solution, even the Naugatuck that flows hard by New Haven; and that the waters of Long Island Sound carry a little gold in solution, as has been known for many years.

We are sure that the Yale economist will finally bring a gold brick home unless somebody puts him on board ship soon. And why, finally, does Professor Fisher keep talking about "synthetic" gold? Synthesis is the opposite of analysis. It is the combination of elements to form a compound. If we ever get artificial gold, it will be by the transmutation from another element into the gold element.

Another Bubble Burst

A FEW DAYS AGO a brief announcement appeared in an inconspicuous place in the daily press, stating that the Edge bank plan had been abandoned. The entire account took but a few inches, yet what reading could be done between the lines! It was the funeral notice of a grandiose scheme conceived after the Armistice to facilitate the retention of the huge export trade gained during the war and the capture of more. It involved the organization of a huge corporation to finance foreign trade with long-term credits.

It will be recalled that the belief was insistent a few years ago that the United States was destined to become the world's greatest international trading agency and that it was endeavoring to supplant Great Britain—to make the dollar replace the pound sterling. This hope has gradually dwindled, and, viewing the political and industrial attitude of the country, how could it be otherwise? How can a great nation like ours, which howls about importations made with cheap German labor, when imports amounted to but $73,000,000 from Germany compared with exports of $351,000,000 to that country in the first eleven months of 1921—how can that country hope to be a great foreign trader? The record of our trade with Canada, Mexico, and other countries was just as lopsided. It would seem that all we are anxious to do is send our products to every corner of the globe, but to take nothing but gold in return—and how absurd that idea is we all know.

Pick up a copy of one of the London financial journals and you will find statements regarding the condition or possibilities of developing the hair-tonic industry in Siam or copper mines in the fastnesses of Asia. Glance through an American paper of similar type, and what does one find? Nothing discussed but domestic enterprises and investments. Few foreign enterprises are listed on our exchanges, and then only the Canadian Pacific Ry. and Canadian and Mexican mining enterprises, or some foreign bonds.

And what has all this to do with mining? Just this: The American mining engineer has been a pioneer in the development of not only his own country's mineral resources, but also of those of other lands—South America, Australia, Asia, South Africa, to mention a few wide stretches, and he naturally views with regret the forced abandonment of a plan which for a time looked promising enough to help place the country on a new plane in foreign commerce.

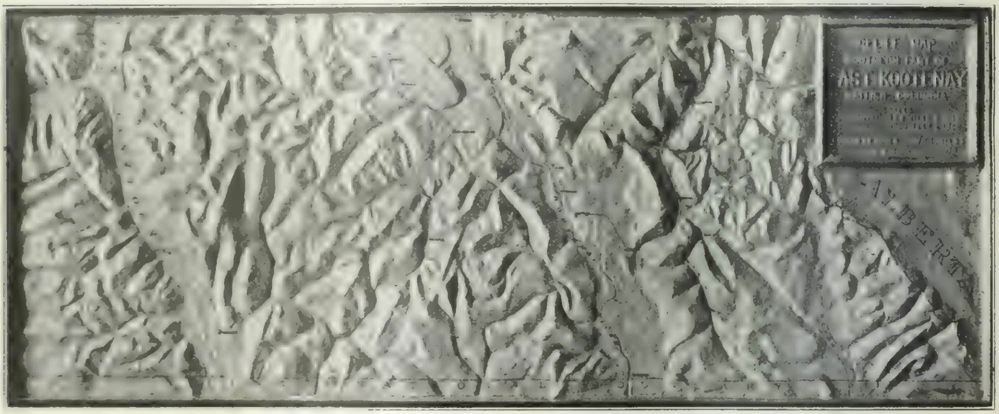
The Institute's Directors' Meetings

A GRACIOUS CUSTOM of the Board of Directors of the American Institute of Mining and Metallurgical Engineers is to hold their meeting in public—to the extent that at each meeting a number of the Institue members are invited, resident or visitors, and after a pleasant dinner of the directors, officers, and guests, the guests sit interestedly by while the board transacts its business. The proceedings of such meetings are private in the sense that they are not for publication, but public in the sense that free discussion of the meetings may circulate by word of mouth to some degree. We do not know how far back this custom originated, but it is a noble gesture, if we may use the phrase, on the part of the directors. It is unavoidable that some private or pressing matters should be discussed and partly settled in committee: nevertheless these semi-public proceedings of the board are frank and free.

WHAT OTHERS THINK

Another Peculiar Effect in Photographing Uneven Surfaces

Referring to the photograph of the interior of a Hardinge mill lined with rail sections and cement, on page [illegible] of *Engineering and Mining Journal* of Nov. 3: The effect obtained, when reversing the photograph, of causing the depressions to look like protuberances and vice versa, is the result of the change in the direction of lighting.



A PHOTOGRAPH OF A RELIEF MAP WHICH, WHEN VIEWED UPSIDE DOWN, MAKES THE RIVERS APPEAR ON RIDGES

We had an example of this in a photograph of a large relief map reproduced in the "1914 Report of the Minister of Mines for British Columbia." This photograph was taken with the lighting from the top left-hand corner, and this agrees with the letter of J. C. Seelig in the Dec. 24 issue, on page 1,005.

I send you a copy of this photograph and you will find that by looking from the left side or top the depressions will appear as ridges and the creeks to run along the ridges. If your photograph had been printed the other way up the question would not have arisen.

Victoria, B. C. H. T. NATION.

Electrostatic Separation Not Dependent Upon the Weather

Under the heading "Echoes From the Fraternity" in the Dec. 31 issue of *Engineering and Mining Journal* is a two-column article entitled "Separation Problems Under Study by Bureau of Mines," outlining plans which have been formulated by the U. S. Bureau of Mines for the complete survey of the milling problems of the Tri-State district of Missouri, Oklahoma, and Kansas. In this article a paragraph is devoted to a comparison of work done by the flotation process and by the electrostatic process, which reads as follows:

> "The second method employs flotation. Tests gave a higher recovery of zinc than was obtained by electrostatic separation, but the spar product is lower grade and finer grinding is necessary. The method, however, is a great improvement over earlier methods, and as compared to electrostatic treatment is preferable in stormy weather."

Apparently the writer of this article is not acquainted with the progress made in electrostatic separation during the last ten years, and this reference to the electrostatic process is wholly misleading and not helpful to the engineering profession, and particularly to the manager, superintendent, or research engineer interested in milling or concentrating problems.

In the early days, prior to 1901, considerable experimental work was done in a laboratory way with electrostatic separation, but nothing of a practical value was accomplished until 1901, when a series of patents covering electrostatic separation was granted to Mr. Dolbear, Professor Blake, Mr. Huff, Mr. Pickard, Mr. Wentworth, and others. These patents followed over a period ranging from 1901 to 1910. The first commercial use of the electrostatic process in the separation of zinc was carried on by the use of the process as operated under the Blake-Mosher patents. At this time the weather conditions seriously affected operation, owing to the fact that a frictional static disk was employed to generate the electrostatic current to effect a separation. This type of generator had been used for years in most schools to demonstrate the action of electrostatic electricity, but commercially it proved to be a failure, and the results were disappointing.

About 1904 Charles H. Huff took an interest in the process, and, realizing its possibilities, employed several expert engineers who developed a new electrical generating set which overcame the difficulties experienced with the static disk machine. A series of patents was granted to Mr. Huff, Mr. Pickard, and Mr. Wentworth covering these later developments. Several plants were installed, and all proved to be satisfactory. The process, operating under the Huff patents, has been in active operation in the plant of the U. S. Smelting Co. at Midvale, Utah, for the separation of iron and zinc since 1908, and this plant has been operating twenty-four hours daily through all kinds of weather.

During the last eight years twenty-six plants have been installed using the Huff process, in the United States, Mexico, Canada, Newfoundland, Norway, Spain, and Australia. These plants have been operating at various altitudes ranging from sea level to 12,000 ft.

and under all kinds of climatic conditions. The process is installed at one plant at Pablo Beach, Fla., where the separating plant is built out on the beach and the fog at times is so thick that it is almost impossible to see an object ten feet distant. Never during the last eight years has a single complaint been made regarding the electrical equipment, which is just as steady and dependable in operation as any electric power line. The action and operation of the process is really just as reliable as that of any concentrating process on the market today; in fact, on most problems, in comparison with flotation, it is simple to operate and very easy to control.

The electrostatic process has many decided advantages in the treatment of a large variety of materials, and it is unfortunate that the erroneous impression mentioned is at various times circulated in reports covering laboratory work where the frictional static disk has been employed. In justice to the process as well as to the engineering profession I have taken this opportunity of setting forth the facts. The electrostatic process has many advantages and is worthy of serious consideration and investigation by every engineer interested in the concentration of ores or of byproducts where there is a difference in electrical conductivity sufficient to effect a commercial separation.

Arlington, Mass. HERBERT B. JOHNSON.

Magnesite From California and Greece Compared

In *Engineering and Mining Journal* of Jan. 14, 1922, H. C. Boydell asks for the facts concerning the comparative quality of magnesite from California and Greece. While a member of the U. S. Geological Survey, I studied the magnesite deposits of this country and published in "Mineral Resources of the United States, 1918," Part 2, more than forty analyses of magnesite from California. In the accompanying table are given a few of these analyses made in the chemical laboratory of the U. S. Geological Survey from samples collected by Federal geologists.

No. 1 is from the mine operated recently by C. S. Maltby. Nos. 3, 4 and 5 are from one of the largest deposits of the state. No. 8 is from the locality formerly worked by Tulare Mining Co. and more recently by the Sierra Magnesite Co.

These analyses are of the materials most nearly like the Grecian magnesite which Mr. Boydell describes. There is a wide range in composition of magnesite from other localities in California, some of them showing as high as 12 to 15 per cent of silica. That there may be a considerable range in the composition of the magnesite in different parts of a deposit is shown by analyses 3, 4 and 5, in which the silica content ranges from 0.14 to 1.10 per cent and the lime from 0.59 to 1.17 per cent. It is apparent by comparison with the analyses given by Mr. Boydell and repeated in the table herewith that some California magnesite is slightly purer than the Grecian material which he sampled and [illegible]

1	[illegible]	[illegible]
2	[illegible]	[illegible]
3	[illegible]	[illegible]
4	[illegible]	[illegible]
5	[illegible]	[illegible]
6	[illegible]	[illegible]
7	[illegible]	[illegible]
8	[illegible]	[illegible]
9	[illegible]	[illegible]
10	[illegible]	[illegible]
11	[illegible]	[illegible]

R. W. STONE

Pennsylvania Geological Survey, Harrisburg, Pa.

The E. M. and the Mining Engineer

Referring to J. P. Varian's lament in the Jan. 7 issue of *Engineering and Mining Journal*, under "What Others Think":

No doubt the *Journal* doesn't care, or at least can't. If a man will begin to look for something to do in other lines than mining and metallurgy, he will soon find they are all in much the same boat; and the *Journal* no doubt has its hands full with paper, postage, and payroll problems as acutely pressing as the idle E. M.'s next plate of ham and eggs. But the idea of the sacrifice of the best years of life for training being sufficient to merit a pension is slightly amiss. The country—in fact the wide world—is full of graduate C. E.'s, M. E.'s, and E. M.'s, whose cost of replacement is little more than common labor turnover.

We shouldn't overlook the great chasm between an E. M. and a Mining Engineer; the former, as a graduate at least, can lay legitimate claim to being little more than a tin-horn surveyor; the mining engineer has everything technical plus a knowledge of business in his make-up. He is not so easily replaced; hence he is retained during a depression while the E. M. is kissed good-by.

Facts are stubborn things, and no amount of emotion or contradictory opinion will change them. The chasm between the two types is bridged in just one way: long, hard, grinding routine work, which in time, to the live wire, will saturate him with the necessary knowledge of business methods. And then he may be justly ranked as an engineer. No, it isn't an appealing situation, but bemoaning the fact cannot change it. If a man is easily replaced, then he is going to be out of work in a depression; if not, he will be retained. Leave short-cuts to big pay for the motion-picture magazine advertisers.

Men are *developed* for the big jobs, but not in two weeks. And the years of downright plugging are the years that count. Care? No; nobody cares but your wife and the grocery man. It is up to the E. M. to absorb the big idea of business, and to become a Mining Engineer; or to coddle his slide rule and forever remain a surveyor. PAUL H. KEATING (E. M.).

Golden, Col.

ANALYSES OF CRUDE MAGNESITE FROM CALIFORNIA AND GREECE

	1	2	3	4	5	6	7	8	9	10	11
SiO_2	0.50	0.73	1.10	0.81	0.14	0.51	0.23	0.80	0.31	0.86	[illegible]
Al_2O_3		0.14		0.00	0.48	1.98	0.04	0.42	0.11	[illegible]	[illegible]
Fe_2O_3		0.21		0.52		0.16	0.20	0.20	0.08		
FeO	0.20		0.72								
CaO	1.92	0.40	1.17	1.04	0.59	0.59	0.19	1.02	0.24	0.55	[illegible]
MgO	45.90	46.61	45.64	46.67	47.07	45.84	46.88	45.94	47.22	46.94	46.38
CO_2	51.68	51.52	51.20	50.60	50.66	50.80	51.77	51.30	51.64	[illegible]	49.84
	100.20	99.61	99.83	99.64	98.94	99.88	99.31	99.68	99.60	[illegible]	[illegible]

The Feld Scrubber for Cleaning Metallurgical Smoke

Installation at the Ducktown Smelter, in Tennessee, Uses the Purified Gas for Manufacture of Sulphur and the Recovered Fume in the Production of Electrolytic Zinc—Ionization Theory Successfully Applied

BY W. F. LAMOREAUX*

Written for Engineering and Mining Journal

SMOKE AND FUME, escaping from metallurgical plants into the atmosphere, has been the source of endless controversy for several decades, and in this country has been the cause of bitter and costly litigation. As a result, many ingenious methods have been devised to overcome the escape of noxious elements and, where practicable, to recover and convert these into valuable byproducts. Metallurgical smoke, as those products have been aptly named, is usually composed of three distinctly defined components:

1. Solids: "Flue dust" and small particles readily acted upon by gravity.

2. Fume: Volatile constituents which, upon reduction of temperature, become condensed or sublimated in the form of infinitesimally small particles which have only a slight tendency to settle.

3. Gases: Usually invisible, and almost entirely unaffected by gravity.

These components may be either soluble or insoluble in water, and many of the elements or compounds that are insoluble in water may be readily soluble in some other media. However, the value of the recovered product may depend entirely upon whether it can be obtained in a dry or wet condition. And, furthermore, the residual gases, after removal of any previously contained suspended matter, may be desirable for subsequent use, in which circumstance the temperature of the gases or their moisture content may be determining economical factors; thus, in the manufacture of sulphuric acid from smelter gases it is important that sufficient temperature be retained in the gases to carry out the Glover-tower reactions; and in the cleaning of iron-blast-furnace gases for combustion in gas engines or for pre-heater requirements, it is important that the moisture content be reduced to the lowest possible amount. These various requirements have influenced or limited the methods of purification of metallurgical gases as well as the recovery of their contents in the form of commercially valuable products.

VARIOUS CLEANING METHODS

The various methods of cleaning gases may be classified in the following order:

Type of Apparatus and Principle and Scope of Operation

1—Gravity: Stagnation of gases, decreased velocity and settling of dust particles in rectangular, balloon or kite-shaped flues; catenary flues; U-shaped and zigzag flues. Employed principally in the recovery of flue dust and heavy particles of solid matter, although, with adequate provisions for cooling, liquid condensates can thus be recovered.

2—Baffling: Interposed plates, wire screens, and Roesing suspended wires, designed to afford increased surface for lodgment of dust particles.

3—Filtering: Use of mattings of various kinds of fibers; woolen and cotton bags; layers of coke, slag or mineral wool as filter materials. Employed for the recovery of fume and very small particles of solid materials.

4—Freezing: Gayley's method of refrigerating, for the removal of moisture and dust contents of gases.

5—Electrical: The Cottrell process of electrostatic precipitation of dust and moisture particles. Not recommended for cleaning inflammable gases, or gases containing inflammable dust particles.

6—Tangential: Dust-laden gases are introduced tangentially into vertical cylindrical shells with sufficient velocity to throw out the heavier dust particles. Employed for the removal of dust or liquid particles having higher specific gravity than that of the gases to be cleaned.

7—Spraying: Dust-laden gases are caused to flow through streams of atomized water, or through checkerwork or grids over which water is continuously sprayed.

8—Centrifugal: The dust-laden gases are caused to pass through chambers wherein water or any other liquid is atomized by means of rapidly revolving impellers. The Feld gas scrubber belongs to the centrifugal type of gas-cleaning apparatus, and combines in its operation all of the functions of gravity, baffling, spraying, and centrifugal removal of the dust or fume particles contained in dust-laden gases. In addition, the Feld scrubber may be employed as a reaction or absorption apparatus for use in chemical reactions.

POSSIBILITY OF WET SCRUBBING

For a number of years there has been among metallurgists much uncertainty, even to the extent of skepticism, as to whether the metallic fumes contained in smelter gases can indeed be precipitated by any wet method. Heretofore such fumes have been precipitated or recovered almost solely by gravity settling in long flues, often of complicated design, or more successfully by means of filtration through various fabrics, particularly woolen bags. Many of the largest smelting plants in this country have adopted the installation of baghouses of enormous sizes and erected and maintained at great cost, to recover the fume contained in their waste gases. In most instances this has been done to avoid damage to vegetation; in other circumstances the fume carried elements of considerable commercial value as recoverable byproducts. But a method of recovering these fumes by means of gas washers or "scrubbers" has either not been developed or sufficiently demonstrated to the point of warranting adoption for commercial use.

Liddell states that "the ferrous metallurgist uses the centrifugal gas washer, but it seems doubtful whether they (the washers) would have any effect on the lead—or copper—smelters' fumes."

Fulton, in referring to wet scrubbing, states: "The method removes flue dust with fair success, but it is not satisfactory for fume, so that the statement may safely be made that the application of water to the smoke stream in various ways for the removal of fume holds out little promise."

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*General Manager Ducktown Sulphur, Copper & Iron Co., Ltd., Isabella, Tenn.

In detailing the qualifications necessary for a successful system of wet condensation, Hofman says:

"An efficient condensation of smelter smoke in this way must do three things: (*a*) reduce the temperature of the gas current to the point at which dissolved moisture forms a mist or fog; (*b*) saturate the floating particles with moisture; (*c*) separate the saturated particles."

CONDITIONS AT THE DUCKTOWN PLANT

It was in the light of such knowledge that the Ducktown Sulphur, Copper & Iron Co., Ltd., undertook to solve the problem of cleaning the waste gases emitted in its copper-smelting operations, with the purpose of utilizing the purified gases in the manufacture of elemental sulphur and also to use the recovered fume in the production of electrolytic zinc.

The ores smelted at this plant have about the following average percentage composition:

Copper	2.30	Alumina	3.20
Zinc	3.75	Lime	7.85
Iron	31.50	Magnesia	2.30
Sulphur	20.85	Undetermined	3.25
Silica	25.00		100.00

The gases leaving the furnace contain 6 to 8 per cent, by volume of sulphur dioxide and the fume content—about 2.2 lb. per 1,000 cu.ft. of smelter gases—has about the following percentage composition:

Moisture	6.62	Arsenic	0.19
Sulphur (*a*)	21.85	Selenium and tellurium	0.17
Lead	4.88	Antimony	nil
Zinc	43.78	Manganese	nil
Copper	0.14	Aluminum	nil
Iron	2.31	Potash	nil
Lime	0.25	"Insoluble"	0.78
Magnesia	0.02	Undetermined, oxygen	18.86
Cadmium	0.15		100.00

(*a*) The sulphur content shown in the above analysis is distributed as follows: As free sulphur, 6.01 per cent; as free sulphuric acid, none; sulphuric trioxide, 5.43 per cent; as sulphides, 10.41 per cent; total, 21.85 per cent.

It will be seen that the ore contains more zinc than copper. Of course the copper is recovered in solid form in the smelting operations, but most of the zinc appears in the fume; indeed, it is the zinc compounds that impart to the waste smelter gases their characteristic whitish or pale yellow appearance.

The principal zinc compound in the fume is the oxide. In the ore, the zinc occurs as sphalerite or blende, ZnS, and, upon entering the blast furnace in admixture with coke, it is first reduced, and then, in the escaping gas stream, is eventually oxidized to ZnO. At the exit of the furnace stack, the smoke stream has the characteristic yellow color of hot zinc oxide, but this color rapidly disappears a short distance away from the stack and the smoke or fume has a white or grayish-white color.

COOL GASES ESSENTIAL TO QUANTITATIVE RECOVERY

Both metallic zinc and zinc oxide possess comparatively high vapor tensions even at very slightly elevated temperatures, and for this reason they do not ordinarily condense or become completely reduced to sublimates until cooled to atmospheric temperatures; furthermore, on account of their great dilution in the gas stream their partial vapor pressures are more than ordinarily reduced, and consequently even lower temperatures are required for their condensation than in such processes as the Witherill process of zinc-oxide sublimation. Therefore, with this type of fume it is almost impossible to effect a quantitative recovery without cooling the gases to a comparatively low temperature.

To those interested in the cleaning of blast-furnace gases, a brief description of the various experiments tried at Ducktown may prove of interest and value.

CENTRIFUGAL CLEANERS, DRY PROCESS

The first method employed in these experiments consisted in passing the gases through a centrifugal cleaner. This apparatus consisted of a cylindrical sheet-metal shell, 36 in. in diameter and 60 in. high, having a conical bottom and flat top. The inlet pipe for the gases was attached to the shell so that the gases entered tangentially near the top of the shell and developed a whirling motion. In so doing the gases encountered a number of deflecting plates, which in turn augmented the tangential course of the gases, thereby causing the heavier floating particles of dust to be thrown outward and downward while the purified gases were removed by suction from the outlet at the top and center of the collector. Practically all of the coarse particles of dust were collected in this manner and removed from the trap, conveniently arranged at the lower end of the cone-shaped bottom.

This apparatus successfully removed the "flue dust" and heavier particles, but was entirely inadequate for the separation and removal of the fume content. The principle of operation is such that the particles of dust must possess sufficient size, or rather mass, to be susceptible to the centrifugal as well as to gravitational force, while being temporarily suspended by virtue of the velocity of the gases. With minute particles of solids, such as compose the fume, the gravitational effect is practically nil, and, likewise, the centrifugal force acting upon the small particle of fume is inappreciable.

This principle of gas cleaning is widely and successfully employed in the iron industry where centrifugal cleaners are placed directly following the downcomers from the blast furnaces. They serve the purpose of primary cleaning, but, to remove the finer material, the gases are subsequently treated in some form of wet-scrubbing apparatus.

BAFFLE WASHER, WET PROCESS

Another type of cleaner tried out was one of the "cone and baffle" washers. This apparatus was first tried with passing dry gases through it, without material efficiency of cleaning. Next, it was arranged to deliver a continuous spray of water at the top while admitting the gases at the bottom. By this means, practically all of the coarser particles of dust were removed, although but little, if any, of the fume. Finally, a much heavier spray of water was introduced, sufficient to form a film of water over the exposed surfaces and to cause a shower of liquid to fall from each cone to the next baffle below. This proved much more effective and removed a part of the fume, but the volume of water required was prohibitive, even though means were available at the time for the recovery and re-use of the wash water.

As in the operation of the centrifugal cleaner, the apparatus is only serviceable for the removal of flue dust and coarse particles, although it showed a pronounced indication that the fume can be to some extent removed from the gases by wet-scrubbing methods.

A great many experiments were undertaken, using coke as a filtering medium, for the removal of the fume contained in the blast-furnace gases. A filter bed 12 ft.

wide and 16 ft. long was filled in with a layer of coke about 4 to 5 ft. deep, of graded sizes, the largest pieces being placed upon the bottom. The first layer of coke, about 1 ft. deep, consisted of sorted pieces about 4 to 6 in. in diameter, hand picked and carefully placed in position; next followed a 1-ft. layer of coke about 2 to 3 in. in diameter; upon the top of this was placed a third layer composed of pieces about 1 in. in diameter, and finally a layer of coke breeze consisting of screened coke about ¼ to ½ in. in diameter. The placing and leveling of the coke was carefully done to avoid crushing or compacting of the finished filter bed, thereby assuring uniform resistance to the passage of the gases through the coke.

Drains were provided in the floor beneath the filter bed so that the coke mass could be sprayed with water and washed free of zinc fume. Water-spray nozzles were arranged at the top of the chamber so that a well-distributed and finely divided spray of water could be thrown downward upon the top of the filter bed. The gases entered beneath the floor, passed through a number of perforations, and thence upward through the coke bed.

WIDE SCOPE OF EXPERIMENTATION

A great many experiments were tried: (*a*) Varying the depth of the coke bed; (*b*) varying the volume of gases, and, correspondingly, their velocity through the filter bed; (*c*) varying the temperature of the gases; (*d*) varying the amount of wash water from the sprays, and (*e*) eliminating the sprays of wash water.

The first experiments were conducted with dry coke (without the use of wash water). A fair degree of cleaning was noted, but in a short time the resistance of the filter bed rose so rapidly (to 6 and 8 in. hydrostatic head) that the centrifugal fans were unable to deliver a sufficient volume of gases for practical requirements.

The coke was then washed with water, allowed to drain as thoroughly as possible, and the experiments were repeated, in every instance being terminated by the prohibitive rise in resistance in the coke mass, owing to coating and clogging of the coke with fume.

Next, the water sprays were operated intermittently, without success; and finally a continuous spray of water was employed. In the latter experiment, the resistance to the passage of the gas was prohibitive, and when the depth of coke was decreased to remedy this difficulty, the cleaning effect was greatly diminished. All attempts were almost equally ineffectual. With a cleaned coke filter bed, the resistance, or pressure drop, was equivalent to about one inch of water for each foot of depth of coke employed, and effective cleaning could not be obtained with less than 4 to 5 ft. of depth. As stated, a fresh filter bed became clogged and obstructed in from three to four hours when filtering the gases at a rate of approximately 250 cu.ft. per hour per square foot of filter area. It was, therefore, apparent that to maintain a continuously effective filter bed, the coke would have to be removed and replenished at frequent intervals and at considerable expense. Unfortunately, too, the coke, after having once become contaminated with fume, could be cleaned only with great difficulty, apparently because a part of the soluble constituents of the fume crystallized in the minute pores of the coke.

The next method employed was that of filtration of the blast-furnace gases through woolen bags. The gases were introduced (after preliminary cooling) at a temperature of about 120 deg. C. so as not to endanger the woolen fabric. It was found that, under proper working conditions, from 2 to 3 sq.ft. of filter area was sufficient thoroughly to clean 1 cu.ft. of gas per minute. The cleaned gases leaving the filter chamber contained no dust or fume that could be detected, even when viewed in a bright ray of light by means of a magnifying glass.

The baghouse contained twenty-four woolen bags, each 18 in. in diameter and 30 ft. long, and having a total filtering capacity of 75,000 to 80,000 cu.ft. of gas per hour at 80 deg. C. Unfortunately, at the time the baghouse was put into service, several rainy days occurred, followed by heavy fogs, during which time the atmospheric humidity averaged between 80 and 90 per cent. This resulted in excessive condensation of moisture on the woolen bags and prevented successful filtration of the gases. To overcome this condensation, the volume of gases treated was increased to 150,000 cu.ft. per hour so as to draw a greater amount of heat into the bag chamber and to elevate the temperature therein to a point sufficiently above the condensation temperature. This worked successfully, and splendid filtration was obtained. The temperature, however, continued to rise, and the volume of gases treated had to be correspondingly diminished. After ten days of satisfactory operation it was discovered that the bags were being rapidly destroyed, finally to the extent of being rent into numerous openings, thereby permitting the gases to pass through without cleaning. The baghouse was then opened and new bags were substituted for the old. At that time it was believed that the destruction of the bags was due to excessive moisture and too high temperature.

SULPHURIC ACID DESTROYS BAGS

Starting again with new bags, careful attention was paid to maintaining the temperatures of the gases within the baghouse to within the range of 80 to 100 deg., this being the working temperature range prescribed in practically all the successful baghouse installations in this country. But under these conditions the new bags lasted for only four days. Samples of the destroyed fabric were analyzed and found to contain zinc sulphite and basic zinc sulphate, and it was concluded that the action of moisture and sulphur dioxide, at the temperature existing in the baghouse, caused a form of hydrolysis of the zinc salts in contact with the woolen fabric, thereby liberating sulphur trioxide or sulphuric acid, which gradually decomposed the wool.

Experiments were then tried in introducing pulverized lime into the gas stream before entering the bags, but without successful results. It was subsequently found that the rapid deterioration of the bags was due to sulphur acids of variable constitution (principally thionic acids), and despite the neutralizing effect that might be expected from the considerable quantity of zinc oxide contained in the gases, together with the pulverized lime that was purposely added as a neutralizing agent, all efforts to prolong the life of the bags proved fruitless, and this method of cleaning the gases was abandoned.

Attention was next directed to the electrostatic method of precipitation as developed in the Cottrell process. A unit or "treater" of the tube type, consisting of twenty tubes or pipes, each 14 in. in diameter and 15 ft. long, designed to treat approximately 200,000 cu.ft. of gas per hour, was installed, together with the necessary electrical apparatus. This was one of the first installations, if not the first installation, of this kind for cleaning gases to be subsequently used for other purposes and where the gases had to be kept undiluted by air; in other words, the conditions and requirements of the Ducktown installation were entirely different from those of any other installation in this country.

On account of the manner of operating the Cottrell process, it was necessary to support the high-voltage electrodes upon powerful dielectric insulators placed within the treater apparatus in such manner that they were at all times exposed to the corrosive action of the gases being treated.

The prime difficulty was due to condensation of sulphurous and sulphuric acids upon these insulators to such an extent that electrical leakages occurred, resulting in arcing over the insulators and consequent interruption of operations. Many expedients were tried to avoid these insulation failures, such as varying the temperature of the gases to control condensation of the acid vapors; inclosing the insulators in various ways, and placing them in different locations with respect to the gas flow. None of these proved entirely satisfactory.

CONDITIONS ESSENTIAL TO PRECIPITATION

The principal constituents of the fume are the zinc compounds, as has already been stated. These compounds are ordinarily present in an unsaturated condition in the blast-furnace gases. If the amount of such compounds in a given volume of gas is not sufficient to saturate the gas at the existing temperature, and subsequently the temperature is lowered by cooling, these compounds will not precipitate from the gas until a temperature is reached that represents the saturation point. Ordinarily, the requisite temperature (corresponding to such saturation point) is lower than the melting point or liquid phase of the compound, so that the substance is precipitated in a finely divided solid state—i.e., as *fume*. It is evident that with decreasing saturation, a correspondingly decreased temperature is required for sublimation, and in treating such zinc compounds as are found in the blast-furnace gases, the temperature must be reduced to practically atmospheric normal (20 deg. C.) before the last traces of zinc compounds can be removed.

If the gases are passed through the cleaning apparatus at a high temperature, it may be clearly seen that, with subsequent reduction of temperature, further sublimation will take place, and result in the formation of a "second crop" of fine fume, thereby defeating the very purpose of the cleaning apparatus. The Cottrell apparatus will not precipitate gases or compounds existing in the gaseous phase; the temperature must be reduced to the point where such compounds are condensed to the liquid or solid phase. This has been one of the difficult problems in the application of the Cottrell process, for the temperature of the gases must be sufficiently lowered to insure the sublimation of all volatile compounds, and with such reduction of temperature there is also condensed and precipitated the undesirable acid constituents of the gases which have so seriously interfered with electrical insulation.

CHANGES IN CHARACTER OF "FUME"

Another peculiar feature of more than passing interest was discovered in connection with the then inexplicable physical characteristics of the dry fume precipitated by the Cottrell treater. It has been mentioned that this fume was intended to be utilized in the manufacture of electrolytic zinc. It was found, however, that the electrically precipitated fume could not be leached; indeed, it persistently resisted every practical means of solution—the dry fume *could not be wetted* by water or any solvent that could be satisfactorily employed in relation to subsequent purification for use as a pure electrolyte. This fume, when placed in water, immediately floated to the surface, and continuous mechanical stirring for forty-eight hours failed to submerge or wet the particles.

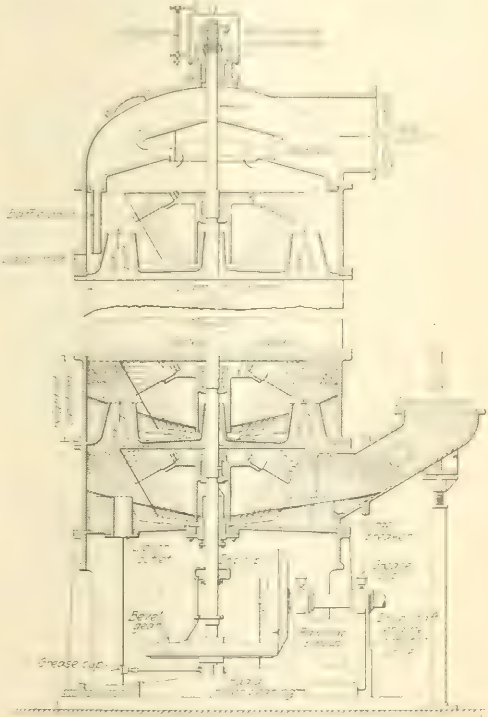


FIG. 1. GENERAL ARRANGEMENT OF THE FELD CENTRIFUGAL SCRUBBER

As a further experiment, samples of the fume were placed in a vessel and the water added therein was violently agitated by a stream of air (and later by live steam), but without success in wetting the particles. The only successful results were obtained by immersing the fume in a fairly strong sodium chloride brine, but this could not be employed, on account of the difficulty in eliminating the chloride that otherwise entered into the electrolyte. It was concluded, and later proved, that the impalpably fine particles of fume had adsorbed upon their surfaces considerable quantities of sulphur dioxide, and that water, or any other common solvent, at ordinary temperatures, was unable to displace the adsorbed films of gas. Only by subjecting the fume to high temperatures, or a preliminary roasting, could the fume be finally saturated with water sufficiently to effect solution.

The next experimental work was done with the Feld scrubber. This apparatus consists of a number of separate washing chambers, illustrated in Fig. 1, mounted one above the other. The ports or openings in the bottom of each chamber act as passages for the ascending gas, as well as overflows for the counter-current flow of the scrubbing or absorbing liquid.

The vertical shaft suspended from a self-centering, anti-friction bearing is provided in each chamber with a series of concentric frustums of cones. The number of cones varies with the size of the apparatus. The spacing between the bottom of the chamber and the bottom of the cones increases toward the shell, to provide for their equable immersion in the scrubbing liquid, as well as to secure adequate agitation to avoid deposition of solids. Fig. 2 illustrates a typical cone assembly.

When the vertical shaft revolves, these cones pick up or pump the scrubbing medium, which is thrown horizontally with considerable velocity through the outer perforated distributing cone. Additional impetus is given the liquid at this point by the greater rim speed of the distributor, and the liquid is projected through the gas space in the form of a fine, high-velocity spray, which, upon impact with the shell, is broken into a mist or fog. This alternating humidifying and scrubbing effect to which the gas is subjected in each chamber provides the intimacy of contact between gas and liquid necessary for the removal of finely divided insoluble matter or for the recovery of soluble constituents existent in extreme dilution, and also provides for the almost universal application of the apparatus as a scrubber as well as a reaction or absorption tower.

PRINCIPLE GOVERNING SCRUBBER'S EFFICIENCY

The effective utilization of the entire volume of scrubbing medium, as compared with the problematical contact in scrubbers of the grid type, or those in which the gas passes over wetted surfaces, can be realized by a consideration of the infinite number of smaller drops into which the normal globule is broken, as compared with the other types mentioned. A globule $\frac{1}{10}$ in. in diameter, broken up into drops having a diameter of $\frac{1}{100}$ in., would produce 1,000 of the smaller particles and would present ten times the original liquid surface to the gas stream. This increase in the amount of surface presented per unit volume of liquid assures greater penetration and consequent absorption of the soluble vapor constituents, and, if solids are present in the gas, enables such particles to be thoroughly emulsified by the scrubbing medium. This factor is enhanced by the number of liquid contacts, or recirculations, that take place in the counter-current flow through the apparatus. The number of contacts per unit volume of liquid varies with the service, ranging from a minimum of twenty-five per minute in physical service to a maximum of three hundred per minute in some chemical services.

These factors, responsible for the effective utilization of the liquid, enable the use of smaller volumes of scrubbing medium, thereby securing higher concentration of the effluent. In continuous operations, where liquid recirculation is practiced, marked economy in installation costs and power consumption is effected, owing to the smaller volumes of circulating liquid needed.

The vigorous liquid agitation eliminates the possibility of internal stoppages, as has been demonstrated on scrubbers operating for several years using liquids carrying suspended, insoluble, reactive material. Any liquid entrainment is removed from the gas by means of the deflectors or baffles in the dome, and the collected liquid is returned through the drain to the top chamber.

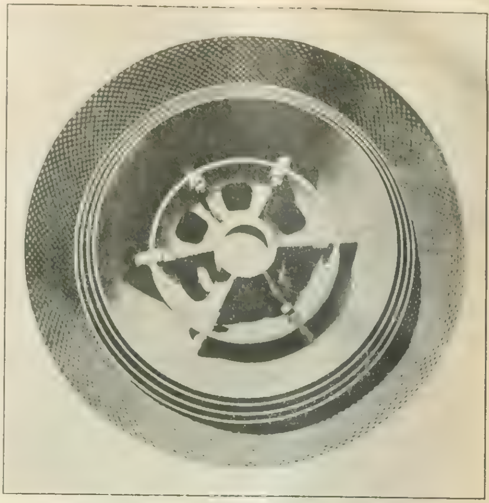


FIG. 2. A TYPICAL CONE ASSEMBLY IN THE FELD SCRUBBER

For primary washing, the Feld scrubber is ordinarily constructed with seven chambers or sections; the lower three being the washing chambers, the fourth one being a separating chamber and the upper three being the cooling chambers. The washing is accomplished mostly in the lower sections, whereas the upper sections perform primarily the function of cooling and dehumidifying the gas, all of the functions being subject to variation at will, depending upon the amount of gas passed through the scrubber and upon the volume and temperature of the scrubbing liquid used.

APPARATUS USED AT DUCKTOWN

The Feld gas scrubber first used in the Ducktown experiments was a standard design 5-ft. diameter, seven-section machine, manufactured by the Bartlett-Hayward Co., of Baltimore. It was estimated to be capable of cleaning 200,000 to 250,000 cu.ft. of gas per hour and was driven by a 10-hp. motor. The capacity of this scrubber was much more than required for the purposes for which the gas was to be utilized—namely, the production of elemental sulphur. The cleaned gas was delivered to the sulphur-reduction furnace wherein the sulphur dioxide, by reaction with incandescent coke, was reduced to sulphur vapor and condensed as "flowers of sulphur." The reduction furnace was capable of treating 40,000 to 50,000 cu.ft. of gas per hour; therefore, in the initial experiments, this volume of smelter gases, containing about 7 per cent of sulphur dioxide, was delivered to the scrubber.

It should be noted here that one of the essential requirements in the successful operation of the sulphur reduction furnace was that the gas should be cleaned as thoroughly as possible; otherwise the coke became quickly coated with zinc compounds to such an extent that the reactions were greatly diminished and uncontrollable; furthermore the elemental sulphur produced under such conditions was contaminated with zinc sulphide (or polysulphides), rendering it unmarketable. Also, it was found important that the moisture content of the gases be kept as low as possible, to prevent the formation of hydrogen sulphide, which seriously interfered with the reactions in the reduction furnace. These were some of the positive requirements placed upon the Feld scrubber, and it should be borne in mind that this was the first installation where this apparatus was employed for the cleaning of copper-smelter gases.

In the first trial, the scrubber was operated with a shaft speed of about 120 r.p.m. and with a flow of about 1,000 gal. of water recirculated through the scrubber per hour, but the gas did not appear to be perfectly cleaned, although a large amount of dust and fume was removed, as shown by the color of the wash water and by the steadily increasing amount of soluble zinc compounds as determined by analyses of the recirculated wash water. The cleaned gases contained less than 0.1 lb. of fume per 1,000 cu.ft., as compared with 2.1 lb. contained in the gas delivered to the scrubber—a recovery of approximately 95 per cent of the solid matter originally contained in the smelter gases. With this large volume of wash water, it was soon discovered that about 50 to 60 per cent of the sulphur dioxide contained in the entering gases was dissolved out or absorbed in the solution.

The next experiments were, therefore, devoted to reducing this absorption of the sulphur dioxide, and it was decided to discontinue the recirculation of the wash water, and to use only the amount of water necessary to reduce the temperature of the exit gases to the lowest attainable point, and correspondingly to permit the temperature of the outflowing wash water to rise to as high a point as permissible without incurring damage to the revolving lead cones of the washer. The shaft speed of the scrubber was also increased to 150 r.p.m.

The results of this experiment were immediately most encouraging, and it was soon found, with added experience, that the loss of absorbed sulphur dioxide could be reduced to a negligible amount, and the cleaning effect upon the gases was almost perfect. The extremely minute amount of fume that passed through the scrubber was invisible and the amount of water vapor present in the exit gases was little, if any, greater than the relative humidity of the outside atmosphere. The practical results attained through this degree of cleaning of the gases were evidenced by the fact that the elemental sulphur produced in the reduction furnace assayed as high as 99.2 per cent pure and contained less than 0.4 per cent zinc; whereas with the uncleaned gases, the zinc content in the recovered sulphur ran as high as 14 per cent.

OPERATING RESULTS

To illustrate the practical results obtainable (on the basis of cleaning 50,000 cu.ft. of smelter gas per hour), the following data may be of interest:

TABLE I. OPERATING RESULTS

Scrubber Section	Gas Temperature Deg. C.	Water Temperature, Deg. C.	Absorption Volumes SO_2 per Volume of Water
Top	Exit	Enter	
No. 7	38	24	33
No. 6	40	25.5	32
No. 5	43	27.5	30
No. 4	46	30	28
No. 3	49.5	33	25
No. 2	54	37.5	22
No. 1	60	43	17
Bottom	Enter	Exit	

Sulphur dioxide in gases entering scrubber, 6.0 per cent by volume.

Sulphur dioxide in gases leaving scrubber, 5.25 per cent by volume.

Specific heat of smelter gases, 25 lb. calories per deg. C. per 1,000 cu.ft.

Solubility of SO_2 in water, 17 volumes SO_2 per volume of water, at 43 deg. C. (temperature of outlet water)

Wash water used, approximately 175 gal. per hour, or 3.5 gal. per 1,000 cu.ft. of gas.

Operating the scrubber with an outlet-water temperature of 95 to 100 deg. C., practically no sulphur dioxide remains in the outlet water, and apparently, better gas-cleaning efficiency is obtained with the hotter water; but this practice is conducive to a greater content of water vapor in the exit gas. Therefore it was found to be more practicable to work with colder wash water, and where the loss due to absorption of sulphur dioxide might otherwise be too high, the saturated wash water was recirculated with practically no loss of sulphur dioxide.

The scrubber runs continuously twenty-four hours per day without other attention than occasional oiling of the bearings, and has fulfilled every requirement of a gas-cleaning apparatus.

CONDENSATION OF SULPHUR VAPOR

Having solved the problem of cleaning the smelter gases for use in the sulphur-reduction furnace, experiments were next undertaken in the recovery of the elemental sulphur produced from these gases. For this purpose a second Feld scrubber, identically like the first, was installed.

These experiments were particularly interesting, as they developed not only the problems of fume precipitation but those of chemical absorption and reaction as well. That the reader may appreciate the broad scope of application of the Feld scrubber, it may be well first to explain the nature of the reactions in the sulphur-reduction furnace and something of the conditions to be met in the condensation of the elemental sulphur. As has been mentioned, the sulphur dioxide is reduced to elemental sulphur by reaction with incandescent coke maintained at a temperature of 1,100 to 1,300 deg. C. by the passage of electric current through the coke mass. The cleaned smelter gas contains normally 6 per cent sulphur dioxide, which reacts with carbon according to the following equations:

$$2SO_2 + 2C = 2CO_2 + S_2$$

or

$$2SO_2 + 4CO = 4CO_2 + S_2$$

Under these conditions, the sulphur vapor present in the exit gases has a partial vapor pressure of about 14 mm. (normal barometric pressure at Ducktown being about 725 mm.). This corresponds to a condensation temperature of about 255 deg. C., at which point sulphur vapor of this partial pressure begins to condense to liquid. Below this point the sulphur continues to condense as liquid until a temperature of 115 deg. C. is reached; corresponding to a partial vapor pressure of sulphur of about 0.03 mm. With a *slow rate of cooling* of the gases, at least 95 per cent of the sulphur vapor should be condensed in the liquid form; or if the temperature drops below 115 deg. C. and if the gases are not slowly cooled, the sulphur vapor passes directly into the solid phase and collects as "flowers of sulphur." More rapid cooling will result in the formation of fume of impalpable fineness.

INSTALLING THE SECOND SCRUBBER

Now, the sulphur-dioxide content of the smelter gases does not remain at all constant, varying between 5 and 10 per cent, because of irregular charging of the ores into the blast furnace and irregularities in the furnace blast. These fluctuations in sulphur-dioxide content, of course, result in corresponding fluctuations in the amount of sulphur produced in the sulphur-reduction furnace, and in the partial vapor pressures of the sulphur, necessitating constant adjustment of the temperature conditions for the condensation and recovery of the sulphur. Such control of temperatures and rate of cooling could not be adequately governed, and as a result the sulphur vapor often became super-cooled, with the attendant formation of fume. This fume was so finely divided that, when borne in the exit gases, it readily passed through eight thicknesses of closely woven handkerchief linen without obstruction. It was to collect this fume that the second Feld scrubber was installed.

In the first trial of this scrubber, it was soon discovered that successful recovery operations depended not only upon the performance of the washer itself but upon the physical condition of the elemental sulphur contained in the gases as they enter the washer. Various allotropic modifications of sulphur may be produced, both in the liquid and solid phases, and, as has already been explained, these modifications are governed by the temperatures, vapor pressures, and the time element existing throughout the period of their formation or transformation.

If the temperature of the gases entering the scrubber is too high, the sulphur will be precipitated in a more or less plastic form, which, according to the operatives' views, resembles scrambled eggs. The sulphur, when allowed to precipitate in this form, then tends to collect in masses, and these masses, after being rolled around in the scrubber sections and increasing in size, become lodged in the overflow pipes, causing obstructions, which prevent the circulation of the scrubbing liquor. If the temperature of the gases is too low, the sulphur appears in an almost colloidal form, rendering subsequent recovery from the scrubber liquor very difficult, if not almost impossible. The most desirable condition is the formation of a pseudo-crystalline variety, quite similar to the commonly known "flowers of sulphur." In this form the sulphur is readily removed from the scrubber liquor either by settling or by direct filtration. In either of these forms, however, the Feld scrubber removes the last visible trace of sulphur from the gases, and the only attention necessary is the occasional regulation of the flow of wash water (about 100 gal. per hour) and, of course, the replenishing of lubricants to the bearings.

OPERATING DIFFICULTIES

Occasionally irregularities occur in the operation of the reduction furnace, and carbon-oxysulphide or hydrogen sulphide are formed through over-reduction; at other times sulphur dioxide may escape reduction by passing through channels or pipes in the coke mass within the furnace; but in either instance, these compounds are entirely absorbed in the scrubber, and, reacting with the saturated solutions which circulate in counter flow against the gases, produce a milky-white colloidal solution of sulphur, which is immediately recognized by the operating attendant. The second scrubber thus affords all of the various indicative factors necessary to the practical control of reduction and condensation. With this correlation of reactions and positive control, the sulphur is collected in the condensation apparatus almost entirely in the form of "flowers," and the Feld scrubber is called upon to function as a gas-cleaning apparatus only when the temperature control is inadequate.

In a theoretical discussion of the principles involved in the successful removal of finely divided dust particles, or fume, from suspension in gases, it is necessary to know something of colloids and adsorption; for anyone familiar with metallurgical smoke will undoubtedly agree that the smoke is composed of particles possessing an extremely high degree of dispersion. And it is now generally conceded that all solids tend to adsorb, or condense, upon their surfaces films of gas or vapor from the atmosphere into which they are brought in contact. The amount of adsorption in any given case is dependent upon the nature and physical state of the solid and also upon the pressure and temperature of the gas; in general, with increase of pressure or decrease of temperature, adsorption is augmented.

Not only do solids adsorb gases, but adsorption phenomena may be found among any pair of gaseous, liquid or solid phases, provided the temperature and pressure conditions are favorable and one of the phases is existent in a sufficiently dispersed form. Adsorption is purely a surface phenomena and probably a manifestation of the forces of adhesion. An extremely subdivided phase possesses a relatively large surface compared with the mass of any substance, for the surface varies as the square of its unit measure, whereas the volume varies as the cube of that dimension.

Considering a cubic foot of any solid material subdivided into smaller cubes, or a cubic foot of any liquid subdivided into small spheres or drops, it may readily be seen how rapidly the number of particles and their aggregate areas increase. Thus a cube containing one cubic foot has an area of 6 sq.ft., whereas a sphere of the same volume has a diameter of approximately 14.89 in. and an area of 4.85 sq.ft.; and, by subdivision, the number of particles and their aggregate areas will be as follows:

TABLE II. SUBDIVISION OF CUBES AND SPHERES

Equivalent to One Cubic Foot			
Number of Particles, as Cubes	Number of Particles as Spheres	Diameter or Length of One Edge Inch	Aggregate Area of Particles, Sq.Ft.
1,728	3,300	1.0	72
13,824	26,400	0.05	144
110,592	211,247	0.25	288
1,728,000	3,300,000	0.1	720
13,824,000	26,400,000	0.05	1,440
27,000,000	51,560,000	0.04	1,800
64,000,000	122,200,000	0.03	2,400
216,000,000	412,500,000	0.02	3,600
1,728,000,000	3,300,000,000	0.01	7,200

It will be noted that, comparatively, the aggregate areas of spheres and cubes is the same when the diameter of the sphere is taken equal to the length of one edge of the cube.

Now, as far as can be determined by most careful observation (for actual determination cannot be made), the spray produced by the revolving, perforated cones of the Feld scrubber is comparable with the finest mist particles. The peripheral velocity, or rim speed, of these cones is about 1,800 to 2,000 ft. per minute, and at this tangential velocity the scrubber liquor is projected through the gas space in the form of very fine spray, which, upon impact with the shell, is still further subdivided into a mist or fog.

According to the U. S. Weather Bureau, rain appears to begin when the drops reach a diameter of 0.04 mm. (0.0016 in.), and in Bentley's experiments on the size and frequency of raindrops, the following data were obtained:

TABLE III. SIZE OF RAINDROPS

Apparent Size of Drops	Diameter of Drops	
	Millimeter	Inch
Very small	Under 0.8	Under 0.03
Small	0.8 to 1.5	0.03 to 0.059
Medium	1.6 to 3.5	0.063 to 0.137
Large	3.5 to 5.0	0.137 to 0.197
Very large	Over 5.0	Over 0.2

It is not an unreasonable estimate to place the average size of drop produced by the Feld scrubber as not exceeding 0.01 in. in diameter; therefore, as shown in Table II, each cubic foot of liquor atomized within the scrubber will produce about 3,300,000 liquid particles, having an aggregate area of 7,200 sq.ft. On this basis, it may prove interesting to calculate what intimacy of contact may be attained between these particles of liquid and the particles of fume carried by the gases in passing through the Feld scrubber.

CAPACITY OF FELD SCRUBBER

A 5-ft. diameter seven-section Feld scrubber will clean approximately 200,000 cu.ft. of gas per hour (55.5 cu.ft. per sec.) and will require about 20 gal. (2.675 cu.ft.) of scrubbing liquor for each 1,000 cu.ft. of gas cleaned (or 0.002675 cu.ft. of liquor per cubic foot of gas). On the same basis, 1.1 gal. of scrubber liquor each second will be delivered to the scrubber. The gas space contained in a scrubber of this size is about 150 cu.ft., so that a unit volume of gas takes about 2.7 seconds' time in which to pass through the scrubber.

In each chamber or section of the scrubber, the liquor is picked up by the revolving cones, dashed into spray and mist, the latter coalesced and precipitated to the bottom of the chamber only, in turn to be picked up by the cones, and the cycle repeated in a period of about one-half second. Thus, by means of each set of cones, revolving with a peripheral velocity of 1,800 to 2,000 ft. per minute, about two gallons of liquor per second will be atomized, and as about one gallon of liquor is delivered to the scrubber each second, it will become atomized and coalesced approximately twice each second in each section of the scrubber, and, in the seven sections of the scrubber, this effect is attained fourteen times during each second the scrubber is in operation. Therefore, during the 2.7 seconds, in its passage through the scrubber, each cubic foot of gas will be penetrated by $2.7 \times 14 \times 0.00267 \times 3{,}300{,}000{,}000 =$ approximately 333,679,500 particles of scrubber liquor.

One cubic foot of Ducktown fume in a compressed (or solid) state weighs approximately 312.5 lb. Each 1,000 cu.ft. of smelter gas contains about 2.2 lb. of fume, or 0.0022 lb. of fume per cubic foot of gas, or a volumetric equivalent of 0.00000705 cu.ft. of fume. Suppose all the fume will pass through a 200-mesh screen: the fume particles will have a diameter of approximately 0.00236 in. The number of particles can be computed from the formula:

$$n = \frac{6 \times V \times 1728}{d^3}$$

where

n = *number of particles,*
V = *volume of original mass in cubic feet,*
d = *diameter of particles in inches.*

Substituting:

$$n = \frac{6 \times 0.00000705 \times 1728}{0.00236 \times 0.00236 \times 0.00236}$$

$= 5{,}620{,}000$ *particles of fume per cubic foot of smelter gas.*

From the above, it will be seen that the ratio of liquor particles to fume particles is 333,679,500 to 5,620,000, or about 60 to 1. Therefore, each particle of fume is exposed to contact with sixty particles of liquid during its passage through the scrubber, and, during its long and circuitous course of travel in the midst of the cyclonic swirling of the gases, it is almost impossible for a particle of any substance to escape repeated contacts with the atomized scrubber liquor.

The volumes of flow of both the gas and the liquor are at all times under control and can be varied and relatively proportioned to meet operating conditions within the rated capacity of the scrubber. The wonderful effectiveness and efficiency of the Feld scrubber, as a gas-cleaning apparatus, may thus be more readily appreciated.

EFFECT OF IONIC ATTRACTION

Now to return again to more theoretical considerations: It may readily be shown by experiment that when drops of water are broken up as in falling raindrops, or by atomizing water by means of spray nozzles the particles become positively charged with electricity. The positively charged particles condense more readily on negatively charged particles or on negative ions than they do on positively charged particles, and, also, liquid drops take up negatively charged particles or ions more readily than positive ones.

When dust is blown about by the wind, it becomes charged electrically, and from experiments made by Rudge, the following generalizations were deduced:

1. Non-metallic elements give *positively* charged clouds when the finely divided solid material is blown into a cloud by a current of air.
2. In similar manner, metallic elements give *negatively* charged clouds.
3. Solid acid-forming oxides give *positively* charged clouds.
4. Basic oxides give *negatively* charged clouds.

In the treatment of material containing or constituting salts, the charge apparently depends on the relative strength of adsorption of positive and negative ions.

Finely divided metallic sulphides generally acquire a positive charge, but the metallic oxides, sulphates, and sulphites acquire negative charges. In general, it has been found that highly dispersed substances, suspended either in gases or liquids, carry electrical charges, and this is particularly true of colloidal and ionized substances. It may be stated that, as a rule, basic colloids acquire negative charges, whereas acid colloids acquire positive charges.

RALSTON'S CONCLUSIONS

Ralston states that "the amount and sign of the electric charge on a suspended particle depends entirely on the composition of the solution in which it is contained, so that it is possible to make this charge either positive, negative, or zero, by the use of proper proportions of the proper electrolytes." The same conditions are found to be generally true in the case of finely subdivided particles in suspension in gases, and for the same reason—namely, the minute particles exhibit all of the phenomena associated with adsorption; they acquire surface films derived from the preponderant free ion present in the fluid (either liquid or gaseous) in which the particles are suspended, and, in metallurgical smoke, the particles are usually *negatively* charged.

Bivalent compounds or substances appear to acquire relatively higher electrical charges than monovalent compounds, and trivalent compounds carry even higher charges; the higher the valence of the cation, the greater will be the electrical charge-carrying capacity: therefore, polyvalent compounds, or rather ions, such as the ferrocyanides, ferricyanides, phosphates, and chlorates, are found to carry the highest charges, and the cations of these salts are found to be very easily recovered in the Feld scrubber.

LAWS THAT GOVERN FLOCCULATION AND PRECIPITATION

The relationship between adsorbed films and the accumulation of electrical charges upon the surfaces of minute particles is undoubtedly a most intimate one; indeed, it may be said that the one is more or less dependent upon the other. The extensive research work that has been done in connection with the study of the flocculation and deflocculation of slimes and the coagulation of colloidal solutions all seems to lead to the same conclusion, and it may be further stated that those conditions which favor flocculation of slimes and precipitation of colloids also favor the precipitation and removal of fume particles from gases. Each particular case will generally be found to possess some particularly individual characteristics, but the general analogies will hold throughout. In the flocculation of slimes, one has to deal with finely divided or colloidal particles suspended in liquids; with fume, one has the same characteristically minute particles of matter suspended in gases.

If an electrically charged solid particle is free to move, as is the fume particle suspended in the gas-stream, it will be attracted to any particle or body that is oppositely charged, and will move at a rate proportional to its charge or the potential difference between the particles, the force of attraction varying inversely as the square of the distance between the particles. Of course, the electric charges borne by the particles are very small, but they are, nevertheless, of sufficient magnitude to develop a force of attraction between oppositely charged particles, or a force of repulsion between particles having like charges; provided that any two of the particles are brought within their radii of action.

FORCES AFFECTING OPERATION OF SCRUBBER

The forces effective in the operation of a Feld scrubber may now be considered. The spray or mist particles produced in the scrubber are *positively* charged, whereas the particles of fume contained in the smelter gases are *negatively* charged, and, all the physical conditions being such that these oppositely charged particles are brought into most intimate contact, the result is that these particles are mutually attracted and the fume particles are wetted and submerged within the liquid and thus removed from the gas stream.

The various factors and calculations adduced in explanation of the functioning of the Feld scrubber in cleaning metallurgical smoke afford interesting studies that may be applied to various individual services, either in the scrubbing of industrial gases or in its use as a reaction tower for the conduct of chemical operations.

Its operating results would indicate that former failures in the wet treatment of fume were due to inherent faults in the apparatus employed, and are proof of the efficacy of water scrubbing when the essential intimacy of contact between gases and liquid is actually assured.

The combination of the various desirable features mentioned, together with its simplicity of installation and operation, make the Feld scrubber an apparatus that should attract the consideration of the metallurgical industry as a whole.

Production of the French Bauxite Mines

The increase in the production of the French bauxite mines has followed closely the development of the aluminum industry, according to Ernest L. Ives, Consul at Paris, in *Commerce Reports*. From 21,707 metric tons of bauxite extracted in France in 1890 the production increased to 309,294 metric tons in 1913. In this amount the various producing regions were represented as follows: Var, 258,074 metric tons; Herault, 43,800 tons; Bouches-du-Rhone, 4,270 tons; Ariege, 3,150 tons.

During the same year the world's production of bauxite was given as follows: France, 309,294 metric tons; United States, 213,605 tons; Italy, 6,952 tons; England, 6,153 tons. Therefore, previous to 1914 the French production represented about 58 per cent of the world's production of bauxite, and the production of the United States represented 40 per cent.

The war greatly modified the situation. From the beginning of hostilities France was obliged to limit its exports and consumption, and also the production of its bauxite mines. In 1915 the production amounted to only 56,522 metric tons; in 1916, 106,200 tons; in 1917, 120,916 tons, or about one-third of the peace-time production. Of this amount 101,748 tons was suitable for the production of aluminum.

In contrast, extraction in the United States increased from 297,041 tons in 1915 to 568,690 tons in 1917. Since that time French production went up noticeably, and it is reported to have reached 160,685 tons in 1919. However, the present economic crisis has also affected the aluminum industry.

In 1913, when the bauxite production of other countries was insufficient to cover their needs, France consumed 141,729 metric tons and was able to export over half of its production, or 168,439 metric tons, which was shipped principally to the following countries: The Netherlands, 51,333 metric tons; England, 49,695 metric tons; Germany, 31,156 metric tons; United States, 12,173 metric tons; Belgium, 10,980 metric tons; and Switzerland, 1,823 metric tons. Before the war France supplied bauxite to the principal markets. It was, however, losing the United States market, the exports to which decreased from 33,189 metric tons in 1911 to 12,173 metric tons in 1913.

This situation could not be maintained during the war. As early as 1915 France exported only 41,448 metric tons of bauxite, or one-fourth of the 1913 exports. This tonnage increased to 62,802 metric tons in 1916, but decreased to 39,341 metric tons in 1919. The following year saw a considerable increase in French exports of bauxite, which amounted to 130,031 metric tons, over 80,000 metric tons of which went to England and about 30,000 metric tons to the United States. England thus became the chief importer of French bauxite.

According to reliable opinions, it is thought that the French production of aluminum is likely to increase from 25,000 to 30,000 metric tons, as compared to 13,500 metric tons in 1913. The probable French consumption of bauxite might then be about 200,000 metric tons per year. This, however, is a purely approximate figure and its realization might be far off if the present economic situation continues.

The French mines, which produced over 300,000 metric tons of bauxite before the war, will be in a position to fill the needs of the national industry, and there will still remain a large exportable surplus.

Iron Mining in India—Tata Iron & Steel Co.

MINING A RICH POCKET OF FLOAT, GORUMAHISANI MINE

LOADING IRON ORE, STOCKPILED AT MINE

LOADING ORE INTO CARS, OR "TUBS"

SCREENING FLOAT ORE AT GORUMAHISANI MINE

STOCKED IRON ORE AT JAMSHEDPUR FURNACES

HAND DRILLING IN DOLOMITE QUARRY

The Joplin District in 1921

BY JESSE A. ZOOK

[illegible] Engineering and Mining Journal

THE year 1921 was one of retrenchment in readjustment of the mining business to accommodate new conditions. The feature of the year in the Joplin zinc-lead mining district was the admirable manner in which a complete rearrangement was effected. Losses were discharged to that account, and the meager profits, where made, were accepted as a gift. Mines, one after another, were closed down, until only those with the richest ore deposits could afford to operate, and even these would have failed to produce a profit with any class of labor other than the wholly American element employed in this district. Men accepted, one after another, the necessary wage reductions and even gave more of themselves in order to keep in operation the few mines able to withstand the shock. Mine owners and miners gave of their substance, by donations to a permanent road improvement fund, to aid miners finding no mine employment. There were instances of want but none of distress, many being cared for by individuals and organizations contributing to funds and finding employment at odd jobs for those in need. "Find something for men to do" was the policy pursued, which was a greater aid than letting men be obliged to ask for charity.

The output of Oklahoma was all from Ottawa County and of Kansas from Cherokee County. Of the total Missouri shipment all but 1,214,780 lb. of blende, 120,860 lb. of calamine, and 49,880 lb. of lead was produced in Jasper County, the tonnage excepted being the contribution from Newton County. No other county in southwest Missouri made ore shipments through purchasing agents in this district.

Newton County, with over 8,000 tons of calamine shipped in 1920, found a market for only 60 tons last year. Greene, Ozark and Barry counties gave out some mineral wealth in 1920 but none in 1921. Arkansas, with little in 1920, reported less in 1921.

Readjustment lost to the Joplin district, according to 1921 valuation standards, almost $25,000,000. The decrease was 245,000 tons of blende, 10,075 tons of calamine, and 23,581 tons of lead. According to pre-war standards, the 1921 valuation is almost $2,000,000 below that of 1914 and more than $4,000,000 under that of 1913, though the tonnage of both blende and lead in 1921 exceeded either of those years.

The average weekly shipment of blende in 1921 was 6,118 tons. Stocks in bins at the mines increased during the year 12,000, or 231 per week, indicating an average production of 6,349 tons per week. Demand for lead ore, in disproportion to its occurrence with zinc ore, occasioned the increased stock of blende. Operations at a number of mines were primarily for lead. Association of the two ores accounted for the blende production in excess of the demand.

PRICES

The blende in demand for the manufacture of Prime Western grades of slab zinc began the year on a basis of $29 per ton of 60 per cent zinc, declining the first week to $27.50 and in the fourth week to $22.50. This level held, with the exception of $21 the first week of March, until in the third week of April it was advanced to $25 for four weeks. In mid-May it dropped back to $22.50 and to $21 on the first and $20 at the end of June, holding this level to the last week in August, when for two weeks a considerable tonnage was purchased on a $19 basis. The end of September reinstated the price level to $21. In October it was $22.50, $25, and $23. Throughout November a $25 basis prevailed, at which figure 30,000 tons of reserve stock was sold to avoid an Oklahoma taxation of $2 to $3 per ton. December opened with $26 and closed with $29 basis, re-establishing the opening quotation of the year. Grades of blende used in the manufacture of sheet zinc sold during a large part of 1921 on a like basis with Prime Western, on account of the restriction of production of sheet zinc while the market was absorbing war stocks.

Following the period when the greatest record price ever attained for zinc calamine was reached in 1920, the demand for this product entirely disappeared, except for a few transactions in mid-year on a $10 to $12 basis for 40 per cent zinc, a price so low that all production was suspended.

Lead concentrates were on $55 basis for 80 per cent lead at the beginning of 1921, declining to $50 on the first and to $35 at the end of February, continuing to mid-March, when it advanced to $40 on the upward trend to $60 in mid-May, then declining steadily to $40 by the end of June. The reaction following sent it as steadily upward to $60 at the end of September, dropping to $55 at the end of October and to $53.50 at the end of November, when it was advanced by renewed demand to $54, and closed the year at $58.

SHIPMENTS OF ZINC BLENDE, CALAMINE AND LEAD IN THE JOPLIN DISTRICT, 1921, WITH VALUES

	Blende, Pounds	Calamine, Pounds	Lead, Pounds	Value
Oklahoma	467,630,340	....	100,656,500	$8,133,330
Kansas	131,103,170	......	27,928,610	2,327,280
Missouri	38,801,150	120,860	2,761,230	565,250
1921 Total	637,534,660	120,860	131,346,340	$11,025,860
1920	1,127,532,560	20,271,740	178,508,930	35,619,560
Decrease	489,997,900	20,150,880	47,162,590	$24,593,700

ORE PRICES IN THE JOPLIN DISTRICT FOR TWELVE YEARS

Per Ton of 2,000 Pounds

	Zinc		Lead	
	High	Average	High	Average
1910	$52.00	$40.42	$58.00	$51.98
1911	51.00	39 90	64.00	56.76
1912	67.00	53.33	68.00	56.60
1913	59.00	42.26	58.00	52.52
1914	54.00	40.46	54.50	46.55
1915	138.90	79.30	80.00	55.08
1916	131.70	84.72	104.80	84.07
1917	101.95	67.70	135.50	98.00
1918	78.70	51.33	106.00	88.98
1919	57.60	43.08	89.00	66.43
1920	61.50	46.49	112.50	95.40
1921	36.85	24.49	65.20	51.92

MONTHLY AVERAGE PRICES OF BLENDE, CALAMINE AND LEAD IN 1921, IN THE JOPLIN DISTRICT

Per Ton of 2,000 Pounds

	Blende	Calamine	All Zinc Ores	Lead
January	$31 46	......	. . .	$49.47
February	25.86	....	......	47.02
March	22.89	$16.00	$22.86	45.51
April	22.90	10 00	22.89	44.98
May	23.88	15.10	23.41	56.19
June	23 78			48.17
July	21.96			44.97
August	21.67			49.61
September	22 56			53.56
October	22.74			59.65
November	24.35			58.82
December	25.96			56.99
Year	$24 49	$14.03	$23.77	$51.92

The Calumet & Arizona

Deepest Level Most Promising of Those Opened So Far Copper Occurs In Lenticular Masses Ore Is Direct Smelting, Requiring No Milling

By JAMES H. McCLINTOCK

Written for Engineering and Mining Journal

TO THE WESTWARD of Bisbee, barely outcropping at several points, is a modest showing of quartzite, lying just below limestone. Save among district geologists, this quartzite is not given proper honor. In fact, it is the flooring of the district, bearing upon it the limestone within which have been and are being found the wonderful copper orebodies for which Bisbee has world-wide fame. From its surface showing above Bisbee it runs deeper and deeper to the eastward, until at the Campbell shaft of the Calumet & Arizona the steady 15 per cent dip is expected to give ore down to 4,000 ft. Without doubt, there remains 700 ft. more of stoping ground below the present bottoming of Calumet & Arizona's Junction shaft, which has its sump down to 2,350 ft., this being the deepest in the district. This statement, if properly digested, may give the reader an idea that Bisbee will be a thriving camp long after the demise of the men now operating its mines.

The Calumet & Arizona for ten years has been dropping its "center of gravity" just 11 ft. a year. By this expression is meant the mean depth of ore-stoping operations. This center is now below the 1,500 level. In reality, the lowest mining work is along the 1,800 level of the Junction, with 1,200 ft. yet to be explored below to the expected bottoming of the matrix limestone. It should be stated here that whereas ore was found in the company's uppermost mine, the Irish Mag, at 450 ft., the Junction shaft went through about 700 ft. of barren ground before striking pay rock. Yet in that same shaft was exhibited the very unusual feature of cutting two orebodies, one below the other. The first was 50 ft. thick at 900 ft. depth and the other 30 ft. at 1,800 ft. On this last level have been found three orebodies of high-grade ore. Indeed, according to the assistant general manager, I. B. Joralemon, more ore is likely to be developed on this 1,800 level than on any other of the mine. As yet the 1,600 level is by far the biggest ore producer.

It should be explained that the limestone is far from being uniformly impregnated. The copper occurs in lenticular masses, the longest of which, in the Calumet & Arizona, was about 500 ft. in extreme dimension. New bodies are found by exploratory drifting, usually along seams or leaders that are readily recognized by the experienced miners. Yet thousands of feet of work of this sort has been done in the district without result. The only surface copper ore ever found in the district was at the famous Glory Hole, just above the business section of Bisbee. Thence the ore is found at greater and greater depths. Irish Mag bottomed in the quartzite at 1,350 ft.

The average of the ores of the Calumet & Arizona is 5 per cent copper, though still richer ores are coming from the lower levels, where the product is singularly "brassy" chalcopyrite and bornite, so heavy that only 8 cu.ft. are required to make a ton. It averages at least 35 per cent sulphur, with occasional rise to 44 per cent. At the smelter this excess sulphur is eliminated by roasting down to 7 per cent. Little silica is found anywhere on the property. At one time there was exchange of heavy sulphides for the siliceous ores of the Old Dominion at Globe, but this had to be suspended when freight rates rose. On this account, for siliceous ores, the purchase of the Eighty-five mine, near Lordsburg, N. M., was made.

Calumet & Arizona has a total holding of 2,300 acres, rather generally in the zone of ore probability. Of this only 230 acres has been explored. So, laterally, as well as with depth, there is much ground for development.

Some day the Campbell shaft will be the main opening of the Calumet & Arizona. It now is 1,700 ft. deep, and connects with the Junction, about 2,500 ft. distant, on the 13th, 14th and 16th levels. Work on the Campbell has been suspended until completion of a new drift on the Junction 1,800 level, this to drain the new shaft. As soon as the Campbell concreting is finished to the 1,700 level sinking will be resumed to 2,300 ft., probably the base depth for many years to come.

Junction, the main shaft today, is to have concrete work continued down to 2,300 ft., but with its lowest working level at 2,200 ft., leaving the sump below for skip clearance and other needs. A great pump station is to be placed at the 2,200 level, raising water to the surface in one great lift, at a pressure of over 900 lb. per sq.in. The pumps are now lifting a steady flow of 3,300 gal. a minute, at a cost of over $25,000 a month. If the pumping were to be considered as a single item, and not in connection with the general work, the expense probably would be double this sum. The Junction pumps for the whole mining basin, this work continuing in the present slack period just as in the busiest of times. The only other pumps operated are on highly acid water at the Copper Queen's Czar shaft, the handling of which requires special equipment.

Ore has been developed in the Bisbee district over an area that is two and one-half miles from north to south and two miles wide. Its western limitation is believed to be known, but its eastern extension is merely guesswork. On the northeast, the Dividend fault cuts it off.

Calumet & Arizona is now continuing development work only from the Junction and Briggs shafts. It is remarkable as one of the few Arizona mines that handles a single class of ore by a single simple reduction process, that of straight smelting and of matte bessemerizing. The company owns no concentrator and needs none. It also has little oxide or carbonate ores. Ores now worked are primary in character. The company has a modern and efficient smelting plant at Douglas, and a sulphuric-acid plant, designed primarily to provide for the needs of the leaching tanks of the New Cornelia.

Calumet & Arizona is under the general management of John C. Greenway, once a lieutenant of Rough Riders and in the Great War a distinguished and much honored soldier, who rose to regimental command. His activities also include the operations of the Calumet & Arizona subsidiary, the New Cornelia, at Ajo

Mining Engineers of Note

Samuel John Truscott

SAMUEL JOHN TRUSCOTT, now of London, has seen nothing of American mining, but he has, nevertheless, observed a good bit more of mining throughout the world than falls to the lot of the average engineer. Born at Fowey, in Cornwall, in 1870, he early caught the mining spirit among the mines of Cornwall. Entering the Royal School of Mines in 1886 he was graduated in 1889. His first position was an interesting and adventurous one in far-off Singapore—which is not so strange, considering the great fondness of Britishers for travel and adventure in foreign lands and the mining engineer's tendency to work in odd corners of the earth—with a firm of mining engineers who placed him successively as assayer for a gold mine in the Malay States, manager of an alluvial tin mine, surveyor in the location of a government trunk road, and explorer of a ruby mine in Siam. He was once involved in a native rebellion and lost house and equipment. The jungle of that day has given way to the modern rubber plantation or has been removed to expose valuable tin deposits. "My sojourn was too early for these developments, nor could I foresee them," says Mr. Truscott. On his way home in 1892 Mr. Truscott visited Japan, and particularly the Ashio copper mines. Traveling through Canada down to New York, he proceeded to England. Again he took to the outskirts of civilization, passing through Johannesburg to an appointment in the romantic Lydenburg district of the Transvaal. Kopje, and veldt, kraal and sunshine are now his pleasant remembrance of that experience. It was not long, however, before the Witwatersrand absorbed him, and in succession he served as assayer, sampler, and finally engineer with John Hays Hammond and H. H. Webb, being in South Africa during the stirring times of the Boer war. The work with Hammond extended over the period during which that engineer was in a Pretoria prison in company with Rhodes, Farrar, and Fitzpatrick under sentence of death for participation in the famous Jameson raid. The mine of which he was then manager, the Nigel Deep, was naturally shut down. His stay in Johannesburg brought him into pleasant contact with Pope Yeatman, H. Hellman, and many other Americans. Striking out for himself, Mr. Truscott gave up the connection established in South Africa and returned to England to publish an accumulation of technical notes. This work finished, he went to the Ural Mountains of Russia on a reconnaissance associated with Hammond. Little resulted from this visit, as the important copper mines now known in that district were not then appreciated; their value is the creation of arts of mining and dressing subsequently developed. The head-hunting Dyaks and the orang-utan were his next neighbors on a year's exploration of Central Borneo. Then he became manager of a gold-silver mine in a beautiful part of the northern arm of the irregularly shaped island of Celebes. Here again he became involved in native trouble necessitating military relief. He afterward was made leader of an exploring party on the Ivory Coast of West Africa, and in 1902 returned to the Rand, but, receiving an attractive offer to assume the management of an important gold-silver mine in Sumatra, he accepted it and remained there until the successful results of his efforts made it possible for him to think of retiring. Later in London Mr. Truscott occupied himself as consulting engineer to interests in the Dutch East Indies, was an anonymous contributor of London items to *Engineering and Mining Journal* and during a short absence of T. A. Rickard acted as editor of the *Mining Magazine*. He is a member of the council of the Institution of Mining and Metallurgy, and of the A.I.M.E. He has written a book on "The Witwatersrand Goldfields: Banket and Mining Practice," and a translation of "Ore Deposits," by Beyschag, Vogt, and Crush.

SAMUEL JOHN TRUSCOTT

Mr. Truscott entertains a high regard for the American technical press, having recently written: "Were it not for the excellent technical periodicals of your country, the fact that I have seen nothing of American mining would stamp me as lopsided. But your periodicals are so good, and I have read them so assiduously, that I may fairly claim to have a balanced view of my subject. I look forward, however, shortly to acquire information and inspiration by an actual visit to the United States."

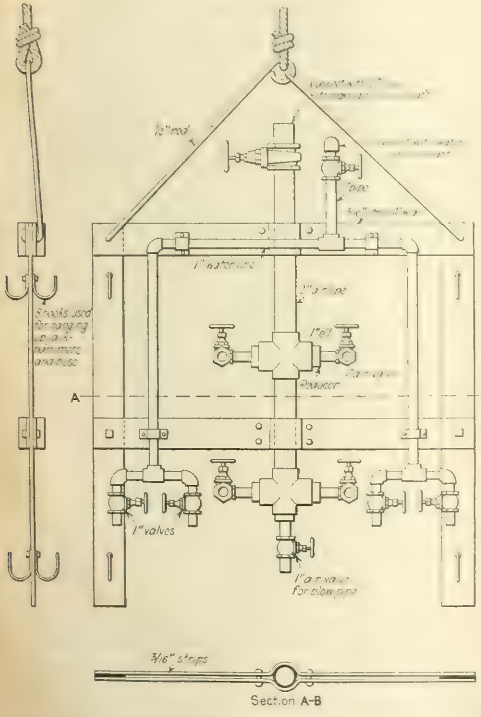
HANDY KNOWLEDGE

Drill Rigging for Shaft Sinking

By M. J. Elsing

Written for *Engineering and Mining Journal*

A drill rigging is used to some extent for shaft sinking in the Southwest and has given considerable satisfaction. After the last bucket of muck has been hoisted, the rigging, which is shown in the accompanying sketch, is lowered from the surface and hung from the last timbers in the shaft at a height convenient for drilling. One air and one water connection is made, after which drilling can be immediately started. The individual drills are all connected and are hung on the different hooks ready for immediate operation when they are needed.



SHAFT SINKING DRILL RIGGING

The rigging can be made in any blacksmith shop. The equipment consists of ordinary air and water pipe, reducers, street ells, and valves. All are assembled more or less as shown in the sketch. The hooks should be sufficiently large to hang a drill on, as well as several coils of hose.

The rigging, as shown, consists of connections for air and water for four drills and also a connection for a blow pipe at the bottom. It is a simple matter to make it for six or seven drills, if desired. It is always well to have an extra drill or two to replace one that may get out of order.

When the round is completed, the men hang the drills on the hooks and the rigging is hoisted to the surface, where it remains until it is needed for the next round. Defective hose or drills are replaced and everything is put in good order for the next round. The time that can be saved by the use of this simple device is surprising. Every shaft crew that has tried it in this district has indorsed it enthusiastically.

Bolt and Nut Trays

By Donald M. Liddell

Written for *Engineering and Mining Journal*

In a mill that I recently visited the master mechanic had taken a lot of old elevator buckets and nailed them against the wall to hold the various sizes of bolts, nuts and washers for which there was constant use. A small hole had been bored in the bottom of each bucket, so that if water accidentally got in it would run out. Small-size buckets were used for the small-size hardware and big buckets for the large. The wedge shape of the buckets makes it possible to put them closer together and to get into them more conveniently than any other form of tray that I have seen.

Pre-Heating Air for Reverberatory Furnaces

By N. L. Stewart

Written for *Engineering and Mining Journal*

A great many smelter men have considered pre-heating air for reverberatory furnaces. Of course, in many plants it would not be desirable to utilize the waste heat in heating air, but where electric power can be purchased at a reasonable figure it might be more economical to use the waste heat in this manner than for generating steam.

The stumbling block generally has been the flue dust. If checker work or tubes were used, it was difficult to keep them clean.[1] It has been demonstrated recently, however, that waste-heat boilers can be kept clean with soot blowers, and therefore it is reasonable to suppose that pre-heating tubes could be cleaned in a similar manner. It is proposed to pass the gases first through a small set of boiler tubes, and afterward through a large set of air-heating tubes.

With the arrangement shown in the accompanying sketch the small number of steam tubes would stop all molten flue dust and chill the gases enough to prevent burning out the air-heating tubes. The small amount of steam produced could be used for blowing the tubes and for heating buildings around the plant. Also, the blower might be driven by a steam turbine instead of a motor. The location of the soot blowers is not indicated. The proper number and location might have to be determined by trial.

The following assumptions were made: Air raised 500 deg. F. above atmospheric temperature; a reverbera-

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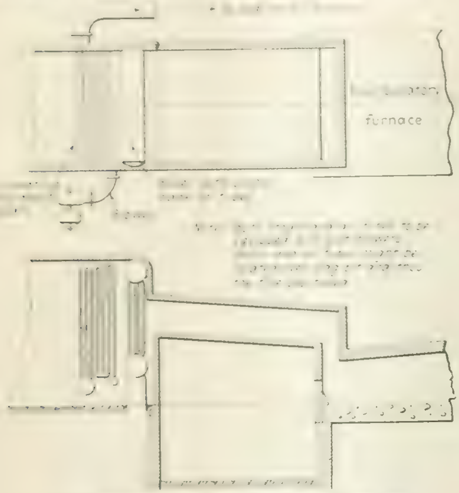
[1] *Engineering and Mining Journal*, July 16, 1921, p. 101.

[illegible] furnace requires 100 tons of coal per twenty-four hours, which, at 100 cu.ft. of air per lb. of coal, requires 13,900 cu.ft. of air per minute at atmospheric temperature (a small amount of air would leak through the brickwork); velocity in air tubes about 3,000 ft. per minute; heat transfer 0.03 B.t.u. per minute per sq.ft. per degree difference in temperature. This would require 4,100 sq.ft. of heating surface, = 135 pipes 6 in. in diameter and 20 ft. long; about 110,000 lb. of heating tubes, costing approximately $12,000.



ARRANGEMENT FOR PRE-HEATING AIR FOR REVERBERATORY FURNACES

It should be noted that the air is shown as going up one set of tubes, down another, up two sets of tubes and down three. This allows for expansion of the air.

When using pre-heated air in a reverberatory it would be necessary to close the firing end of the furnace tightly. If this tended to burn out the end wall, it might be necessary to replace the wall with a water jacket. Judging by the above stated figures, the cost of such an installation should not be prohibitive.

Pulling Rope for Locomotives

By H. H. Hunner

Written for Engineering and Mining Journal

Breaking in or pounding down a new track over fresh fills and a soft roadbed with modern big equipment is conducive to numerous "spills." If one is trying to keep a 300-ton shovel busy digging earth at the same time, something speedy is needed as a re-railing aid. The following method of using a pulling rope in conjunction with a re-railing frog was devised by George Leibig, pit foreman for the Cornwall Ore Bank Co., of Cornwall, Pa.:

The rope may be cut from old hoisting rope and should be about 1½ in. in diameter and 25 ft. long. Tie or clamp one end of the rope to a hook and the other to a coupling link. If tied, the first pull of the locomotive will make a never-slip knot. It is also easier and quicker to re-tie the rope than to change cable clamps if a tear occurs.

The section ahead of a derailed truck is uncoupled and the link end of the rope attached to this. The hook is caught in the truck frame back of the journal box on the side which will draw the wheels to the track. After the wheels are pulled close to the rails, the replacing frogs are used along with the rope. The side pull of the rope on the truck crowds the wheels to the rails and counteracts the overturning effect of a loaded car on the frogs.

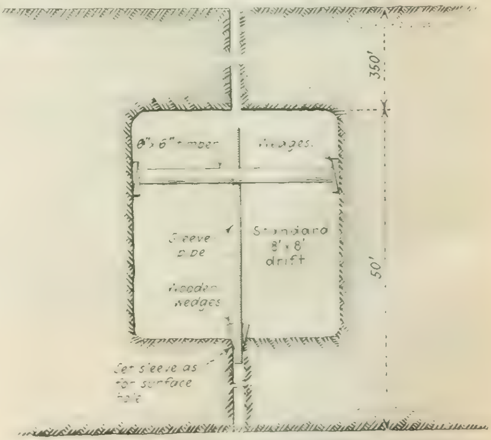
Warped "A" frogs can be used and need not be blocked up or fastened to the ties. With trucks askew of the track on an extra hard pull, a second engine to shove may avoid a possible tear in the rope, and save time. Nearly any derailed car can be quickly replaced without unloading and with little damage to the track. Where a piece of track is giving trouble, the ropes are carried on the locomotives, and only fifteen or twenty minutes are required as a rule for jobs that formerly took one-half hour to three hours.

Completing Diamond-Drill Hole

By Roy H. Poston

Written for Engineering and Mining Journal

It was found desirable to complete a surface diamond-drill prospect hole after it had broken into an underground drift that was easily accessible. The accompany-sketch shows how it was done. After "holing through," the drill rods were carefully let down to the bottom of the drift and the position was marked. They were then raised far enough to permit the placing of the sleeve pipe in the drift bottom, as shown, this pipe coming to within a few inches of the roof of the drift to insure the rods entering it when lowered. This pipe was well wedged in position at the bottom and held in place at the top by the 6 x 6-in. timber shown. No trouble was experienced in completing the hole.



DIAMOND-DRILL "HOLING THROUGH" A DRIFT

Erasing With Bread Crumbs

By C. Nye

Written for Engineering and Mining Journal

To remove pencil marks from linen tracings without injuring ink lines, scatter over the tracing crumbs of the soft part of fresh rye bread, and with these crumbs under the palm of the hand, rub the tracing with a circular movement.

THE PETROLEUM INDUSTRY

The New Wamac Oil Pool, in Illinois

By H. A. Wheeler

Written for Engineering and Mining Journal

THE GREAT ACTIVITY in the prolific Illinois oil fields closed with the discovery of the Carlyle pool (in Clinton County, western Illinois), in 1911, in which year the rich pool at Electra, Tex., attracted operators and speculators to the Mid-Continent fields from Illinois and all the older states. The continuous series of exceptionally rich pools that have been opened in Kansas, Oklahoma, Texas, Louisiana, and Arkansas since 1911 have monopolized the attention of the oil fraternity, and the older Eastern fields have been neglected, with the exception of the Kentucky outburst three years ago. The latter appealed to small operators, on account of its shallowness, despite its unfavorable record for erratic, short-lived producers.

The Allendale pool, in Wabash County, Ill., was discovered a few years after the Carlyle boom, but it proved to be much smaller than the older eastern Illinois pools, and attracted only local interest. Since then, no important oil discoveries have been made in Illinois, although a rich but limited gas field was discovered at Staunton, in Macoupin County, in western Illinois, in 1914, and the old Ava gas field, in Jackson County, southern Illinois, has finally developed into a producer of fair gas wells.

FAVORABLE GEOLOGICAL STRUCTURES STILL UNEXPLORED

Yet there are many attractive structures in western Illinois that have received limited or no attention, as the old Eastern oil operators are still largely ignoring geological aid, in striking contrast to the Mid-Continent operators, and to the enormous advantage of the latter, as the unprecedented, brilliant series of important discoveries that have been made in the Mid-Continent fields attests.

Based on encouraging geologic structure, the Petro Oil & Gas Co., of St. Louis, has been quietly wildcatting or prospecting in western Illinois, and after first bringing in small wells of dubious value, the company opened up a new pool in December at Wamac, in Marion County, in western Illinois, two miles south of Centralia, that promises to develop into a valuable producer. The drillers discovered a new sand—known as the "Petro sand"—at 800 ft., that is a new producing horizon in western Illinois. Four wells have thus far been brought in by the Petro company in six weeks, that came in at 100 to 300 bbl. from over 30 ft. of open, soft pay sand, with no water. Thus far little gas has occurred with the oil, so that the wells do not flow, and at present are shut in awaiting the erection of a pumping plant. The wells are small until shot with twenty or more quarts of nitroglycerin, after which the soft sand opens up and becomes a generous producer. As there is little caving, with no under-reaming and only one water sand to case off, little casing is required, and the wells can be drilled within a week at a moderate expense.

FIVE PRODUCING SANDS IN CENTRALIA DISTRICT

The great attractiveness of this field is the fact that this new Petro sand is No. 3 out of eight possible horizons. Five have been producing for the past twelve years in the Centralia district, namely:

The "Dykstra" sand (No. 1), at 600 ft., and the "Wilson" sand (No. 2), at 700 ft., that came in at from 5 to 25 bbl. The latter, or Wilson, sand was also found to be a light producer in the Petro pool, but for the present is being ignored for the much richer Petro or No. 3 sand at 800 ft.

The No. 4, or "Stein," sand occurs at about 1,400 ft., coming in with 25- to 100-bbl. wells in the near-by rich Sandoval pool and at 5 to 1,000 bbl. in the Carlyle pool, twelve miles distant.

The No. 5, or "Benoist," sand, at 1,500 to 1,650 ft., comes in with 50- to 500-bbl. wells and is a persistent sand throughout Illinois, being at the base of the Pottsville horizon.

All the above are "true sands," or sandstones, and occur in the lower Coal Measures, and to date no drilling has been attempted below the Benoist or No. 5 sand.

The following three deeper sands are productive elsewhere in Illinois and promise to become valuable producers in the Centralia district when deeper developments are attempted:

No. 6, or the "McCloskey," sand, which is an oölitic member of the St. Louis or Mississippi limestone. It occurs at about 1,700 ft., and produces 500- to 4,000-bbl. wells in Lawrence County, seventy-five miles east, and is the richest sand in Illinois.

The No. 7, or "Niagara," is a persistent, thick horizon of dolomitic limestone at about 2,200 ft. that is saturated with oil for over 100 ft. where it outcrops in western Illinois. On a good structure, such as occurs on the strong anticline at Centralia, this is likely to be a large producer.

The No. 8, or "Trenton," limestone should be found at about 2,500 ft. at Centralia and is the "Last of the Mohicans," or the lowest geologic horizon at which commercial quantities of oil have been found in this region. It is usually a pure, non-dolomatized, thick limestone, and for this reason was regarded as of no commercial importance by the Illinois Geological Survey, although I have always urged its development, as it shows more or less oil on its outcrop across the western Illinois border in Missouri. A few wells are producing from the Trenton in the Casey district in eastern Illinois, at a depth of about 2,600 ft., but though they come in at from 100 to 200 bbl., they quickly settle to small but persistent producers of a high paraffine oil. Last year the Waterloo field in Monroe County, western Illinois, was opened in the Trenton horizon, where a heavy fault brings it within 400 ft. of the surface, and the wells come in at 20 to 200 bbl.

The No. 3, or Petro, sand oil is dark, has a good flash (high gasoline) and is 32 gravity Be. It is of the usual Illinois grade, and sells today for $2.27 to $2.50 per bbl., and last year sold for $3.77 to $4 per bbl. As the Illinois pipe line is already at Centralia, and as there are three trunk roads (the Illinois Central, the Burlington, and the Southern railroads), the shipping facilities are exceptionally good, and adjacent coal mines (530 to 600 ft. deep to the No. 6 seam) furnish cheap fuel. This important discovery is so recent and is so slightly known that it has thus far created only a local boom, and close-in leases are selling at low prices. The old-time operators, who ignore geology, are shy of Centralia, on account of its past bad record; for though considerable drilling has been done east and north of town (never before to the south or in the Wamac district) during the last twelve years, it has been in a badly faulted, broken district where an occasional well would be surrounded by a ring of dry holes only one location distant. The old wells are on "pimples," or high spots in the sand, and unless the driller struck one of these limited pimples, operations resulted only in bringing in "dusters." The Wamac pool, on the contrary, shows a regular formation that is free from faults, and hence the outlook is bright for the development of a large, rich pool that should completely redeem Centralia's former reputation.

H. F. Bain Located Centralia Anticline in 1903

It is interesting to note that when the present Illinois Geological Survey was organized, about 1903, under the directorship of Dr. H. F. Bain, the present Director of the Bureau of Mines, one of his earlier maps located the above Centralia anticline, to which he called attention as a possible oil field. This valuable information was ignored by over 95 per cent of the oil men, but when oil was struck in a new coal shaft at Junction City, two miles north of Centralia, in about 1909, drilling was started that later opened up the wells at the above-named mine at Sandoval and east of Centralia.

Last year the Petro company found some oil at Irvington, eight miles south of Centralia, and last month brought in the above-mentioned Petro pool two miles south of Centralia. Though these five pools vary greatly in value, they are all on the strong anticline mapped by Dr. Bain previous to any oil discoveries, and when as many tests have been made along this structure as along the La Salle anticline, in eastern Illinois, the field may duplicate the extremely profitable record of that exceptionally prolific series of large oil pools that have been developed by over 23,000 wells.

Increase in Petroleum Exports Since 1913

Petroleum exports from this country have increased greatly since 1913, according to the fuel division of the Department of Commerce in its surveying of last year's overseas trade.

Exports of crude oil in 1921 approximate an increase of more than 190,000,000 gal. over those of 1913, with a corresponding increase in value of more than $16,000,000. The quantity and value of refined products for 1913 was 1,941,996,000 gal., valued at $140,868,000, against about 2,411,000,000 gal., valued at approximately $359,700,000, in 1921.

The Oil Supply of the United States

A review of the producing, probable, and possible oil-bearing regions in the United States by a joint committee composed of members of the American Association of Petroleum Geologists and of the U. S. Geological Survey has resulted in an inventory estimate that 9,000,000,000 bbl. of oil recoverable by methods now in use remained in the ground in this country Jan. 1, 1922.

The committee responsible for the original preparation of the estimates and finally for the adjustment and revision of the results in joint conference comprised F. W. De Wolf, state geologist, Illinois; W. E. Wrather, Dallas, Tex.; Roswell H. Johnson, Pittsburgh, Pa.; Wallace A. Pratt, Houston, Tex.; Alexander W. McCoy, Bartlesville, Okla.; Carl H. Beal, San Francisco, Cal.; C. T. Lupton, Denver, Col.; Alexander Deussen, Houston, Tex.; K. C. Heald, Washington, D. C.; and G. C. Matson, Tulsa, Okla., representing the American Association of Petroleum Geologists; and, for the Federal Survey, David White, chief geologist, chairman; W. T. Thom, Jr., A. E. Fath, Kirtly F. Mather, R. C. Moore, state geologist, Kansas, and K. C. Heald. Mr. Heald represented both the Survey and the association. These men were assisted in subcommittees by a number of oil geologists, including oil-company geologists, directors of state geological surveys, and consulting geologists who were especially familiar with the regions considered.

The estimates for local areas, fields, or districts have been consolidated by states, groups of states, or broad regions in non-productive states, as follows:

ESTIMATED OIL RESERVES OF THE UNITED STATES, BY STATES OR REGIONS

	Millions of Barrels
New York	100
Pennsylvania	260
West Virginia	200
Ohio	190
Indiana and Michigan	70
Illinois	440
Kentucky, Tennessee, Northern Alabama, and Northeastern Mississippi	175
Missouri, Iowa, North Dakota, Wisconsin, and Minnesota	40
Kansas	425
Oklahoma	1,340
Northern Louisiana and Arkansas	525
Texas, except Gulf coast	670
Gulf coast, Texas and Louisiana	2,100
Colorado, New Mexico, and Arizona	50
Wyoming	525
Montana, Nebraska, and South Dakota	100
Utah, Nevada, Oregon, Washington, and Idaho	80
California	1,850
Eastern Gulf Coastal Plain and Atlantic Coast States	10
Total	9,150

The New England states are regarded as too unpromising to deserve consideration. Most of the northern peninsula of Michigan and the State of Minnesota are placed in the same category.

Of the total estimated oil reserves of the United States, amounting in round numbers to 9,000,000,000 bbl., 5,000,000,000 bbl. may be classified as oil in sight and 4,000,000,000 bbl. as prospective and possible. Rather more than 4,000,000,000 bbl. should be assigned to the heavy-oil group. These oils will be recovered mainly in the Pacific Coast, Rocky Mountain, and Gulf states. The contents of the Lima-Indiana region, which yields oil of a distinctive type, are estimated at 40,000,000 bbl. In general the so-called paraffin oils of moderate and high grade, as contrasted with the heavier oils, amount in all to about 5,000,000,000 bbl. The estimated reserves of high-grade oils of the Appalachian states are about 725,000,000 bbl.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Western Editor Distributes Silver Medals to Walter Fitch, Jr., Co. Crew

The presentation of the silver medals, awarded to the shaft sinking crew of the Walter Fitch, Jr., Co. by *Engineering and Mining Journal*, took place at Eureka, Utah, on the evening of Jan. 19. Following a banquet, which was attended by the shaft men as well as local mine superintendents, foremen, and others, J. Fred Johnson, superintendent of the Chief Consolidated mine, introduced George J. Young, Western Editor of *Engineering and Mining Journal*. Mr. Young briefly discussed the relation of *Engineering and Mining Journal* to the mining industry. In presenting the medals, Mr. Young pointed out the great lesson to industry in the contest, dwelling upon the vital element of team work and co-operation, in that each man was particularly responsible for his part in the work. The medals presented are of silver, each being a replica of the gold medal and engraved with the name of the recipient. At the conclusion, Walter Fitch, Sr., president of the Chief Consolidated Mining Co., called attention to the fact that the contest was world-wide, and said that to the Tintic district fell the lot of winning by a remarkable margin. He thanked *Engineering and Mining Journal* for its recognition of the splendid work done in shaft sinking, on behalf of the recipients of the medals, the shaft crew foremen, shift bosses, and the Walter Fitch, Jr., Co. Mr. Fitch also extended his thanks to Mr. Young for his personal visit to the district and the distribution of the medals to the men. The medals for the few members of the shaft crew who were unable to be present were turned over to Superintendent Johnson for distribution.

Boston Section, A.I.M.E., Holds Seventy-Second Meeting

The seventy-second meeting of the Boston Section, A.I.M.E., was held at the Engineers Club, Boston, on Jan. 9, 1922, being preceded by the usual dinner. Allen H. Rogers, chairman of the committee on the affiliation of Boston technical and engineering societies, reported that the details of the plan were still being worked out, and will be submitted to members later.

F. W. Paine, G. W. Metcalfe, and Prof. E. E. Bugbee were appointed to serve as a committee to prepare nominations for officers for the coming year.

W. H. Bassett, technical superintendent and metallurgist of the American Brass Co., gave an interesting account of the formation of the Institute of Metals and its incorporation into the A.I.M.E. as the Institute of Metals Division. Robert J. Anderson, metallurgist of the U. S. Bureau of Mines, followed with an interesting illustrated talk on "Aluminum and Its Alloys." Mr. Anderson described the discovery and history of aluminum, its development and present application and the peculiar properties of its alloys. The last speaker of the evening was L. H. Pomeroy, of Cleveland, who described the application of the aluminum alloys to the automobile industry.

Columbia Section, A.I.M.E., Disapproves Proposed Revision of Mining Laws

Columbia Section, A.I.M.E., had charge of the noon meeting of the Associated Engineers on Dec. 28, at Spokane, Wash., with D. F. Henderson, president of Associated Engineers, in the chair. After the routine business of Associated Engineers, the meeting was turned over to Ivan De Lashmutt, chairman of Columbia Section, who called on several members to respond to the subject of "Revision of the Mining Laws." Speakers were Rush J. White, Dean Francis A. Thomson, Sidney Norman and others. None favored the proposed revision as a whole, but it was admitted that some changes in the present law are desirable.

Senator Miles Poindexter, the principal guest, stated that he was glad to have the opinions of local engineers and mining men and assured those present that nothing will be done in Congress without the advice and support of those most interested.

At the evening meeting, following a dinner, the election of officers for the coming year was held. Rush J. White was elected chairman; Frank M. Smith, vice-chairman, and L. K. Armstrong, secretary-treasurer. Mr. White addressed the meeting briefly, expressing his desire that more meetings of the section be held outside Spokane in the future, and he also spoke of the interest of mining engineers in the proposed revision of the national mining law.

The subject of the evening was the general topic, "The Geology of the Northwest, With Special Reference to Economic Possibilities." O. P. Jenkins, associate professor of economic geology at the State College of Washington, and Virgil Kirkham, of the geological faculty of the University of Idaho, were the speakers.

Mining Congress Formed in Durango

The Durango Mining Congress, of Durango, Mexico, has recently been organized for the purpose of collecting and distributing data on the mining industries in the State of Durango and in other ways be of assistance to those interested in mining in that district. Ernest Stein is secretary.

Reciprocal Agreement on Lead Between United States and Canada Sought

At a meeting of the Northwest Mining Association held on Jan. 19, the following resolution dealing with a phase of the lead-mining situation was unanimously carried:

Whereas, Senator Poindexter has initiated an effort to bring about a reciprocal agreement between Canada and the United States, providing that lead bullion derived from ores shipped across the international line, either way, may be returned free of duty to the country of origin; and

Whereas, Such agreement would not in any way interfere with the lead schedules provided for in the Fordney Tariff bill now before Congress and by which import duties of 2⅛c. per pound upon lead bullion and 1½c. per pound upon lead in ore of foreign origin are provided; and

Whereas, Adoption of such reciprocal agreement with Canada would provide alternative smelting outlets for ore from districts adjacent to the international line in British Columbia and Washington, thus promising more uninterrupted development and greater prosperity in both; Now, therefore, be it

Resolved, That the Northwest Mining Association, in regular weekly meeting assembled, this nineteenth day of January, 1922, heartily indorses and commends the action of Senator Poindexter and pledges its support in any manner that may bring about such reciprocal arrangement by legitimate means. It also calls upon other members of the Congressional delegation from this state [Washington] to support the efforts of Senator Poindexter, and suggests that the matter be immediately laid before public organizations in mining districts in this state and British Columbia, to the end that it may receive careful consideration on both sides of the international line and such recommendations as may seem proper to impress the desires of both peoples upon their respective governments; and be it further

Resolved, That the officers of this organization be and hereby are directed to send copies of this resolution to the Honorable Mackenzie King, Premier of Canada; Senator Poindexter; the chairman of the Finance Committee, United States Senate; to the Chairman of the Ways and Means Committee, House of Representatives; to members of the Congressional delegations from Northwestern states and civic bodies in the Kootenay district of British Columbia and northern part of the State of Washington, with the request that favorable action be taken.

Colorado Petroleum Geologists Organize

The Rocky Mountain Association of Petroleum Geologists was organized in Denver on Jan. 26. Max Ball was chosen president; J. M. Douglas, vice-president, and C. B. Osborn, secretary-treasurer. Semi-monthly meetings will be held in Denver, the next meeting being scheduled for Feb. 9. The program includes the presentation and discussion of papers pertaining to the geology of the Rocky Mountain region.

Committee Chairmen for N. W. Mining Convention Selected

Chairmen for all committees for the Northwest Mining Convention to be held at Spokane, Wash., on Feb. 14, have been appointed by the trustees of the organization. The various chairmen appointed were as follows: Program, Frank A. Ross; entertainment, Fred Howe; finance, G. B. Dennis; publicity, Major R. A. Laird; reception, C. A. Gram; information, J. T. Omo; mineral exhibits, R. A. Moore, and transportation, C. H. Goodsell.

MEN YOU SHOULD KNOW ABOUT

G. C. Bateman, of Cobalt, Ont., was in New York last week.

Glenn L. Allen has returned to Warren, Ariz., from Guadalupe, Mexico.

G. M. Colvocoresses, of Humboldt, Ariz., was recently in San Francisco.

R. L. Chase, of Denver, is in Indianapolis on business pertaining to mining interests.

N. M. Bullock, of Rockdale, Tex., has been appointed a member of the State Mining Board of Texas by **Governor Neff.**

Rush T. Sill, of the firm of Sill & Sill, has returned from examination work in Randsburg and the Slate Range, in California.

A. B. Needham, of Harrisburg, Ill., has accepted a position on the engineering staff of the Butte & Superior Mining Co., Butte, Mont.

A. T. Thomson, assistant to the president of the Phelps Dodge Corporation, with headquarters in New York, was a recent visitor at Clifton, Ariz.

A. G. Mackenzie, of Salt Lake City, was in New York last week, after having attended the ore freight rate hearings before the Interstate Commerce Commission in Washington.

J. S. Negru, managing editor of *Chemical and Metallurgical Engineering* will sail for Europe on Feb. 11 for a six months' trip through Germany, France, Belgium, and other European countries. The purpose of the trip is to study industrial and economic conditions and observe the latest advances in science, engineering, and technology.

ROBERT I. REES

Colonel Robert I. Rees has been named by the President as assistant director of the U. S. Veterans' Bureau, in charge of its rehabilitation division. Colonel Rees is a graduate of the Michigan College of Mines. He was a distinguished graduate of the Army School of the line in 1913 and of the Army Staff College in 1914. He served as a corporal of Company B of the Engineers' Battalion during the Spanish-American War. He was commissioned as second lieutenant in 1899 and served through the successive ranks of lieutenant, captain, major, and colonel, and on July 22, 1918, was appointed temporary brigadier general. Colonel Rees has been awarded the D. S. M. and is an officer of the French Legion of Honor. He is a member of the National Research Council and and active member of the George Washington Post No. 1, American Legion of the District of Columbia. As assistant director in charge of rehabilitation, Colonel Rees will have direct supervision of the rehabilitation of more than 104,000 disabled veterans who are in training, both in private and governmental institutions. He will have direct charge of all vocational schools and training establishments, and will assume the responsibility for the rehabilitation of the men who were disabled in the World War.

George A. Stahl, of Denver and Cripple Creek, has been elected president of the Colorado Metal Mining Association for the coming year. Other officers named by the board were: **Jesse F. McDonald**, of Leadville, first vice-president; **R. M. Anderson**, of Breckenridge, second vice-president; **Bulkeley Wells**, of Denver, third vice-president, and **M. B. Tomblin**, of Denver, secretary and treasurer.

George E. Collins, of Denver, has been re-elected governor of the Colorado chapter of the American Mining Congress. Other officers re-elected by that body, which met jointly with Colorado Metal Mining Association, were: **J. F. Welborn**, first vice-president; **Charles A. Chase**, second vice-president, and **George A. Stahl**, third vice-president. **A. M. Collins** was re-elected treasurer, and **M. B. Tomblin**, secretary.

F. N. Bendelari, manager of the Underwriters' Land Co., was elected governor of the Tri-State branch of the American Mining Congress at the meeting of the organization held at Picher, Okla., on Jan. 13. He succeeds **Edgar Z. Wallover, Jr.**, of the Golden Rod M. & S. Co. Directors for the organization elected included: **M. F. Owen**, manager of the Black Eagle Mining Co.; **C. F. Dike**, manager of the Montreal Mining Co.; **John W. Newton**, manager of the Commerce Mining & Royalty Co.; **W. T. Landrum**, manager of the Cortez Mining Co.; **P. W. George**, manager of the Federal S. & R. Co.; and **C. A. Rice**, manager of the Laclede L. & Z. Co., The organization is made up exclusively of mine operators.

Mining and metallurgical engineers visiting New York City last week included: **W. F. Ferrier**, Toronto, Ont.; **Charles R. Meissner**, Pittsburgh, Pa.; **Thomas H. Clagett**, Bluefield, W. Va.; **Rudolph Ericson**, Iron River, Mich.; **Edwin A. McKanna**, Tampico, Mexico; **O. N. Scott**, Toronto, Ont.; **W. W. Weigal**, Rolla, Mo.; **W. S. Hartman**, Dayton, Ohio; **C. B. Browning**, Britannia Beach, B. C.; **H. J. Morgan**, Cleveland, Ohio; and **L. F. Tefft**, Wallace, Idaho.

SOCIETY MEETINGS ANNOUNCED

The Iron and Steel Institute will hold its annual meeting on May 4 and 5, at the House of the Institution of Civil Engineers, London.

American Ceramic Society will hold a convention in St. Louis, Mo., Feb. 27 to March 3 inclusive. There are seven divisions in the society; hence, seven conventions will be held simultaneously. These are as follows: Ceramic Art, White Art, Refractories, Glass, Enamel, Heavy Clay Products, and Terra Cotta.

OBITUARY

Ralph Muir, formerly a prominent zinc mine owner of Joplin, Mo., died in San Diego, Cal., on Jan. 17. He was born in Canada seventy-nine years ago, and had made his home in San Diego for the last seven years.

George R. Comings, an assayer at the U. S. Assay Office in New York City, died on Jan. 17 at his home, 51 Quincy St., Brooklyn, after being in the Government service forty-eight years. He was born in Cos Cob, Conn., on June 2, 1860, received his education in New York City schools and obtained a degree in chemistry from Cooper Union. Mr. Comings entered the Assay Office at the age of thirteen and worked under Dr. Torrey, who was the first assayer in the history of the office and who was succeeded by his son, Herbert G. Torrey, Mr. Comings succeeding the latter on Nov. 1, 1910.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded

Leading Events

The Utah Consolidated Mining Co., of Bingham Canyon, Utah, has been granted a new trial of the apex case in which the decision was awarded the Utah Apex company.

Iron-ore operators of northern Minnesota have opened their fight on the so-called occupational tax law passed by the last Legislature. The State Tax Commission has been enjoined from examining the companies' books until the constitutionality of the law has been judicially decided.

The mine taxation situation in California is to be surveyed by a committee of the American Mining Congress. Taxes paid by Arizona operators are set forth on p. 222 of this issue.

Reduction of ore freight rates is a matter now being considered by the Interstate Commerce Commission. Favorable action on basic commodities is likely to be obtained, it is thought.

Transfer of ownership of various mining properties is reported. The East Butte Copper Co. has acquired holdings in Colorado; the McCracken silver mine, in Arizona, has been sold; the United Eastern directors have bought the control of a Mexican silver property. Coniagas, at Cobalt, has taken an option on the Ruby.

Decision in Hollinger's Suit Delayed

Judgment Reserved for Three Weeks in Case Against Northern Canada Power Co.

Judgment has been reserved for three weeks in the case of the Hollinger Consolidated Gold Mines against the Northern Canada Power Co. The action brought was for damages of over $2,000,000 for failure to supply the full requirements of the Hollinger company according to the terms of the power contract, which gave the Hollinger first call on power. The power company claimed that the contract was with the original Hollinger, before the amalgamation with the Miller Middleton and the Acme.

Hollinger at present is treating 4,000 tons a day and using 8,000 hp. The power required during 1922 will probably increase to 10,000 hp. During the course of the trial it was brought out that the ultimate aim of the directors is from 7,000 to 8,000 tons-daily capacity.

The company has declared the regular four-weekly dividend of 1 per cent, payable Jan. 28. Hollinger directors have an option on the Murray properties, near Elbow Lake, in northern Manitoba, and are taking in large amounts of supplies. An option on claims in West Shining Tree, held by the same interests, has been dropped.

Colorado Smelting Situation Being Studied

Edgar Newhouse, chairman of the board of directors of the American Smelting & Refining Co., was in Denver during the annual meeting of the Colorado Metal Mining Association and was in conference with a committee of that organization regarding smelting conditions in Colorado. Important changes are expected as a result of the conference.

Rand Strike Continues

By Cable From Reuters to "Engineering and Mining Journal"

Johannesburg, Jan. 27.—The conference between mine owners and representatives of the unions was broken up without achieving any result.

Wallaroo & Moonta To Suspend

By Cable From Reuters to "Engineering and Mining Journal"

Adelaide, Jan. 23—Announcement is made that the Wallaroo & Moonta Mining & Smelting Co., of South Australia, is suspending operations owing to the continued depression of the copper market.

Utah Consolidated Gets New Trial

The Utah Consolidated Mining Co., of Bingham Canyon, Utah, has been granted a new trial in its litigation with the Utah Apex Mining Co. over ore claimed by both companies, and adjudged to belong to the Utah Apex by the United States District Court of Salt Lake City, which ordered the Utah Consolidated to pay damages of over $1,000,000. In granting the motion of the Utah Consolidated for a rehearing of the case before the Circuit Court of Appeals, Judge Johnson, of the Utah court, fixed the bond of the Utah Consolidated at $1,300,000 to act as a supersedeas bond and as a bond for costs and damages on appeal.

The Utah Consolidated opened and mined a large tonnage of ore beneath the holdings of the Utah Apex, which it claimed according to apex rights as making in the Highland Boy limestone, the ore-bearing formation of the Consolidated. The Utah Apex claimed the ore on the ground that it had its occurrence in connection with the Utah Apex fissure system; and this claim was upheld by the Utah court after much interesting expert testimony had been offered by both sides.

Occupational Tax Fight Now On in Minnesota

Iron-Mining Companies Get Order Restraining Tax Commission From Examining Books

Active steps have been taken by the iron-mining companies of northern Minnesota to test the constitutionality of the new occupational tax on iron-ore operation which became a law April 11, 1921. The Oliver Iron Mining Co., a subsidiary of the United States Steel Corporation, and thirty independents secured a temporary order in the United States District Court at Duluth on Jan. 24, enjoining officials of the state from proceeding with the collection of this tax. In the petition of the plaintiffs the constitutionality of the law is questioned in a number of its vital phases.

Two days later, at a preliminary hearing in Duluth, Judge Page Morris granted an order restraining the state from examining the companies' books holding that the companies would suffer an irreparable loss if the state were allowed to examine the books and the law were later held unconstitutional. A hearing on the interlocutory injunction will be held in Federal court at St. Paul about March 1, before three Federal judges, who are to be designated later.

The law provides that all iron-ore operators shall pay to the state an occupational tax of 6 per cent of the valuation of all ores mined, in addition to all other taxes. The state tax commission has recently sent to the mining companies blank forms calling for data from which the first taxes under the new law were to be computed, and it was for that reason that proceedings were instituted at this time.

The petitioners assert that the tax is a property tax. The state laws already place a general ad valorem tax on all ores mined or unmined. It is claimed that the new law places a [illegible] tax [illegible] in any one year, whereas during the year that the ore is in the ground it is subject to [illegible] tax. The plaintiffs assert that they are therefore denied equal protection of the laws provided by the Federal Constitution and that the state Constitution is violated wherein it states that taxes must be uniform upon the same class of subjects.

It is further asserted that the tax is on the article of interstate commerce (as 85 per cent of the ore is shipped outside the State of Minnesota) and is for that reason unconstitutional, as Congress alone has the right to regulate commerce.

If the tax is an occupational tax, it is claimed, it violates the provision allowing equal protection, by singling out one industry. The state law does not permit taxes on occupations, it is said. If it is an income tax, they say, then it is also unconstitutional, for the state statutes do not sanction a tax on incomes.

Colorado Operators Will Cut Wages Again

No Reduction at Cripple Creek—Notice Filed With Industrial Commission

Notice has been filed with the Colorado Industrial Commission by the principal metal-mine operators of Telluride, Leadville, Aspen, and other districts in the state, that, effective March 1, there will be a wage reduction of 50c. per shift for all surface and underground employees. It is understood that operators at Cripple Creek will make no reduction at this time, as the scale for this camp is already 25c. below that paid in other districts. The reduction will make a $3.50 minimum applying to muckers, trammers, and surface men. Under the new scale machine men will receive $4 to $4.25.

Testimony in Star Injunction Case Continued

Presentation of evidence by the plaintiffs in the injunction proceedings brought by Eugene R. Day and Sarah E. Smith, to restrain the Hecla Mining Co., of Wallace, Idaho, from joining with the Bunker Hill & Sullivan Mining & Concentrating Co. in acquiring a joint interest in the Star Mining Co., at Mullan, Idaho, continued last week at Spokane. Part of the time was taken up by arguments of counsel for both sides as to the admissibility of evidence tending to show the Star property as worthless to the Hecla company on the lines of the proposed deal. The court decided that such evidence should be largely eliminated. There was further argument as to whether the Hecla directors' action in acquiring a half interest in the Sullivan Mining Co. was *ultra vires*. No decision had been given as to this up to the time of writing. The Sullivan Mining Co. was organized by the Hecla and the Bunker Hill & Sullivan companies for the joint operation of the Star mine.

Conditions Improving in Arizona Copper Camps

Little Activity Yet, but Preparations Are Under Way—Old Dominion To Resume

Optimism prevails in the copper camps of Arizona, though warnings are given that unskilled labor will not be needed from outside for some time. President James S. Douglas of the United Verde Extension has announced that his company will resume production at the Clemenceau smelter about March 1, though with a relatively small output and employing about 500 men at mine and works. He hopes to secure added economy by shipping bullion via Los Angeles and Panama. United Verde within a few days will start a steam shovel at work toward the old glory hole, above the mine, but there is no intimation as to when mine and smelter operation will be resumed. About 150 men are to be employed. In addition, contracts are to be given at once for the erection of a million-dollar crushing plant that is to be completed by August.

Old Dominion, at Globe, is to start a furnace some time in March, according to the general manager, W. G. McBride. He says that much work is to be done underground, in repairs and in preparing stopes for ore production. Then the ore bins will be filled before the first furnace is blown in. Mr. McBride also says that this district has no surplus of skilled men, though rather too many of the unskilled are already on hand. Old Dominion was producing at the rate of 2,000,000 lb. of copper a month at the time of closing last spring, but is not expected to get back to this for several months.

At Douglas, several hundred men are employed on repairs to the Copper Queen smelter, with sixty days' work ahead. A new roof is being put on the smelter building, the reverberatory and roaster stack is being repaired, and the blast furnaces are being put in condition for operation. Few are being employed save skilled men, and these from the old force. General Manager Hodgson is moving headquarters of operations for the Arizona Copper mines from Clifton to Morenci. From that district comes word only of improvements to be made, which are to cost millions of dollars and to take many months for completion. Recently it was announced that operations are to be resumed at the Iron Cap and Superior & Boston properties at Globe.

Oregon Opposes Mining Law Revision Bill

The provisions of the Arentz mine law revision bill have been made the object of a protest to Congress by the Oregon Legislature. Particular objection is made to placing a limit on the time in which mining claims may be patented. The Legislature holds that the proposed revision would retard the development of mining resources.

East Butte Acquires Property At Silver Plume, Col.

Takes Over Seven-Thirty, Dives-Pelican and Diamond Tunnel — Will Build 400-Ton Flotation Plant

Negotiations which have been pending for some time were recently consummated whereby the East Butte Copper Co., of Montana, takes over the Dives-Pelican, Seven-Thirty, and Diamond Tunnel properties, which include a group of over sixty claims, all within a mile of Silver Plume, Col. Workmen are dismantling the old Neshotah mill, which will be replaced with a 400-ton flotation plant. The properties contain more than twenty miles of underground workings, and a large part of the tonnage for the mill will come from dump rock and stope fillings. A large force will at once be employed in clearing out and retimbering the old drifts and opening up undeveloped territory.

It is said that the purchase price is a little under $500,000, the first payment, one of 5 per cent, being less than $25,000. It is also reported that the company can drop the project at any time, so that the arrangement is practically as if it had taken the properties under option. Enough ore is said to be already in sight to pay the purchase price.

Santa Fe Announces Cut on Small Shipments

The Santa Fe railway company has announced a freight rate cut on less-than-carload ore shipments to 130 per cent of the carload rate.

Would Exempt Diamond-Drill Explorations From Taxes

Bill To Be Presented in Michigan Legislature—Present Method Checks Development

A bill will be drawn up for presentation to the Michigan Legislature to exempt diamond-drill explorations from taxation for a period of five to ten years. There is some talk of a special session, and it is held that the proposed measure will be presented then. It will be introduced by Representative P. H. O'Brien, of Iron River. He has written Governor Groesbeck in part as follows concerning his bill:

"There was a time in my own district when six or seven diamond-drill corporations were exploring for iron ore. Now there are none, because as soon as the drill records a deposit of ore, the property is placed upon the assessment roll. The result has been that mining companies have discontinued diamond-drill exploring, and the country has remained undeveloped. My suggestion is to exempt all diamond-drill explorations for a period of five to ten years, and then, if properties are not developed, to place them on the tax roll. Thus diamond-drill explorations would be encouraged throughout the entire upper peninsula, with a resulting benefit to the entire country."

Arizona Commission To Prosecute Delinquent Corporations

After deliberation on the subject for many months, the Arizona Corporation Commission is about to start action against Arizona corporations that have failed to observe the requirements of state laws with respect to the filing of annual reports, with accompanying fees. About 1,000 corporations are delinquent, involving an apparent loss to the state of about $2,000,000.

Gold Rush to Elbow Lake, Man., Under Way

A rush to the Elbow Lake district in northern Manitoba, where gold was discovered last May, is in progress. The original discovery was made by the Murray brothers, who sold an option on two claims to the Hollinger Consolidated Gold Mines, Ltd., of Porcupine, Ont. This company examined the claims during the summer and began work in October and now has an engineer and twenty-five men at work. It is also cutting a sleigh road from Mile 56 on the Hudson Bay railroad northwest to the claims. It is said that two trenches were cut across the orebody, one 75 ft. long and the other 60 ft. long, both showing values all the way. The gold is coarse. Claims are being staked.

Coarse gold was first found in this region at Copper Lake, twelve miles from Elbow Lake, by J. P. Gordon in 1919. The Gordon claims have since been diamond drilled.

NEWS FROM WASHINGTON

By **PAUL WOOTON**
Special Correspondent

Ore Freight Rate Reductions Thought Likely

Change Would Benefit Basic Commodities — Producers' Representatives Heard by Interstate Commerce Commission

That railroad rates on iron ore should be reduced materially has been the contention of many witnesses appearing before the Interstate Commerce Commission during the consideration of the case which involves a review of the rate structure of the entire country. P. S. Sprague appeared for the Lake Superior Iron Ore Association. His argument dealt chiefly with the rates from the mines to the upper Lake ports, but the need for the reduction also applies between the Alabama mines and Southern furnaces. Closely linked with this demand has been the insistence that the rates on pig iron must be reduced before any material reduction in the cost of steel can be effected. The present rate on pig iron was declared by some witnesses to be throttling the whole foundry industry.

Judging from questions asked and the general attitude of the commission, it is probable that rates will be reduced on basic commodities, particularly on low-class freight. It is evident, however, that the commission is going to be absolutely sure that the transportation machine is not impaired by these reductions. The members of the commission are calling in each instance for facts and figures, and apparently are not convinced that a general reduction in rates will mean increased revenue through an increased volume of business. They are determined to know just how the revenue of the carriers will be affected by each specific reduction demanded. Witnesses frequently are asked if they prefer low rates to an assurance of service.

Practically all witnesses agree that coal should be favored in rate reductions. The general opinion seems to be that coal rates at least should be relieved of the 1920 increases. In that connection, it is pointed out that iron-ore rates have not been increased to the same relative extent as have the rates on coal. No one predicts that reductions will be made prior to April 1.

A reduction in the rate on metallic ores was urged by A. G. Mackenzie, secretary of the Utah chapter of the American Mining Congress. He also asked that there be a reduction in the rate on bullion from the West to New York. High freight rates, he said, are causing great waste, in that only the higher-grade ores can be shipped.

Committee Favors Duty on Tin As Protective Measure

Domestic Smelting and Refining an Infant Industry—Financial Juggling Abroad a Factor Considered

Though no final decision has been reached by the Finance Committee, it is understood that it is favorably inclined to a duty on tin in bars, blocks, pigs, or in granulated form. The committee apparently is convinced that a duty is necessary to the maintenance of the domestic tin smelting and refining industry. Another important feature is the fact that a duty on tin would be a large revenue producer.

Reliable information in the hands of the Finance Committee indicates that the several plants in this country which have attempted the smelting and refining of tin have operated at a loss. As the industry dates only from 1916, it falls clearly within the infant industry class. It has been established to the apparent satisfaction of the committee that costs abroad are lower. A specific duty of 4c. has been asked by the smelting interests to enable them to compete on equal terms in the refining of Bolivian ores. An argument to which weight is attached is that such a duty would enable American refiners to purchase Chinese ores, thereby making for the development of a new source of supply.

Another factor evidently influencing the Finance Committee is the financial juggling of tin which takes place in the London and Straits Settlements markets. The existence of an American industry established on a stable basis would tend to stabilize prices.

Ford's Offer for Muscle Shoals Ready for Congress

Will Benefit Public Greatly, Say Proponents—Means Subsidizing Private Enterprise, According to Those Opposed

Henry Ford's offer for the Muscle Shoals water-power project and the Government nitrate plants near by has been duly signed by Mr. Ford and is now before the President. The offer is to be formally transmitted to Congress, along with the comment of the Secretary of War, in the near future.

A clash of major proportions is certain to mark the legislative course of this proposition. It is being fought on the one hand by those who claim that private enterprise will be receiving the equivalent of a subsidy from the public treasury. The proponents of the Ford proposal argue that it presents the alternatives of accepting this offer or of writing off an investment of $105,000,000. In addition, they contend, the acceptance of the offer assures great public benefit in that it will utilize a resource now going to waste and will provide for the fixation of atmospheric nitrogen—a necessary step for the national defence. In addition, there is the important matter of introducing a powerful competitor to the existing fertilizer interests and the assurance of the development of the extensive bauxite deposits in the states of the central and eastern South.

Patent Office Relief Bill Passes House

Despite the opposition of such influential members as majority leader Mondell and Chairman Madden of the Appropriations Committee, the House has passed without amendment the Patent Office relief bill by the overwhelming vote of 305 to 44. The Senate Committee on Patents expects to consider the bill immediately, and it is known that a majority of the committee favors the reporting of the bill to the Senate on the earliest possible date.

NEWS BY MINING DISTRICTS

London Letter

Labor's Attitude Causing Comment—Kalgurli Mine's Record Good—Consolidated Mine Selection May Pass Dividend

By W. A. DOMAN

London, Jan. 10.—In mining circles the attitude of labor has formed the chief topic of discussion for the last week and, in fact, is the main topic at the moment. Whether one turns to South Africa, Australia, or West Africa, this matter seems uppermost. In Australia, of course, the demands of the workers' unions, with the helplessness of the authorities, have reacted with boomerang effect upon the Broken Hill Proprietary Co., so far as its steel works at Newcastle are concerned, and the Barrier Range mines are also affected. Most prominent, however, now is the strike of white miners in the Transvaal, both on the coal and gold mines. Wage reductions are the root cause, the men apparently refusing to face the economic facts, and demanding virtually the same pay as when the gold premium was high.

The initial mistake was made in allowing the miners a share in the premium when it was first obtainable, or, at any rate, without making it clear that a fall in the premium would mean the wiping out of the advances conceded. According to the latest news, matters have now come to such a pass that the Chamber of Mines is even willing for the natives to be repatriated and the mines to be closed down rather than to be continually at the mercy of the unions, which threaten to dislocate the industry unless their demands are granted. The selling price of the gold before the premium was obtainable was 85s. per oz. For December last, the output is calculated to fetch 93s. 9d, or only 8s. 9d. above normal. To the bulk of the mines, this meager advance does not provide sufficient margin to allow profitable working to be carried on.

The old Kalgurli mine has done remarkably well by its shareholders. It has earned a profit right up to the very end. In November, the mine and the plant were disposed of to the Oroya Links for £20,000, and on the capital of £120,000 it is expected that the shareholders will receive almost £1 a share. The company entered the dividend list in 1901, and has not once been a defaulter. The total distributed to date, apart from what may come in the liquidation, exceeds £1,705,000.

A rumor is current, and I give it with all reserve, that the Consolidated Mines Selection will not pay a dividend for the past twelve months. Whether this story is put out for speculative purposes or whether it is a *ballon d'essai*, is not clear, but when the circumstances are considered, it may contain a shred of possibility. The company is interested in the Southwest Africa diamond fields, and no income is at present being derived, or seems likely to be derived for a considerable time, from that source, owing to the depression in the diamond trade. The Brakpan and Springs mines have made reduced distributions, and it is not unlikely that the company has been called upon—always, of course, with its associates, for the Consolidated Mines Selection directors are too astute to shoulder such heavy burdens alone—to give substantial assistance to some of its subsidiaries, especially the West Springs. Financial undertakings have their ups and downs, and Walter McDermott has at recent annual meetings of shareholders of the Consolidated Mines Selection plainly hinted that dividends could not be expected to continue on such a generous scale.

Johannesburg Letter

Strike at Crown Mines Causes Drop in November Gold Output—Diamond Situation Reviewed

BY JOHN WATSON

Johannesburg, Dec. 20—A fire on the 8th level of the Ferreira Deep on Dec. 8 resulted in the fatal gassing of one man. While efforts were being made to extinguish the fire, a fall of rock occurred at the 7th level station, catching five timbermen and ultimately causing their death.

The Transvaal gold output for November was declared on Dec. 10 as 704,236 fine ounces. Compared with October this shows a decrease of 3,589 oz. The chief factor causing the decreased output has been the strike at the Crown Mines, whose decrease of 4,098 fine ounces is the largest on the list. The East Rand Proprietary Mines shows a drop of 3,027 oz. The largest producer for the month was Government Gold Mining Areas (State mines) with a total of 62,726 fine ounces, this being an increase of 2,709 over the October figure.

At the annual meeting of the De Beers company, held at Kimberley on Dec. 9, the chairman, Sir David Harris, reviewed the operations of the year ended June 30 last, which had been a critical and trying one for the diamond industry. Large quantities of Russian brilliants had been thrown on the world's market by the Soviet government and others, and these had been sold for cash to American and other countries, at about half the ruling rates for South African diamonds. During the last two years the De Beers company had paid over £2,000,000 in taxes. The company has decided to cease all operations except town-lighting, trams and pumping, which will affect 650 men.

AUSTRALIA

Queensland

Hampden-Cloncurry Mining on Limited Scale—New Guinea Company To Ship Ore to Australian Smelters

From Our Special Correspondent

Brisbane, Dec. 11—Two of the three large copper companies in the Cloncurry district, the Hampden-Cloncurry and the Mount Cuthbert, have just issued statements showing their respective positions. Neither did any smelting in 1921, because it was impossible for them to do so profitably with wages and other costs as high and the price of copper as low as it has been during the period.

The directors of the Hampden company say that substantial reductions in wages, railway freights, and in the cost of general supplies are necessary before any resumption is economically possible. This company has done well in the past. There is still a surplus of liquid assets over liabilities amounting to £88,700. During the time the smelters have been idle, 1,000 tons of ore has been drawn from the Duchess mine, and the management suggests that mining on a limited scale, 100 tons of ore per day, shall be resumed at two of the company's mines, and the ore dumped on the surface, to assist the position when smelting is resumed. This work has already been started, and forty men are engaged on it.

The manager of the Hampden-Cloncurry Mines, Ltd., is also the manager for the New Guinea Copper Mines, Ltd., and he has recently, after a visit to the properties of the latter company, brought news to Queensland regarding its operations and the bearing of these operations on copper mining in this state. The Debuna and Laloki mines, held by the Papuan company, are now ready to produce ore, and satisfactory arrangements have been made for the working of the mines by native labor. About £250,000 has been spent in developing the mines and in building a railway, jetties and other necessary equipment. The proved ore reserves of the two properties are given by Mr. Huntley as 235,000 tons of ore averaging roughly 4½ per cent of copper and 2½ dwt. of gold per ton. It has been decided not to erect smelters in New Guinea, but to ship the ore to the mainland after it has been treated locally in such a way as to prevent the liability to firing in transit. As it is highly basic, it is believed that a ready market will be found for it by companies that have siliceous ores awaiting a suitable fluxing material. In addition, the 40 per cent sulphur content has a considerable commercial value. The company itself owns the Mount Chalmers mine, in Queensland, and it should be able to utilize that property to advantage by the use of ore from Laloki.

CANADA

British Columbia

Suit Over Engineer Mine To Be Appealed—Operations at Premier, Surf Inlet and Granby

Stewart — Regular shipments of sacked high-grade ore are expected from the Silverado group within a few weeks. It will be transported to the lower camp by tram and thence rawhided to tidewater. The Premier mine is the only substantial shipper from the district at present. Many miners and prospectors are wintering at Stewart and Hyder. George Clothier, the resident mining engineer, is advocating more trails, and it is assured that Government assistance, as far as finances will permit, will be extended where it is recommended.

The eleven-and-a-half-mile aerial tramway of the Premier mine was put in operation on Dec. 20. Two large compressors, coupled to two Diesel units, have been installed and are in operation, and a concrete foundation has been built at the foot of Cascade Creek ready for building the housing for the machinery of the main power house, which, it is expected, will be finished early this year.

The average number employed in 1921 was 382, the total tonnage mined 15,129 tons, the total length of tunnel and drifting 4,027 ft., and the total diamond drilling done, 6,821 ft. About 50 ft. from the entrance of No. 2 tunnel a 5 x 6-ft. shaft has been sunk to a depth of 420 ft., connecting Nos. 3 and 4 workings. It is supplied with steel cage, guides and the required safety devices, and is used for hoisting men and supplies.

Anyox — Referring to the Hidden Creek mine and the smelter operations of the Granby Consolidated Mining & Smelting & Power Co., the inspector of mines states that low copper prices compelled two cuts in wages during the year, that the number of the employed had to be cut materially, and that the loss by fire of main crusher No. 2 at the mine necessitated rebuilding and the installation of a new crusher. This was completed in October. The structure is of concrete and is fireproof. The average number of men employed during 1921 was 212, as against 385 for 1920, and the output in wet tonnage from the Hidden Creek mine for the year was 914,000 tons, as against 802,667 tons for the previous year, an increase of 112,333 tons.

Surf Inlet—As to the Belmont Surf Inlet Gold Mines, Ltd., the inspector says that the Pugsley mine, which adjoins the Belmont and is owned by the company, may be considered an established producer. Ore bins have been built for handling its output, and an aerial tramway has been constructed from these to the bunkers at the head of the Surf mine. The tram is a two-bucket high-speed reversible type, capacity per bucket being 1,500 lb., and the span between buckets 2,300 ft. It is operated by a 25 hp. motor. The elevation between terminals is 390 ft. and the capacity per eight hours 100 tons.

Sidney Inlet—Operations will be resumed soon on the Tidewater Copper Co.'s property at Sidney Inlet, Vancouver Island. Important ore reserves are said to have been blocked out.

Vancouver—An appeal has been entered by the Engineer Mining Co. against the recent judgment handed down by the British Columbia courts, which leaves the Engineer mine, at Atlin, in the hands of the heirs of the late Allan I. Smith, to whom the mine was left by the will of the late Captain Alexander. It is said that the action will be carried to the Privy Council before the litigants will be content to consider the issue settled.

Trail—Ore shipments received at the Consolidated smelter Jan. 15 to Jan. 21 totaled 8,631 tons, of which 8,256 tons came from company mines. Other shippers were: Arlington, Slocan City, 5; Bell, Beaverdell, 39; Knobhill, Republic, Wash., 29; L. T., Slocan City, 6; Ottawa, Slocan City, 32; Paradise, Lake Windermere, 35; Rosebery Surprise, New Denver, 175; and Rambler Cariboo, Rambler, 54.

Ontario

Coniagas Takes Option on Ruby—Dome Announces Capital Repayment

Cobalt—The Coniagas has taken an option on the Ruby property, adjoining the Green Meehan mine, in the northeast end of the camp. This isolated section has produced several hundred thousand ounces, and it is believed that the Huronian formation, in which practically all the ore in Cobalt is found, persists under a considerable portion of the Ruby ground, and that it offers good possibilities for prospecting. A diamond drill will first be used to determine the geology.

Kirkland—The discovery of rich gold ore on the claims of the Lightning River Gold Mines has resulted in considerable staking in that area. At present prospectors must travel forty miles from Kirkland on snowshoes.

At the annual meeting of the Teck Hughes no announcements were made regarding recent developments, as had been anticipated. It is understood that a strike has been found at 600 ft. Rich ore has been opened up for a length of 150 ft. on the 900 level of the Kirkland Gold.

During 1921 over 900 claims were recorded in the Larder Lake mining division, which is 200 more than for 1920, the best previous year.

Porcupine—The long-anticipated capital repayment by the Dome has finally been announced by the directors, who have decided to pay $1 a share on April 20 to shareholders of record March 31. Some changes in the charter will be necessary and the consent of the Lieutenant Governor in Council will have to be obtained.

MEXICO

Jalisco

Amparo and Cinco Minas Reduction Plants Only Ones in Operation—Mezquital del Oro Mine Leased

In common with other industries and general trade, mining in Jalisco is almost stagnant, and there is little activity of note to be recorded. General economic conditions are affecting Mexico as well as most other countries, and it is evident that no great activity can be looked for until the return to normal of all business. But little capital can be interested in silver mining, which is the principal branch of the industry followed in Jalisco. Political and labor conditions are not causing anxiety, and there is nothing to prevent active development and exploitation of the mineral wealth of the state as far as these are concerned. Travel, even in the remotest districts, seems absolutely safe, and scouts are to be seen everywhere.

Only two reduction plants are now operating in the state, those of the Amparo Mining Co., at Etzatlan, and of the Cinco Minas Co., at Hostotipaquillo. Both plants are running at capacity.

The Mexican company owning the Piedra Bola mine, not far from Ahualulco, has decided to erect a mill and cyanide plant for the treatment of its lower-grade ores, and machinery and equipment are now being purchased. The company has been shipping large quantities of high-grade ore to the smelter for some time, and it has accumulated ample cash resources. It is reliably reported that offers for the purchase of the mine were made by the Amparo Mining Co., and the El Oro Mining & Railway Co., both of which were refused.

The United States Smelting & Refining Co. has given up its option on the Mazata mine.

The El Oro Mining & Railway Co. is keeping the pumps at work in the Casados mine, but it is greatly feared that this option will also be dropped.

The Pinabete mine, which has not been touched during the revolutionary troubles, is being cleaned out and retimbered. This mine has a great reputation, and it is hoped that work will be continued uninterruptedly.

The Mezquital del Oro mine has been taken under lease and bond by E. J. Hunter & Co., of San Antonio, Tex., and work has been resumed in a crosscut started some years ago to explore parallel veins outcropping not far from the original Mezquital vein, famous as having given a number of bonanzas. The Mezquital mine is one of the few gold mines of Mexico, there being practically no silver in its ores. The mine is also somewhat singular in that as far down as mining operations have been carried on, about a thousand feet, the ore is still oxidized.

R. J. Cottna, of Worcester, Mass., has formed the San Geronimo Co. to take over and operate mines in the Mascota district, and it is said that machinery and supplies for a mill and cyanide plant are already at Vera Cruz.

ARIZONA

Mining Companies Pay About Half of Total State and County Taxes, Excluding Collateral Levies

By James H. McClintock

Phoenix — Next to transportation costs, the greatest subject of criticism among officials of Arizona mining companies is taxation. Of each $100 assessed for state, county, and city purposes, the mines are now paying $[illegible], compared with $12 for railroads, $[illegible] for livestock, and $1.83 for motor vehicles. According to the state tax commission, during the current fiscal year state, county, and municipal revenues in Arizona will amount to $17,431,[illegible], and it is apparent that mines are depended upon for paying a material part of the public costs, though in only a few instances are they charged with city taxes.

The tax commission believes its system of mine assessment, based upon physical valuation and bullion product, is a good one. There has been comparison of the assessment from 1916 to 1920, inclusive, with the values of the mining stock as shown on the New York stock board, in semi-annual readings. The stock values of the Phelps Dodge, United Verde, or Arizona Copper properties cannot be estimated, for these stocks are not dealt in on the exchange; but the average stock value of the other large mines for the period specified was $269,945,761. The average Arizona tax assessment on the indicated properties per annum was $261,479,912. The assessments on these same mines for the current year aggregate $268,544,147.

The estimate that about one-half of the taxes of Arizona, state and county, is paid by the mining corporations does not include taxation on such collateral industries as mining railroads, mercantile establishments, banks, and even towns that are dependent upon the mining industry for their existence. Although the tax valuations of the several mines have been a matter of record, the actual cash paid in taxes has not had as much publicity. It has, to a material degree, been dependent upon the varying tax rates of the counties. Individual mines do much toward support of the several counties. For instance, Arizona Copper pays 58.06 per cent of the income of Greenlee County, Ray Consolidated 57.27 in Pinal County, Inspiration 47.54 in Gila County, New Cornelia 34.7 in Pima County, and United Verde and United Verde Extension respectively 35.75 and 30.7 in Yavapai County.

The actual taxes paid by Arizona mines from which reports have been received are to be listed as follows: Phelps Dodge, Morenci, $217,662; Bisbee-Douglas, $919,973; total, $1,137,635; Inspiration, at Miami, $851,061; United Verde, Jerome-Clarkdale, $664,334; Calumet & Arizona, Warren, $619,123; Ray Consolidated, at Ray (Pina County), $556,680; at Hayden (Gila County), $61,130; total, $617,810; United Verde Extension, Jerome-Clemenceau, $552,495; Arizona Copper, Clifton, $482,242; Miami Copper, Miami, $440,455; New Cornelia, Ajo, $139,497; Old Diminion, Globe, $182,642; United Eastern, Oatman, $114,915; International Smelting, Miami, $95,569; Magma, Superior, $70,992; Arizona Commercial, Globe, $33,712; American Smelting & Refining, Hayden, $[illegible]2,295; Iron Cap, Globe, $30,[illegible]; Ray Hercules, Ray, $21,673; and Tom Reed, Oatman, $18,392.

The Amalgamated Copper Mines Co., in its effort to block construction of a flood check dam on Cave Creek, north of Phoenix, has secured change of venue, alleging local bias, due to self-interest. The plaintiffs have given bond and will start work at once.

Kingman — The McCracken silver mine, in southern Mohave County, has been taken over from F. A. Garbutt by L. D. Adams and Joseph C. Buchen, said tc represent Eastern interests. It is said that the property is to be equipped with a 150-ton mill. Sufficient water for the plant is available.

Oatman—Contracts have been signed by the Tom Reed management for milling fifty tons of ore a day for the United American and fifty tons for the Telluride property. Charges have been fixed at cost plus $2 a ton. American ore will go through the Tom Reed 400 level to the Aztec shaft, and thence be trammed to the mill. Telluride ore will go to the mill by auto truck. The ores are about the same as have been milled in the past, and there is assurance of high extraction. The mill is handling about 125 tons a day, mainly from the east side line, near the Big Jim ground recently awarded the company in the litigation with United Eastern.

Henry Zulch, engineer for the Tom Reed Gold Mines Co., has completed a model and maps of the underground workings and veins of the ground in dispute with the United Eastern.

Announcement has been made that the directors of the United Eastern have taken over a controlling interest in El Tigre, an old silver property, 175 acres in extent, in the State of Nayarit, Mexico, 100 miles south of Mazatlan and ten miles from the Southern Pacific of Mexico. Title has just been secured through favorable action of the Mexican Federal authorities, and cash is understood to have been paid. The main vein, 15 ft. wide, has been gouged to about 50 ft. in depth, but is to be opened by modern methods.

COLORADO

Cornucopia Company's Mill Making Initial Run

Blackhawk—The new fifty-ton mill of the Cornucopia Mining & Milling Co. is making its initial run. The property is in the Perigo district, eight miles north of Blackhawk, and has been under development for two years. It is said that large bodies of milling ore have been opened up from the tunnel workings. Amalgamation, concentration, and flotation will be employed to save the gold, silver, and copper.

CALIFORNIA

Mine Taxation Situation To Be Surveyed — Pattinson Mine Building Twenty-Stamp Mill—Many Small Properties Active

San Francisco.—Preparatory to surveying the mine taxation situation the American Mining Congress has appointed the following committee for California: C. E. Jarvis, of the California State Board of Control; Albert Burch, E. E. Paxton, of the Engels Copper Mining Co., Newton Cleveland, of the Yuba Consolidated Gold Fields Co., and Robert I. Kerr, secretary of the California Metal and Mineral Producers' Association. It is stated that the present system of mine taxation in use in California is too stringent in comparison with that applied to other industries. A survey of conditions is to be made and a more equitable system of taxation is to be recommended.

The Kennedy mine, at Jackson, is now operating forty stamps continuously, and has cleaned out the debris resulting from the flooding of the mine two years ago. Ore is being mined on the 4,050 level. The Argonaut is operating at maximum capacity. Although certain clews to the robbery of the amalgam which took place at the Argonaut some time ago have been unearthed, the thieves are still at large.

The wire-rope tramway of the Mountain Copper Co., at Keswick, has been completed and is expected to be put in operation soon. The tax suits started by this company and by the Mammoth have been decided in favor of the companies. The hull of the Gardella dredge near Lewiston, Trinity County, has been completed, and the machinery will soon be installed. The Shasta Zinc & Copper Co. will, it is expected, resume operation this spring.

Many small or two- and three-man gold properties are being opened up in Plumas, Sierra, and Nevada counties.

In Inyo County there is much activity in the silver-lead prospects and mines. The Birch Creek Mining Co. is operating a silver mine near Big Pine. The Black Eagle, at Independence; the Bunker Hill mine, at Big Pine, operated by the Base Metals Co.; the Casa Diablo, near Bishop, the Old Custer, at Darwin, and the Jumbo, at Big Pine, all small properties, are now operating. The Tecopa Consolidated is employing about seventy men and is shipping silver ore. It is the largest operation in the county. The Cerro Gordo has only a few men at work.

In Tuolumne County, the Pattinson mine, near Tuttletown, is building a twenty-stamp mill. The Nevada Wonder Mining Co. has taken an option on the Chilino mine, near the Pattinson, close to Tuttletown.

In El Dorado County, the El Dorado Lime & Minerals Co. is opening up a limestone deposit near White Rock, and has proved, according to a local report, an extensive deposit. The Grit mine is operating ten stamps. The Poverty Point mine is to be reopened, and work is to be resumed at the Jones property.

NEVADA

Old Wine Property Sold—Ore From Camp of Platinum Shows Gold Only

By Our Special Correspondent

Virginia City—The Old Wine Mining Co.'s property, south of Gold Hill, has been purchased jointly by the Comstock El Dorado Mining & Milling Co., of Reno, and the Spearhead Gold Mining Co., Reorganized, of Goldfield. The property has been opened to a depth of 700 ft., but some of the workings are now inaccessible. Production is estimated as $1,000,000. Gold values predominate. The Spearhead equipment in Goldfield will be moved to Gold Hill and work begun cleaning out the main shaft and preparing for resumption of development.

Hazen—A shipment of 2,625 lb. of ore from Platinum, ten miles north of Winnemucca, assayed 9 oz. gold per ton. The ore was tested for platinum, with negative results. There was considerable discussion several weeks ago over the reported fiinding of platinum here.

Mina—The mill of the Simon Silver-Lead Mines Co. is operating successfully. Output is about three carloads per week of silver-lead concentrates, and about the same of zinc concentrates. The silver-lead concentrates assay 35 oz. silver, 50 per cent lead, and 8 per cent zinc, or 80 per cent recovery of the lead and zinc. The zinc concentrates assay 42 per cent zinc, 6 per cent lead, and 5 oz. silver, or a recovery of 62 per cent of the zinc contents. Most of the silver and lead in the zinc concentrates will be saved at the company smelter at Harbor City, Cal., which assures a total recovery of about 90 per cent of the silver and lead contents in the ore.

Tonopah—The Tonopah Belmont continues to produce over 500 tons of ore per day and to accomplish the usual amount of development work. There is no change in production at the West End, Tonopah Mining, or Tonopah Extension. At the MacNamara and Montana mines, leasers are at work and doing well.

Argentite—At the Sanger mine, the original discovery in this district, eleven men are at work. Hoisting and compressor machinery are now being installed, and work will soon be resumed in the north and south drifts on the 100 level. Both of these faces are said to be in milling ore. On the Ecklund property the only work is shaft sinking, and the management intends to continue sinking to 200 ft. depth before doing any lateral work from the shaft.

Divide—The report covering the Tonopah Divide Mining Co.'s operations for 1921 is optimistic. With a net profit for 1921 of $101,559, cash in banks on Dec. 31, $126,945, and official statements regarding increasing ore reserves, with discussion of plans for the construction of a mill, it would appear that the company has several years of profitable operations to look forward to, with good prospects of important developments on the lower levels.

Ely—Mining operations, excluding work at the Ruth mine of the Nevada Consolidated Copper Co., are almost at a standstill, but every indication points to early resumption of activity by both the Nevada Consolidated and Consolidated Coppermines, the forces of these companies being gradually increased in the last two months. Work at adjoining camps has been held up by heavy snow and severe weather. An important strike of silicious silver ore is reported at the Exchequer mine, at Cherry Creek.

Pioche—Increased tonnage from the Black Metals mine, made possible by the opening of a new stope of richer silver fluxing ore, featured the shipments from the Pioche district for the week ended Jan. 27. A smaller shipment was made by the Bristol Silver Mines, owing to cold weather. Black Metals, Inc., shipped 265 tons and the Bristol 90 tons.

E. D. Smiley plans to build a combined concentrator and cyanide plant for treating lead-silver oxidized ores. He has obtained a lease from the Amalgamated Pioche Mines & Smelters Corporation on the old Yuba mill site.

OREGON

Co-operative Claimholders' Association Incorporated Under New Law

Bourne—The tonnage handled at the E. & E. mill has been increased to 140 daily, the result of recent improvements to the plant. Further changes are planned which will make it possible to handle 200 tons daily.

Grant's Pass—The first mining company to incorporate under Oregon's special co-operative law has been chartered by the state commissioner. It will be known as the Co-operative Claimholders' Association, and the head office is at Grant's Pass. The property of the company embraces 1,500 acres of placer ground in the Waldo mining district of Josephine County.

Homestead—Work is being done in preparation for the sinking of a 300-ft. shaft on the property of Copper Syndicate Co., near Homestead.

IDAHO

Armstead Mill Nearing Completion

Sandpoint—The high-voltage transmission line to the Armstead mine, at Talache, is completed. The power, which will be supplied by the Mountain States Power Co., will be used for operating the new mill.

Hailey—The Compensation group of sixteen claims, near the Minnie Moore mine, has been bonded by L. A. Dithmer, to Kenyon and Reynolds, of Burley. The property has been inactive for years. A small crew is working.

Wallace—The Star Mining Co., following the settlement of its litigation with the Federal Mining & Smelting Co. on account of trespass on the Star ground through the Morning mine, at Mullan, Idaho, has declared a dividend of $250,000.

MONTANA

Anaconda Preparing To Resume at Berkeley and Pennsylvania Mines—B. & S. Working Three Shifts

By A. B. Keith

Butte—Butte & Superior's important development on the 2,600 level of the Black Rock mine has been the principal feature of the week locally. In grade the ore is running practically the same as on the upper levels, but there is evidence that it will be found in greater tonnage. Bunches of glance and bornite occur in larger masses, and engineers express the opinion that it is possible that marked enrichment may be found at any time. The company is now employing three shifts, totaling more than 600 men, and the number will gradually be increased to 1,000. Work is being rushed at the Black Rock concentrator, and it is hoped to have this plant working in the course of a few weeks.

The Anaconda Copper Mining Co. is preparing to resume operations at the Berkeley and the Pennsylvania copper mines in addition to the Mountain View, where track-laying is nearly completed, preparatory to starting. With these three mines in operation, the company will be working seven of its larger properties.

Repair work is under way at the Boston & Montana reduction works at Great Falls, particularly at the refining plant. Officials believe that operations in this department can be resumed by Feb. 15. A report is in circulation in Anaconda circles that plans have been made for doubling the capacity of the Greene-Cananea plant, but this cannot be verified, although no denial is forthcoming. The Anaconda is an owner of Greene-Cananea stock, and in addition leading officials of the former are credited with possessing good blocks of this stock. With Anaconda's metal output inadequate to supply the normal copper and zinc requirements of American Brass, it is presumed that Inspiration Copper, which the Anaconda controls, and Greene-Cananea will be called in to supply any deficiency.

North Butte is reported to be considering deep-development work in consequence of the Butte & Superior's disclosure of copper ore on the latter's 2,600 level, and it would not be surprising were the company to consider crosscutting the northwest veins in the Rainbow group of claims, which property is controlled by interests that are affiliated.

The Davis-Daly and East Butte companies are expected to get together soon in the matter of lower smelting rates for the former, which will permit a resumption of operations at the Colorado mine, which formerly furnished the Pittsmont smelter of the East Butte with its largest customs tonnage. East Butte has resumed operations at its Elkhorn gold properties. It has also recently acquired property at Silver Plume, Col. (see p. 218).

UTAH

Question of Freight Reductions to the Fore—New Strike at Columbus-Rexall Holding Out

[illegible]

Salt Lake City—The campaign to reduce freight rates in the intermountain region is being watched with much interest by Utah mining men. Such a reduction is of great importance to the welfare of the state and to its most important industry, the mining and smelting industry, which, according to figures compiled by A. G. Mackenzie, secretary of the Utah chapter of the American Mining Congress, employs [illegible] per cent of all the men in the state reported by workmen's compensation insurance. It is estimated that of the total cost of production freight charges represents about 22 per cent. Wages and other costs are being lowered to the level of 1913, but unless freight rates also come down there is little chance of betterment. In summing up the situation, Mr. Mackenzie estimates that in 1913 there were 213 operators and that in the present year there are only 131. Those mines which are able to continue operations are the producers of ores with a high silver content, and these are shipping only their higher-grade ores, which is, of course, a wasteful method of operation.

Metal quotations, with the exception of those of silver, fixed at $1 an ounce by the Pittman Act, have reached the pre-war level, and, if it were not for the Pittman Act, all of the metal mines of the state would have to close down. Exclusive of the Utah Copper Co., shipments (mainly silver-lead ores) in 1913 amounted to 2,683,174 tons, and in 1921 the tonnage of these ores dropped to 751,800. In 1917 the ore shipped from Utah had a silver content of 4.6 oz. per ton and 63.3 lb. lead. This content steadily increased, until in 1921 the silver content per ton was 16.38 oz. and the lead content, 119.4 lb. The average value of the ore was $11.71 per ton in 1917 and in 1921 it was $25.84. These figures speak for themselves. It is estimated by H. W. Prickett, of the Utah traffic bureau, that with freight rates on ore as low as the pre-war rates, the ore tonnage of the Western carriers would in a few months increase to 65 per cent over the shipments of 1921.

Park City—Shipments for the week ended Jan. 20 amounted to 2,024 tons, as compared with 1,983 tons the week preceding. Shippers were: Judge allied companies, 912 tons; Silver King Coalition, 823; Ontario, 289.

Alta—At the Emma mine, development work is being done on the Montezuma fissure, recently cut in a drift from the Bay City tunnel level. The fissure was lost through faulting. Raising is being done on a stringer of ore encountered in the work. A forty-ton shipment recently ran 39 oz. silver and 5 per cent lead.

Officials of the Columbus-Rexall report the new strike is holding out and is of importance.

MICHIGAN

The Copper Country

Calumet & Hecla Preparing Rapidly for Resumption — 8,650,000 lb. Refined Copper in January

By M. W. Youngs

Houghton.—At the Calumet & Hecla [illegible] repairs are being speeded preparatory to resuming production. The most extensive work under way is in the conglomerate department of the Calumet & Hecla. It is unlikely that all of these shafts will be ready for mining operations by April 1, for the vein in the lower levels has caved badly and a longer period will be required for the removal of broken ground and reconditioning of the shafts. Several of the shafts, however, will doubtless be ready by that date. Two shifts of timbermen are at work in several of them.

The Allouez shafts are in good condition, and will require little repair, although no mining has been done in them since July, 1920. Allouez is well opened in its lower levels, and the stopes in both Nos. 1 and 2 shafts yielded a better grade of rock in 1920 than had been milled in some years. The yield averaged closed to 19 lb. to the ton, about 3 lb. better than in 1919, and the percentage of discard was only half that of 1919. Normally, Allouez's output is close to 10,000,000 lb annually.

Three shifts of timbermen are at work in Ahmeek's No. 2 shaft, replacing the concrete skipway with timber. This is the biggest job on the Ahmeek program, and it is believed that it can be completed before April 1. Ahmeek openings are generally in good condition.

A small number of men have been taken on at Isle Royale, where all underground openings are ready for actual mining. The most important repair work here will be in No. 5 shaft, where the concrete skipway will be replaced with timber for 1,000 ft. or more. This work can easily be completed before April 1. The Isle Royale mill is in good condition and can be started whenever it is needed. Isle Royale should be one of the first properties to get back to normal.

Construction of the power house and hoisting plant at the Seneca company's Gratiot No. 2 shaft will be started early in the spring. Work in the shaft will be temporarily suspended while concrete is poured for the collar. All openings in Seneca continue in good ground. The property now has nearly 8,000 ft. of drifts.

Six furnaces are now in service at the Calumet & Hecla smelter, two of which are working on special orders and four smelting cupola blocks.

The refined metal output of smelters in the Michigan copper district in January was estimated to be 8,650,000 lb. This is approximately 40 per cent of normal. The month closed with ten furnaces in blast. Of these Calumet & Hecla had six, Quincy one, and Michigan (Copper Range, Hohawk and Wolverine) three.

MINNESOTA

Cuyuna Range

Court Orders Assessment Against Cuyuna-Minneapolis Iron Co. Stockholders

Brainerd—Receivers for the Cuyuna-Minneapolis Iron Co. have secured favorable action upon an application for a court assessment against the stockholders of the company. On Jan. 21 Judge McClenahan, in the district court here, held that because the articles of incorporation of the company embraced other powers than merely mining operation, double liability could be held against the stockholders. He accordingly ordered an assessment of $1 on each of the million shares.

The Cuyuna-Minneapolis Iron Co. was the operator of the Ida Mae mine, on the north Cuyuna Range, a manganiferous iron-ore property active during the war. The operators spent $300,000 on development, and have been paying $45,000 per year royalties, although the property has been idle for two years. The stock of the company is in the hands of about 500 stockholders in eleven states, the majority being held in Pennsylvania. It is stated that one Pennsylvania banker owns 365,000 shares, holds $275,000 of a "gold bond" issue of the company, and $50,000 in promissory notes.

JOPLIN-MIAMI DISTRICT

Missouri-Kansas-Oklahoma

Flannery Mine May Start Again—Republic Property Changes Hands—Oronogo Circle Resumes

By P. R. Coldren

Joplin—Walter F. Friday, of Pittsburgh, Pa., has been in this district to look over the Flannery mine, at Sarcoxie, Mo. If the price of zinc ore should improve, this mine will be started again. It is a sheet ground property, and was a steady producer for several years. Its principal owner is said to be State Senator William Flynn, of Pittsburgh.

The Cosden-Aiken interests, which own the Admiralty Zinc mines, have taken over the old Republic property, in the south part of Picher, Okla., and are operating it under the name of the Helen Mining Co.

After being closed for over a year, the Oronogo Circle mine, at Oronogo, owned and operated by the Connecticut Zinc Co., started on Jan. 15. The Circle plant is the largest in the district, not excepting the Eagle-Picher Lead Co.'s Netta concentrator at Picher. It is managed by A. J. Burnham, of Joplin, and preparations for reopening have been under way for several months. Underground pillars have been blasted away, so that the open-air mining operations can be pursued, and several electric drags and underground crushers have been installed. Since the plant shut down, many "gougers" have been working on the property, and have taken out considerable lead ore. Eleven acres of land have been cleared of the surface dirt.

THE MARKET REPORT

Daily Prices of Metals

Jan.	Copper N. Y. net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
26	13.375	30.25	31.00	4.70	4.375	4.55@4.60
27	13.375	30.25	31.25	4.70	4.375	4.55
28	13.375	30.25	31.25	4.70	4.375	4.525
30	13.25@13.375	30.75	31.50	4.70	4.40	4.50
31	13.25@13.375	31.375	32.00	4.70	4.40	4.50
Feb. 1	13.25	31.00	32.00	4.70	4.35@4.40	4.45@4.50

*These prices correspond to the following quotations for copper delivered: Jan. 26, 27, 28, 13.625c.; Jan. 30, 31, 13.50@13.625c.; Feb. 1, [illegible]

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Jan.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
26	64⅞	65⅝	71¼	155¾	157½	23⅛	23	25½	26
27	64½	65⅜	71	157	158¾	23⅛	23	25⅝	26⅛
28									
30	64½	65¼	71	157½	159¼	23⅛	22⅞	25¼	26⅛
31	64	64¾	71	159½	161¼	22¾	22½	25	25½
Feb.1	63¼	64⅛	70	158½	160¼	22	21¾	24¾	25¼

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Jan.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	Jan	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
26	422¼	99⅝	65⅛	35	30	425¼	99⅝	66⅛	35⅜
27	423¼	99⅝	65⅛	34⅞	31	427	99⅝	66¼	35½
28	424¼	99⅝	65½	35⅛	Feb. 1	428	99⅝	66⅜	35⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Average Metal Prices for January

Copper:	
New York Electrolytic	[illegible]
London Standard	[illegible]
London Electrolytic	[illegible]
Lead:	
New York	4.700
St. Louis	4.388
London	23.667
Silver:	
New York, foreign	[illegible]
New York, domestic	99.625
London	35.035
Sterling Exchange	$421.750
Zinc:	
St. Louis	4.691
London	26.321
Tin:	
99 per cent	31.480
Straits	32.100
London	163.065
Antimony	4.463
Quicksilver	49.960
Platinum	97.260

Metal Markets

New York, Feb. 1, 1922

Extreme sluggishness continues to characterize the local metal markets. The price of copper asked by the smaller interests has succumbed further to the lack of demand, and the same is true of zinc. Lead is in fair demand at unchanged prices, and tin is slightly higher, owing to higher sterling exchange rates. Industrial conditions generally are not improving as fast as was expected.

Copper

Two or three fair-sized orders have been placed during the last week, but the purchasers in each transaction were careful to get the best price possible. The deliveries were generally for the second quarter. Most of the business of which we have reports was done on a 13.50c. delivered basis, but it was of small total volume. The larger producers continue out of the market, and as most of them are in a satisfactory financial position, they are likely to be content to wait several weeks longer if necessary before forcing any copper on the market. Should a buying movement begin, the price of copper would probably react to the 14c. level quickly, as no great tonnages are available at much under this price. However, it may be another month before any buying of importance develops, and in this interval it would not be surprising to see the price drop even slightly under current quotations.

Export business has been confined almost entirely to interests outside of the Copper Export Association, whose prices have been such as to net about 13.375c., f.o.b. refinery. The Export Association's price remains at about 14c. delivered, which is too high to attract possible buyers.

Lead

The official contract price of the American Smelting & Refining Co. continues at 4.70c. This is about the level at which prompt lead can be obtained in New York from other interests also. Demand has not been large, but has kept up well with that of recent weeks. The several lots of lead in the St. Louis district which were being offered up to Saturday at 4.375c. were apparently taken off the market over the week-end, and on Monday and Tuesday most of the business was placed at 4.40c. Today however, a slight weakness seems again to have developed, and there are rumors that 4.35c. might be done on good-sized orders for early delivery. The statistical position of lead continues excellent, and producers are not worrying over the decline in London. That has been caused by arrivals from Spain which were more than sufficient to take care of the demand. Spanish production would probably be curtailed though if the price dropped much further.

Zinc

There was no prolonged pause in the decline in zinc during the week. Although several large producers attempted to accommodate only their [illegible] [illegible], the producers [illegible] fairly large tonnages on the decline. A fair tonnage has been reported for forward delivery, as far ahead as April and May. For that position a premium is being generally asked of about 10 points, but some producers are hesitant about quoting on future zinc. The high-grade market is unchanged at [illegible] [illegible] allowed.

Tin

The price of tin has advanced [illegible] [illegible], owing both to the advance in London and the stronger quotation of sterling exchange. Buying has been of fair volume by solder manufacturers, but tin [illegible] seem well supplied. The scarcity of spot tin continues, but this should be relieved early in March, when three or four large cargoes are due to arrive.

Tin for April delivery was quoted at the following discounts from spot: Jan. 26th, 0.125c.; 27th, 0.25c.; 28th, 0.25c.; 30th, 0.375c.; 31st, 0.75c.; Feb. 1st, 0.50c.

Arrivals of tin, in long tons: Jan. 25, London, 225; total for January, 4,275; Warehouse stocks, 696; landing, 635; total visible supply, 5,606.

Gold

Gold in London: Jan. 26th, 97s. 5d.; 27th, 97s. 4d.; 30th, 97s.; 31st, 96s. 6d.; Feb. 1st, 96s. 3d.

Foreign Exchange

During the last week sterling reached the highest figures since August, 1919. The rise is attributed to short covering. On Tuesday, Jan. 31, francs were 8.28c.; lire, 4.57c.; and marks, 0.4975c. New York funds in Montreal, 5 7/16 per cent premium.

Silver

Buying in the London market by the Indian bazaars for this week's shipment to India has advanced the price for ready silver, and the market has also been steadied by the lack of sales from China, Shanghai being closed on account of the New Year holidays. There have been orders in the New York market at somewhat below the parity of the London spot price, but the chief strength locally has come from the sharp advance in sterling exchange. The immediate future of the market will depend upon the position of China when business is resumed after the holidays.

Mexican Dollars—Jan. 26th, 49⅝; 27th, 49⅝; 28th, 49¾; 30th, 50¼; 31st, 50¼; Feb. 1st, 50½.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 4.45c.; market dull. W.C.C. brand, 5¼@5¾c. per lb. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—7c. per lb.

Bismuth—$1.90@$2 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@[illegible] per lb.

Cobalt — Metal, $3@$3.25 per lb., black oxide, $2 per lb. in bbls.

Iridium—Nominal, $170@$190 per oz.

[1]Molybdenum Metal — In rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

Nickel—Standard market, ingot and shot, 41c.; electrolytic, 44c. Small tonnages, spot, nominal at 32c.

Monel Metal—Shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

Osmium—$70 per troy oz. Nominal. $70, Los Angeles, Cal.

Palladium—Nominal, $60 per oz.

Platinum—$100@$105 per oz.

Quicksilver—$46@$48 per 75-lb. flask. San Francisco wires $48.70.

[1]Rhodium—$150 per troy oz.

[1]Selenium — Black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb.

[1]Thallium Metal—Ingot, 99 per cent pure, $20 per lb.

[1]Tungsten Metal—Wire, $35@$60 per kilogram, according to purity and gage.

Metallic Ores

Chrome Ore—Ore analyzing 40@45 per cent Cr_2O_3, crude, $18@$20 per net ton; ground, $25; analyzing 45@50 per cent Cr_2O_3, $19@$21; ground, $25; f.o.b. Atlantic ports. Quotations are nominal.

Iron Ore—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $6.45; Mesabi bessemer, 55 per cent iron, $6.20; Old Range non-bessemer, 51½ per cent iron, $5.70; Mesabi non-bessemer, 51½ per cent iron, $5.55.

Magnetite Ore—F.o.b. Port Henry, N. Y.: Old bed 21 furnace, $4.85; old bed concentrates, 63 per cent, $5.75; Harmony, cobbed, 63 per cent, $5.75; new bed low phosphorus, 65 per cent, $8.50.

Manganese Ore — 22@24c. per unit, seaport; chemical ore, $45@$60 per gross ton, lump. Nominal.

Molybdenum Ore—85 per cent MoS_2, 48@50c. per lb. of contained sulphide, New York. Quotation purely nominal.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots.

[1]Titanium Ores—Ilmenite, 52 per cent TiO_2, 1¼@2c. per lb. for ore. Rutile, 95 per cent TiO_2, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore—Scheelite, 60 per cent WO_3 and over, per unit of WO_3, $3, f.o.b. Atlantic ports. Chinese, as low as $2; Nominal.

Uranium Ore (Carnotite)—Ore containing 1½ per cent U_3O_8 and 5 per cent V_2O_5 sells for $1.50 per lb. of U_3O_8 and 75c. per lb. of V_2O_5; ore containing 2 per cent U_3O_8 and 5 per cent V_2O_5 sells for $2.25 and 75c. per lb., respectively; higher U_3O_8 and V_2O_5 content commands proportionately higher prices.

Vanadium Ore—$1 per lb. of V_2O_5 (guaranteed minimum of 18 per cent V_2O_5), New York. Nominal.

Zircon—Zirconium silicate, f.o.b. Pablo, Fla., 4½@13c. per lb.

[1]Zirkite—According to conditions, $70 @$90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

Zinc and Lead Ore Markets

Joplin, Mo., Jan. 28—Zinc blende, per ton, high, $30.55; basis 60 per cent zinc, premium, $26; Prime Western, $25; fines and slimes, $24@$22. Average settling price, all grades of blende, $27.89.

Lead, high, $63.50; basis 80 per cent lead, $60; average settling price, all grades of lead, $61.04 per ton.

Shipments for the week: Blende, 8,560; lead, 1,498 tons. Value, all ores the week, $330,200. Shipments for the month: Blende, 28,466, lead, 7,388 tons. Value, all ores the month, $1,260,210.

Shipments for the month have exceeded output, drawing from the reserve stocks several hundred tons of ore. Purchases each week continued strong throughout the month, though the price level was lowered.

Platteville, Wis, Jan. 28—Blende, basis 60 per cent zinc, $28 per ton. Lead ore, basis 80 per cent lead, $60 per ton. Shipments for the week: Blende, 202; lead ore, 223 tons. Shipments for the year: Blende, 1,403; lead ore, 273 tons. Shipped during the week to separating plants, 364 tons blende.

Non-Metallic Minerals

Asbestos — Crude No. 1, $1,000@ $1,200; No. 2, $500@$750; spinning fibers, $200@$300; magnesia and compressed sheet fibers, $110@$200; shingle stock, $80@$125; paper stock, $45@$55; cement stock, $12.50@$17.50; floats, $7@$10, all per short ton, f.o.b. Thetford, Broughton and Black Lake mines, Quebec, Canada.

Barytes—Crude, $6@$7 per ton, f.o.b. mines. Ground white, $23, f.o.b. mills. Off-color grades, $17@$21, f.o.b. Southern mills. Foreign barytes, crude, f.o.b. New York, $7 per ton.

Bauxite — French bauxite, $8@$10 per metric ton, c.i.f. Atlantic ports. American bauxite, crushed and dried, $8@$10 per gross ton, f.o.b. shipping points; pulverized and dried, $12@$15 per gross ton, depending upon grade; calcined so as to remove most of the combined water, $20 per gross ton, f.o.b. shipping point.

Borax—Granulated, crystals, or powdered in bags, carloads, 5¼c. per lb.; in bbls. 5¾c.

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[1] Furnished by Foote Mineral Co., Philadelphia, Pa.

Chalk—English, extra light, 5c. Domestic light, 4½c.; heavy, 4c. per lb. all f.o.b. New York.

China Clay (Kaolin)—Crude, $6@$8; washed, $8@$10; powdered, $12@$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $13@$20, f.o.b. Virginia points. Imported lump, $14@$20, f.o.b. American ports; powdered, $35@$45, f.o.b., quoted at New York.

Emery—Turkish emery, 6c. per lb. Inferior grades, 3½c., f.o.b., from New England points.

Feldspar—No. 1 pottery grade, $6.50@$6.75 per long ton; No. 2 pottery, $5.75; No. 1 soap grade, $7.25@$7.50, f.o.b. cars. No. 1 Canadian, $22, f.o.b. mill.

Fluorspar — Gravel, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $20@$22.50 per ton, f.o.b. Illinois and Kentucky mines; gravel, $15; lump, $12.50, f.o.b. Lordsburg, N. M. Ground, acid grade, 97 per cent CaF_2, $30, New Mexico.

Fuller's Earth—16 to 30 mesh, $20 per ton; 30 to 60 mesh, $20; 60 to 100 mesh, $17; 100 mesh and over, $15, f.o.b. Pennsylvania points. English, $23@$25, f.o.b. New York.

Graphite—Ceylon lump, first quality, 4½@6½c. per lb.; chip, 3½@5c.; dust, 2@3½c.; No. 1 flake, 5@6c.; amorphous, crude, $15@$40 per ton. All f.o.b. New York.

Gypsum—Plaster of paris in carload lots sells for $4.25 per 250-lb. bbl., alongside dock, New York.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¾ in. size, $1@$1.75 per net ton; 1½ in., $1@$1.25. Prices for other sizes practically the same. Agricultural limestone, $2.50@$3.75 per net ton, f.o.b. eastern shipping points, depending upon analysis.

Magnesite, Calcined — Crude, $12@$15 per ton. High-grade caustic calcined, lump form, $30@$40 per ton. Plastic calcined, $45@$50 in bbls., carload lots, f.o.b. California points. Atlantic seaboard, $60.

Dead-Burned — $33 per net ton, Chewelah, Wash.; $58@$64, Chester, Pa. Austrian grade, $28@$30 per ton, f.o.b., Chester, Pa. (Magnesite brick—See Refractories.)

Mica — India block mica, slightly stained, per lb.; No. 6, 35c.; No. 5, $1.25; No. 4, $2.25; No. 3, $2.90; No. 2, $3.65; No. 1, $5.50. Clear block: No. 6, 50c.; No. 5, $1.75; No. 4 $3.25; No. 3, $5; No. 2, $6.50; No. 1, $8; A1, $6.50@$8.50; extra large, $25; ground, wallpaper grade, $90@$160 per ton (depending upon quantity); ground roofing mica, $25@$70, all f.o.b. New York.

Monazite[1] — Minimum of 6 per cent thorium oxide, $30 per unit, duty paid.

Phosphate Rock—Per long ton, Florida ports, pebble grade: 77 per cent tricalcium phosphate, $9.50 ($10.50 for land rock); 75 per cent, $8; 75@74 per cent, $[illegible].50; 70 per cent, $4.75; 68 per cent, $4.25; 68@66 per cent, $4.

Pumice Stone — Imported, lump, 3@40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

Pyrites—Spanish fines, per unit, 12c., c.i.f. Atlantic seaport; furnace size, 13c.; Spanish lump, 13@14c.; domestic fines, f.o.b. mines, Georgia, 11@12c.

Silica—Glass sand, $1.25@$2.25 per ton; sand-blast material, $2.25@$4.50, f.o.b. Indiana and Illinois points. Amorphous or decomposed variety, soft silica, 250 mesh, $14; 350 mesh, $18; 450 mesh, $28 per ton. Ganister, crude, $2.50 per ton, f.o.b. Illinois points. Molding sand, building sand, glass sand, $2.25@$3, f.o.b. Pennsylvania points.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s. New York.

Talc—20 to 200 mesh, $7@$12 per ton, f.o.b. Vermont; $8.25@$13, f.o.b. points in Georgia; 200 mesh, $16@$20, f.o.b. Los Angeles.

Mineral Products

Copper Sulphate — Large crystals, 5.65c.; small crystals, 5.55c. per lb., f.o.b. New York.

Potassium Sulphate — Powder, domestic, $1 per unit, basis 90 per cent, f.o.b. New York.

Sodium Nitrate — $2.37½@$2.40 per cwt., ex vessel, Atlantic ports.

Sodium Sulphate—For 95 per cent material, $12.50 per ton, f.o.b. in bulk, Western mines, spot and six months' contract; $17@$20 per ton, New York.

Ferro-Alloys

Ferrotitanium—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrocerium—Per lb., $12@$15.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 11½c. per lb. of chromium contained; 4 to 6 per cent carbon, 12c., f.o.b. works.

Ferromanganese—Domestic 78 to 82 per cent, $59@$60, f.o.b. furnace; English and German, $57@$58.35, c.i.f. Atlantic seaport. Spiegeleisen, 18@20 per cent, $25@$27 per gross ton, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, $2.25 per lb. of contained metal, f.o.b. works. Imported material, $1.70@$2.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, $38@$40; 50 per cent, $54@$55; 75 per cent, $115@$120.

Ferrotungsten—Domestic, 70 to 80 per cent W, 40@45c. per lb. of contained tungsten, f.o.b. works. Foreign, 50c., duty paid, f.o.b. Atlantic ports.

Ferro-uranium—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

Ferrovanadium—$4.25@$4.50 per lb. of V contained, according to analyses and quantity.

Metal Products

Copper Sheets—Current New York list price, 21.25c. per lb.; wire, 15@15.25c.

Lead Sheets—Full lead sheets, 7¾c.; cut lead sheets, 8c. in quantity, mill lots.

Nickel Silver—$27.75c. per lb. for 18 per cent nickel Grade "A" sheets.

Yellow Metal — Dimension sheets, 17.75c.; sheathing, 16.75c.; rods, ⅜ to 3 in., 14.75c.

Zinc Sheets — $8 per 100 lb., less 8 per cent on carload lots, f.o.b. works.

Refractories

Bauxite Brick—56 per cent alumina, $130 per 1,000; 76 per cent, Suprafrax, $200 per 1,000; f.o.b. works, St. Louis and Pittsburgh.

Chrome Brick—$41@$43 per net ton.

Chrome Cement — 40@45 per cent Cr_2O_3, $30@$32 per net ton, and $31 in sacks, carload lots, f.o.b. eastern shipping points.

Firebrick—First quality, 9-in. shapes, $32@$37 per 1,000, Pennsylvania, Ohio and Kentucky.

Magnesite Brick—9-in. straights, $53@$55 per net ton, f.o.b. works.

Silica Brick—9-in., per 1,000, $30@$35 in carload lots, f.o.b. shipping points.

The Iron Trade

Pittsburgh, Jan. 31, 1922

Demand for steel products, on the whole, has shown no change in the last two weeks, and the tonnage of business booked by steel mills in the month of January falls decidedly short of the expectations. Signs appearing in the last week have, however, been of a promising character as to tonnage demand in the future, though not as to prices.

Tin plate is doing quite well, showing a production at close to 75 per cent of capacity, and sheets, wire products, and tubular goods together average about 50 per cent of capacity. Bar, plate, and shape production is light. Rail production is materially increased.

Prices of steel products are extremely unsatisfactory. Though open or "regular" prices are not changed, more tonnage is now sold at concessions than at full prices, and there is keen competition everywhere.

Pig Iron — Basic is off 25c. and foundry iron 50c. from previous quotations, the market being now quotable at $19.50 for bessemer, $18 for basic, and $19 for foundry, f.o.b. Valley furnaces, with $1.96 freight to Pittsburgh. Inquiry is light.

Coke

Connellsville—Furnace, $3.25@$3.50; foundry, $4.25@$4.50.

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[1] Foote Mineral Co., Philadelphia, Pa.

COMPANY REPORTS

Consolidated Mining & Smelting Production Increases

By ALEXANDER GRAY

[illegible]

A PRELIMINARY REPORT of the Consolidated Mining & Smelting Co. of Canada makes this comparison of output and value for the last two years:

	1920		1921	
	[illegible]	[illegible]	[illegible]	Value
[illegible]	[illegible]	[illegible]	[illegible]	$1,083,232
[illegible]	[illegible]	[illegible]	[illegible]	791,985
[illegible]	[illegible]	[illegible]	[illegible]	306,754
[illegible]	[illegible]	[illegible]	[illegible]	1,960,999
[illegible]	[illegible]	2,810,890	53,131,270	2,551,895

In the tonnage treated and quantity of zinc-lead produced 1921 was a record year for the company and for the Province of British Columbia. The parallel columns afford opportunity for analysis by those who are interested in the situation that confronted producers. The company's operations were characteristic of what all others had to meet. For the 408,346 tons received at the Trail metallurgical works of the company, the monetary return may be said to have been satisfactory but inadequate. Only a fortieth of that tonnage, it is explained, came from private operators. All else was derived from company mines. At any rate, the results are indicative of what is possible when economies are complete and metal markets more responsive. They follow the preceding year in which the management noted there had been "the most drastic period of deflation ever known"—for which $624,115.15 was written off. The following compilation shows these items as they appeared a year ago and how they have been dealt with:

[illegible] loan expenditure	$1,750,000
Current bank loans and overdraft	3,601,204
Accounts payable	1,777,463
Ores and metals in process	$3,336,463
Stores and materials	1,486,920

At the end of 1919 there was a carry-over in ores, metals, and smelter product of $2,987,297. Capital commitments—which will be refunded—and labor disputes accentuated the industrial reaction. It is to be emphasized, however, that during 1920 the management complained that "a great deal of trouble was experienced during the early part of the year owing to an insufficient and unsatisfactory ore supply," especially of zinc ores, a situation that no longer exists.

Until settlements are effected and the balance sheet appears, no statement can be made as to the improved financial position. Presumably, and according to informal pronouncements, inventories are not so bothersome. It is even intimated that it is the company's competitors—particularly in the Far East—who are doing hard thinking about the quantity and grade of the lead-zinc-silver ore at the beck and call of the company's board of directors. Of the 348,000 tons dealt with in 1920, 260,000 tons came from the Sullivan Mine, at Kimberley, British Columbia. A greater proportion of the 1921 tonnage was from the Sullivan, where underground developments have surpassed expectations and the utmost optimism prevails. Instead of a scarcity of zinc-bearing ores, the company has been shipping a grade averaging 11 per cent lead and 18 per cent zinc. Obviously the detailed balance sheet will have no inverted box rules about it suggestive of the mortuary or the moribund.

Consolidated production must have been sustained throughout the year; for the total Dominion of Canada output of lead in the first half of 1921 was about 32,875,000 lb., compared with 35,953,717 lb. for the whole calendar year 1920. In the same six months of 1921, the total Canadian production of zinc was 28,236,103 lb., of which the Consolidated contributed 28,218,000 lb. Allowing for everything, the record is the outstanding feature of Canada's mineral industries—apart from Hollinger Consolidated gold results. Ontario and Quebec produced no zinc. British Columbia had the field all to itself. Had prices been at all comparable with those of 1920, some of the Consolidated directors feel, they would be the better enabled to greet the rising morn with a larger chest measurement than Chanticleer—and they would not so vehemently wish the de'il was awa' wi' the excise man.

It has devolved upon the management to liquidate inventories—to thaw out the banking position. Liquidity has preceded further plans for expansion. Kobe and Europe took the Consolidated metals. Once money markets are easier, and in the near future, announcements will be made as to concentration and power facilities. As surety for such plans and what they will entail, apart from copper properties and the program therefor, there is an estimated 5,000,000 tons of zinc-lead-silver ore at the Sullivan mine alone, which may be considered conservative by the more enthusiastic directors. The estimate has a factor of safety. The Sullivan is so big that it is more prudent to underestimate and to merely register the generalization that the gross value of what is determined and what may be approximated—what is recoverable with the new metallurgy—will test the capacity of more than one cornucopia. Yet a leading Canadian mining engineer six months ago, exclaimed: "Sullivan! Sullivan! I never heard of it! Where is it?"

Mining Dividends for January, 1922

The following dividends were paid by mining and metallurgical companies during January, 1922:

Companies in the United States:	Situation	Per Share	Total
American Smelters Sec. pfd. "A"	U. S.	$1.50 Q	$146,071
American Smelters Sec. pfd. "B"	U. S.	1.25 Q	39,855
Cresson Consolidated Gold	Col.	0.10	122,000
Eagle-Picher Lead pfd	Mo., Okla.	1.50 Q	15,000
Homestake Mining, g	S. D.	0.25 M	62,790
Phelps Dodge Corporation, c	U. S. and Mex.	1.00 Q	450,000
Rochester Silver Corporation	Nev.	0.025	44,268
Tonopah Belmont Development, s.g.	Nev.	0.05	75,000
Tonopah Extension, s.g.	Nev.	0.05 Q	64,636
United Eastern, g	Ariz.	0.15 Q	204,455
U. S. Smelting, Refining & Mining, pfd	U. S. and Mex.	0.875 Q	425,556
Companies in Canada:			
Asbestos Corporation	Que.	$1.50 Q	$45,000
Asbestos Corporation pfd	Que.	1.75 Q	70,000
Dome Mines, g	Ont.	0.25 Q	119,167
Hollinger Consolidated Gold	Ont.	0.05 4 wks.	246,000
Kerr Lake, s	Ont.	0.125 Q	75,000
McIntyre Porcupine, g	Ont.	0.05 4 mos.	182,014
Nipissing, s	Ont.	0.30	360,000
Wright-Hargreaves, g	Ont.	0.05	137,500

M, monthly; Q, quarterly, c copper, g, gold, s, silver

The dividend record of January contains several additions to the list published three months ago. Cresson Consolidated Gold is again included, after a hiatus lasting since June, 1920; Tonopah Belmont Development Co.'s last payment was 5c. in April, 1921; Nipissing paid 15c. extra. besides the regular quarterly dividend of 15c.; and Wright-Hargreaves paid an initial dividend of 5c. per share. This last is one of the principal producers of the Kirkland Lake district, and the new 175-ton mill, it is predicted, will turn out enough gold to net the company close to $1,000,000 in its first year of operation. The stock is closely held. In addition to the dividends listed, the Star Mining Co., in Idaho, is reported to have paid a dividend of $250,000, though no official advices to this effect have been received.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York 1921	New York 1922	London 1921	London 1922	Sterling Exchange 1921	Sterling Exchange 1922
January	65 950	65 450	39 985	35 [illegible]	372 650	421 750
February	59 233		34 745		385 932	
March	56 023		32 479		389 806	
April	59 337		34 250		391 784	
May	59 810		34 165		396 580	
June	58 510		34 971		377 236	
July	60 260		37 481		362 565	
August	61 597		38 096		364 505	
September	66 160		40 082		371 725	
October	70 970		41 442		386 315	
November	68 234		38 750		396 315	
December	65.760		35 645		414 880	
Year	62 654	. . .	36 841		384 191	

New York quotations cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York Electrolytic 1921	New York Electrolytic 1922	London Standard 1921	London Standard 1922	London Electrolytic 1921	London Electrolytic 1922
January	12.597	13 465	70 964	65 226	79 119	72 321
February	12 556		70 925		75 925	
March	11 976		67.565		71.190	
April	12 438		69.381		71 786	
May	12 742		73 196		74 298	
June	12 697		71.852		75 682	
July	12 170		71 155		75 286	
August	11 634		68 614		72 705	
September	11 948		67 977		72 295	
October	12.673		67.327		73 476	
November	13 035		66.614		74.386	
December	13 555		66 706		74 525	
Year	12 502		69.356		74 223	

New York quotations, cents per lb. London, pounds sterling per long ton.

Lead

	New York 1921	New York 1922	St. Louis 1921	St. Louis 1922	London 1921	London 1922
January	4 821	4 700	4 747	4 388	23 387	23 667
February	4 373		4.228		20 650	
March	4 084		4 000		18 911	
April	4 356	......	4.272	......	20 589	
May	4 952	. .	4 784		23 399	
June	4 485	.. .	4.293		22 563	
July	4 410	......	4.260	......	23 399	
August	4 382		4 217		23 489	
September	4 600	.	4.392		23 148	
October	4.690	......	4.439	......	23 679	
November	4 683		4.356		24 483	
December	4 700		4 369		25 322	
Year	4.545		4 363		22.752	

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York 99% 1921	New York 99% 1922	New York Straits 1921	New York Straits 1922	London 1921	London 1922
January	31 470	31 480	36 000	32 100	190 464	163 065
February	28.534		32.142		166 250	
March	27.296		28.806		156 024	
April	28.990		30.404		163.905	
May	31.431		32.500		177.411	
June	28.514		29.423		167 506	
July	26.755		27.655		164.530	
August	25 662		26 301		155 318	
September	26 280		26 680		156.750	
October	27.278		27.655		156.380	
November	28.592		28.935		158.898	
December	32 106		32 486		169 738	
Year	28 576	..	29 916		165 265	

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis 1921	St. Louis 1922	London 1921	London 1922
January	5 413	4 691	25 262	26 321
February	4 928		24 850	
March	4 737		25 077	
April	4 747		25 530	
May	4 848		26 923	
June	4 421		26 750	
July	4 239		26 262	
August	4 186		25 068	
September	4 235		25 256	
October	4 605		26 315	
November	4 667		25 949	
December	4.835		26 900	
Year	4.655		25 845	

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York 1921	Antimony (a) New York 1922	Quicksilver (b) New York 1921	Quicksilver (b) New York 1922	Platinum (c) New York 1921	Platinum (c) New York 1922
January	5 258	4 465	48 440	47 960	73 400	97 [illegible]
February	5 250		49 545		70 227	
March	5 282		46 796		72 463	
April	5 137		45 423		73 404	
May	5 250		47 000		73 740	
June	5 087		46 846		74 942	
July	4 735		44 950		70 440	
August	4 597		45 028		73 222	
September	4 564	.....	42 660	.	75 960	
October	5 085		39 840		81 800	
November	4 734		39 804		82 609	
December	4 500		49 2 2		78 192	
Year	4 957		45 462		75 033	

(a) Antimony quotations in cents per lb for ordinary brands (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce

Pig Iron, Pittsburgh

	Bessemer 1921	Bessemer 1922	Basic 1921	Basic 1922	No 2 Foundry 1921	No 2 Foundry 1922
January	33 96		31 96		33 88	
February	28 96		26 96		30 25	
March	28 16		26 46		27 85	
April	26 96	....	24 46	.....	26 77	
May	26 21		23 84		25 56	
June	24.96		22 66		24 38	
July	22.84		20 76		22 36	
August	21 96		20 29		21 53	
September	21 96		21 21	..	22 82	
October	21 96		20 96		22 96	
November	21 96	......	20.96	.....	22 74	
December	21 96		20 65		21.96	
Year	25 15		23 43		5 26	

In dollars per long ton

Monthly Crude Copper Production

	1921 September	1921 October	1921 November	1921 December
Alaska shipments	3,709,844	6,160,847	4,841,506	8,881,013
Anaconda	(a)	(a)	(a)	(a)
Arizona Copper	(a)	(a)	(a)	(a)
Calumet & Arizona	(a)	(a)	(a)	(a)
Calumet & Hecla	(a)	(a)	(a)	(a)
Other Lake Superior	4,250,000	4,250,000	5,500,000	5,500,000
Chino	(a)	(a)	(a)	(a)
Con. Ariz. Smelting	(a)	(a)	(a)	(a)
East Butte	949,980	1,000,000	750,000	(a)
Inspiration	(a)	(a)	(a)	(a)
Magma	(a)	(a)	(a)	(a)
Miami	4,268,000	5,084,000	4,514,000	5,030,941
Nevada Cons	(a)	(a)	(a)	(a)
New Cornelia	1,527,493	1,536,725	1,605,936	1,717,183
Old Dominion	(a)	(a)	(a)	(a)
Phelps Dodge	(a)	(a)	(a)	(a)
Ray	[illegible]	(a)	(a)	(a)
Shattuck Arizona	(a)	(a)	(a)	(a)
United Verde	(a)	(a)	(a)	(a)
United Verde Extension	(a)	(a)	(a)	(a)
Utah Copper	(a)	(a)	(a)	(a)
Others, estimated	9,150,000	5,200,000	11,130,000	8,500,000
Total United States	23,855,317	23,231,572	28,341,442	29,629,137
Imports: Ore and concentrates, matte	6,268,635	8,445,551	7,297,583	14,844,641
Imports of blister, unrefined	8,614,851	23,360,893	10,561,454	14,731,185
Imports of refined	10,553,792	761,125	2,139,144	2,447,925
Grand total	49,292,595	55,799,141	49,339,623	61,652,888
Backus & Johnston	350,000	198,000	900,000	822,000
Boleo	771,305	1,041,863	976,815	954,765
Cananea	(a)	(a)	(a)	(a)
Cerro de Pasco	4,594,000	5,330,000	5,618,000	5,536,000
Chile	4,000,000	4,000,000	4,000,000	4,000,000
Cons. M. & S. of Canada	261,855	156,940	200,000	313,290
Falcon Mines	511,280	550,710	518,600	550,800
Furukawa	2,744,371	2,541,508	....	
Granby Cons	2,720,761	2,593,250	2,365,017	2,215,403
Hampden Cloncurry	(a)	(a)	(a)	(a)
Katanga	6,136,515	6,189,435	5,984,370	
Mount Morgan	(a)	(a)	(a)	(a)
Mount Lyell	1,204,000	1,220,000	71,068,000	
Phelps Dodge Mexican	(a)	(a)	(a)	(a)
Sumitomo	1,674,865	1,444,316	2,910,964	

(a) No copper produced during this month.

Comparative Annual Copper Production

	1919	1920	1921
January	135,733,511	121,903,744	90,596,597
February	111,649,512	117,450,000	86,682,941
March	102,040,460	120,309,316	91,046,345
April	98,808,998	116,078,871	46,946,523
May	92,652,975	114,964,207	25,310,511
June	95,856,570	116,107,856	24,623,693
July	100,369,247	109,729,610	22,033,739
August	107,994,040	112,460,254	23,248,398
September	108,703,075	104,9195,62	23,855,316
October	115,143,143	105,231,571	23,231,572
November	117,289,735	106,700,178	28,341,442
December	102,997,633	95,709,009	29,629,137

MINING STOCKS

Week Ended January 28, 1922

COPPER

Stock	Exch.	High	Low	Last	Last Div.	
Ahmeek	Boston	65	[illegible]	[illegible]	Sept. '20, Q	$0.50
Alaska-Br. Col.	N. Y. Curb	2½	[illegible]	[illegible]		
Allouez	Boston	32½	[illegible]	[illegible]	[illegible] '19	1.00
Anaconda	New York	50½	[illegible]	[illegible]	[illegible] '20, Q	1.00
Arcadian Consol.	Boston	3	[illegible]	[illegible]		
Arizona Com'l	Boston	9¼	[illegible]	[illegible]	[illegible] '18, Q	0.50
Big Ledge	N. Y. Curb	*29	[illegible]	[illegible]		
Bingham Mines	Boston	14	[illegible]	[illegible]	Sept. '19, Q	0.25
Calumet & Arizona	Boston	60	[illegible]	[illegible]	[illegible] '21, Q	0.50
Calumet & Hecla	Boston	280	[illegible]	[illegible]	[illegible] '20, Q	5.00
Canada Copper	N. Y. Curb	*25	*25	[illegible]		
Centennial	Boston	12	[illegible]	[illegible]	Dec. '18, SA	1.00
Cerro de Pasco	New York	35	[illegible]	34	Mar. '21, Q	0.50
Chile Copper	New York	18¼	[illegible]	[illegible]		
Chino	New York	28	26	26	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*34	*27	*31		
Con. Arizona	N. Y. Curb	...		3	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	1¼	1 [illegible]	1 [illegible]		
Copper Range	Boston	45½	44	45	Sept. '20, Q	0.50
Crystal Copper	Boston Curb	*62	*55	*61		
Davis-Daly	Boston	9¾	7	8½	Mar. '20, Q	0.25
East Butte	Boston	12¼	11	11¼	Dec. '19, A	0.50
First National	Boston Curb	*78	*70	*75	Feb. '19, SA	0.15
Franklin	Boston	1½	1¼	1¼		
Gadsden Copper	Boston Curb	*40	*30	*30		
Granby Consol.	New York	30½	29½	29½	May '19, Q	1.25
Greene-Cananea	New York	28⅛	27	28⅛	Nov. '20, Q	0.50
Hancock	Boston	†3	†2½	2½		
Howe Sound	N. Y. Curb	2¼	2	2¼	Jan. '21, Q	0.05
Inspiration Consol.	New York	41	38½	38½	Oct. '20, Q	1.00
Iron Cap	Boston Curb	7¼	7¼	7½	Sept. '20, K	0.25
Isle Royale	Boston	26½	25½	26	Sept. '19, SA	0.50
Kennecott	New York	30¼	28	28¼	Dec. '20, Q	0.50
Keweenaw	Boston	†1½	†1¼	1½		
Lake Copper	Boston	2¾	2½	2½		
La Salle	Boston	2	1¾	2		
Magma Copper	N. Y. Curb	30	28¼	29½	Jan. '19, Q	0.50
Majestic	Boston Curb	*3	*3	*3		
Mason Valley	Boston	1½	1½	1½		
Mass Consolidated	Boston	2½	2½	2½	Nov. '17, Q	1.00
Miami Copper	New York	28	27	27¼	Nov. '21, Q	0.50
Michigan	Boston	2½	2¼	2½		
Mohawk	Boston	59	56½	57½	Nov. '20, Q	1.00
Mother Lode Coa.	N. Y. Curb	9½	8	8		
Nevada Consol.	New York	15½	14¼	14⅞	Sept. '20, Q	0.25
New Cornelia	Boston	19	18¼	18	Aug. '20, K	0.25
North Butte	Boston	14	12½	13½	Oct. '18, Q	0.25
North Lake	Boston	†*40	†*20	*25		
Ohio Copper	N. Y. Curb			*10		
Old Dominion	Boston	27	25	26	Dec. '18, Q	1.00
Osceola	Boston	37½	35	35½	June '20, Q	0.50
Phelps Dodge	Open. Mar.	†180	†170		Jan. '22, Q	1.00
Quincy	Boston	47	45	45	Mar. '20, Q	1.00
Ray Consolidated	New York	15¼	14½	14½	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*13	*3	*7		
St. Mary's Min. Ld.	Boston	47	45	45	Dec. '21, K	1.00
Seneca Copper	Boston	17½	17	17½		
Shannon	Boston	1½	1½	1½	Nov. '17, Q	0.25
Shattuck Arizona	New York	8⅝	8½	8⅛	Jan. '20, Q	0.25
South Lake	Boston	*60	*60	*60		
Superior & Boston	Boston	1	1	1		
Tenn. C. & C. cfs.	New York	10¼	10	10¼	May '18, I	1.00
Tuolumne	Boston	*70	*65	*65	May '13,	0.10
United Verde Ex.	Boston Curb	30⅛	29	29½	Nov. '21, Q	0.25
Utah Consol.	Boston	1½	1¼	1¼	Sept. '18,	0.25
Utah Copper	New York	64¼	62¼	62½	Dec. '21, Q	0.50
Utah Metal & T	Boston	1½	1½	1½	Dec. '17,	0.30
Victoria	Boston	1¼	1¼	1¼		
Winona	Boston	*45	*45	45		
Wolverine	Boston	12	10¼	12		

NICKEL-COPPER

Stock	Exch.	High	Low	Last	Last Div.	
Internat. Nickel	New York	12¾	12¼	12¼	Mar. '19,	0.50
Internat. Nickel, pfd	New York	72	70	71½	Nov. '21, Q	1.50

LEAD

Stock	Exch.	High	Low	Last	Last Div.	
National Lead	New York	90¾	86¾	87	Dec. '21, Q	1.50
National Lead, pfd.	New York	112½	112½	112½	Dec. '21, Q	1.75
St. Joseph Lead	New York	13	13	13	Dec. '21, Q	0.25

QUICKSILVER

Stock	Exch.	High	Low	Last	Last Div.	
New Idria	Boston	†2	†1	1		

ZINC

Stock	Exch.	High	Low	Last	Last Div.	
Am. Z. L. & S.	New York	14¼	13⅛	13¼	May '20,	1.00
Am. Z. L. & S. pfd.	New York	39½	39½	39⅞	Nov. '20, Q	1.50
Butte C. & Z.	New York	6½	5½	5½	June '18,	0.50
Butte & Superior	New York	28½	24½	25	Sept. '20,	1.25
Callahan Z.-Ld.	New York	6⅝	5½	5½	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	136	131	133½	Nov. '21, Q	2.00
Yellow Pine	Los Angeles	...	...	*50	Sept. '20, Q	0.03

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

‡ Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil, Colorado Springs, The Financial Press, N. Y.

GOLD

Stock	Exch.	High	Low	Last	Last Div.	
Alaska Gold	New York	[illegible]	[illegible]	[illegible]		
Alaska Juneau	New York	[illegible]	[illegible]	[illegible]		
Carson Hill	New York	13½	12¾	13¾		
Cresson Consol. G.	N. Y. Curb	3	2 11/16	2 11/16	Jan. '22, Q	$0.10
Dome Extension	Toronto	*77	*75	*77		
Dome Mines	New York	22	20¾	21½	Jan. '22, Q	0.25
Florence Goldfield	N. Y. Curb	*23	*21	*21		
Golden Cycle	Colo. Springs	*75	*71	*75	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*4	*4	*4	Dec. '19,	0.05
Hollinger Consol.	Toronto	7.97	7.93	7.95	Dec. '21, 4 wks	0.05
Homestake Mining	New York	57	55	57	Dec. '21, M	0.25
Kirkland Lake	Toronto	35	*32	*32		
Lake Shore	Toronto	1.37	1.31	1.37	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	2.45	2.25	2.45	Jan. '22, K	0.05
Porcupine Crown	Toronto	*16	*14	*15½	July '17,	0.03
Porcupine V. N. T.	Toronto	*20½	*19	20½		
Portland	Colo. Springs	*35	*35	*55	Oct. '20, Q	0.01
Schumacher	Toronto	*35½	*32	*35½		
Silver Pick	N. Y. Curb	*6	*6	*6		
Teck Hughes	Toronto	*29	*28	*29		
Tom Reed	Los Angeles	1.00	*46½	*90	Dec. '19,	0.02
United Eastern	N. Y. Curb	2¼	2	2⅛	Oct. '21, Q	0.15
Vindicator Consol.	Colo. Springs	29	22	29	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*6	*4	*4		
Yukon Gold	N. Y. Curb	1¼	1 1/16	1⅛	June '18,	0.02½

SILVER

Stock	Exch.	High	Low	Last	Last Div.	
Batopilas Mining	New York	⅝	½	½	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*21½	*20	*20½	May '20, K	0.03
Coniagas	Toronto	1.40	1.30	1.40	May '21, Q	0.12½
Crown Reserve	Toronto	*16	*14	*14	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3⅜	3⅛	3¼	Jan. '22, Q	0.12½
La Rose	Toronto	*34	*33	*34	Apr. '18,	0.02
McKinley-Dar.-Sav.	Toronto	*18½	*15½	*18½	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.05	1.00	1.05	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6½	6	6⅛	Jan. '22, Q	0.15
Ontario Silver	New York	5⅛	5	5	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	...	...	*12	Jan. '12,	0.10
Temiskaming	Toronto	*34½	*32	*34½	Jan. '20, K	0.04
Trethewey	Toronto	*8	*7½	*7½	Jan. '19,	0.05

GOLD AND SILVER

Stock	Exch.	High	Low	Last	Last Div.	
Boston & Montana	N. Y. Curb	*68	*54	*56		
Cash Boy	N. Y. Curb	*6	*5	*5		
Dolores Esperanza	N. Y. Curb	...	...	*90		
El Salvador	N. Y. Curb	*4	*4	*4		
Jim Butler	N. Y. Curb	...	...	*6	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	*3	*3	*3	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*8	*7	*8	May. '10,	0.02½
Tonopah-Belmont	N. Y. Curb	1½	1 7/16	1½	Jan. '22, Q	0.05
Tonopah-Divide	N. Y. Curb	*75	*60	*63		
Tonopah-Extension	N. Y. Curb	1⅝	1½	1½	Jan. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1⅝	1 7/16	1 9/16	Oct. '21, SA	0.05
West End Consol.	N. Y. Curb	*84	*76	*84	Dec. '19, SA	0.05

SILVER-LEAD

Stock	Exch.	High	Low	Last	Last Div.	
Caledonia	N. Y. Curb	...	...	*6	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	1.02½	1.02½	1.02½	Dec. '20,	0.15
Chief Consol.	Boston Curb	3½	1 7/16	3 7/16	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	20¾	19½	19½	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†3.00	†1.00	...	July '20, Q	0.10
Daly-West	Boston	†3	†2	...	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†3	†2¼	2¼	Apr. '21, K	0.05
Electric Point	Spokane	*4½	*4	*4½	May '20, SA	0.03
Federal M. & S.	New York	†9⅞	†2	10	Jan. '09,	1.50
Federal M. & S., pfd	New York	41	40	40	Dec. '21, Q	1.00
Florence Silver	Spokane	*18	*18	*18	Apr. '19,	0.01½
Grand Central	Salt Lake	*41	*40	*40	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	4⅞	4 13/16	4 11/16	Dec. '21, Q	0.17
Iron Blossom Con.	N. Y. Curb	*21	*20	*20	Dec. '21, Q	0.02½
Judge M. & S.	Salt Lake	†3.00	†2.25	2.50	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	...	...	*4	June '21, I	0.02
Prince Consol.	Salt Lake	*13½	*10	*13½	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*4½	*4	*4	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*7	*6	*7		
South Hecla	Salt Lake	†1.05	†30	...	Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*12	12	*12	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*4	*3	*3	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.10	1.90	1.90	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.50	2.02½	2.50	Dec. '21, Q	0.05
Utah Apex	Boston	2¾	2¾	2¾	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	*1	*1	*1	Nov. '17,	0.01

VANADIUM

Stock	Exch.	High	Low	Last	Last Div.	
Vanadium Corp.	New York	35⅞	33	33½	Jan. '21, Q	1.00

ASBESTOS

Stock	Exch.	High	Low	Last	Last Div.	
Asbestos Corp.	Montreal	50½	48¼	50½	Jan. '22, Q	1.50
Asbestos Corp., pfd.	Montreal	78	76¼	78	Jan. '22, Q	1.75

SULPHUR

Stock	Exch.	High	Low	Last	Last Div.	
Freeport, Texas	New York	15	12¼	14⅝	Nov. '19, Q	1.00
Texas Gulf	New York	42⅛	40⅝	41⅝	Dec. '21, Q	1.00

MINING, SMELTING AND REFINING

Stock	Exch.	High	Low	Last	Last Div.	
Amer. Sm. & Ref.	New York	47⅝	45⅞	46⅛	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	90⅝	89¼	89¼	Dec. '21, Q	1.75
Am. Sm. pf. A.	New York	87½	87½	87½	Jan. '22, Q	1.50
U. S. Sm. R. & M.	New York	36¾	36¾	36¾	Jan. '21, Q	0.50
U. S. Sm. R. & M. pf.	New York	43¾	43¾	43¾	Jan. '22, Q	0.87½

NEW MACHINERY AND INVENTIONS

Welding Engineer Saves Smelter Big Sum

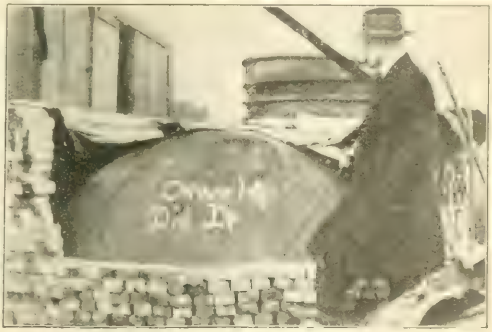
Some time ago the Bunker Hill & Sullivan Mining and Concentrating Co., Kellogg, Idaho, had 26 8-ton cast iron melting pots that had been so badly cracked in service at its smelter that they had either to be scrapped or reclaimed in some manner. They represented an investment of $31,200, but their value as scrap would be less than a tenth of that amount, from which would have to be deducted the cost of transportation to market and reduction, so that the alternative of reclamation was important. Attempts to weld them by the electric-arc process proved failures. The first experiments with gas welding resulted disappointingly also, but the oxy-acetylene process seemed to offer greater promise of success, and the engineering department of one of the large apparatus manufacturers was given an opportunity to work out the problem.

The engineer in charge of the work not only successfully welded several of the pots, which have now been some time restored to service, but conducted the demonstration so that other operators could proceed with reclamation of the remaining pots. The officials of the Bunker Hill & Sullivan Mining and Concentrating Co. were so satisfied with the results obtained that they at once ordered a complete installation of the equipment used, including generators for acetylene, and in the future it will be used on work of this kind and for general welding and cutting at the mine and smelter in making repairs to broken and worn machinery and plant structures.

It should not be concluded, however, that the oxy-acetylene service engineer accomplished his demonstration without some pioneering to develop the best method of procedure. For example, when he tried to pre-heat the first pot in an improvised charcoal furnace, he discovered that 26 sacks of charcoal burning at one time around the pot little more than warmed it. It was not until he supplemented this heat with a blast from an oil and compressed air line and covered the furnace and casting with asbestos paper that he succeeded in securing the pre-heat necessary to proceed with the welding. The pots had been subjected to such high temperatures in service that a large part of the carbon was burned out as in the grate bars of furnaces. This made it necessary to bring the pots to a high temperature before beginning to weld in order to effect a homogeneous weld. Of course the pots were annealed after welding to restore the original structure.

The welding demonstration described was conducted by one of the service engineers of the Oxweld Acetylene Co.'s Seattle branch. The Northport Smelter Co., hearing of the success of the work at Kellogg, Idaho, also ordered Oxweld apparatus especially for the reclamation of melting pots.

MELTING POT PRELIMINARY TO WELDING


COMPLETED WELD ON EIGHT-TON POT

"Hopcalite"—A Destroyer of Carbon Monoxide Gas

After considerable research on the part of the U. S. Bureau of Mines, the Chemical Warfare Service of the U. S. Army and a number of scientists, a mixture of metallic oxides, known as "hopcalite," which, when placed in a gas mask canister, acted to destroy carbon monoxide gas, was developed.

Recognizing the great value of a carbon monoxide mask for industrial use the Mine Safety Appliances Co., Pittsburgh, Pa., undertook the development of masks suitable for different industrial conditions in collaboration with the scientists, utilizing "hopcalite" as the element for removing carbon monoxide.

This work, after many months of perfecting and testing, has culminated in the two types of masks—one type for use against carbon monoxide around blast furnaces and producer plants, and the other an "All-Service" type, for fire departments, and mine fire fighting, where smoke and other gases in addition to carbon monoxide may be encountered.

The U. S. Bureau of Mines was especially interested in developing the carbon monoxide absorbent not only because of its military importance but because of the industrial application for such a material after the war. After the war the Pittsburgh Experiment Station of the Bureau of Mines continued experiments on the use and limitations of carbon monoxide gas masks.

A New Drum- and Scoop-Type Feeder

A combination drum and scoop-type feeder, the largest size of which has a capacity rating of 2,000 tons of dry ore per twenty-four hours, has recently been designed. Such a combination enables the feeder to take a large initial feed and several hundred per cent circulating load as well. The drum of the larger feeder is 48 in. in diameter and allowance is provided for a scoop with a radius of 48 to 54 in., as may be required by the customer. Aside from its large capacity, all parts are reversible. This enables the purchaser to reduce his stock when he has mills operating in opposite directions, as by merely changing the parts the same feeder can be used on a mill rotating in clockwise or counterclockwise direction. Parts are made replaceable to take care of ordinary wear, so that the cost of renewing parts is small.

The initial feed is fed by a chute to the opening in the drum. A scoop on the outside of the drum operates in the ordinary feed box, but it does not have to handle large material; therefore, wear is greatly reduced and there is no danger of breakage to the box. This feeder is manufactured by the Hardinge Co., 120 Broadway, New York.

Device That Makes Measuring a One-Man Job

A convenient aid in measuring with a tape is found in a tape-holding pin known as "Sell Pin," which is made of brass and can be attached to any measuring tape in a few seconds by inserting the loop at the end of the tape into the open loop of the pin, and then closing the pin loop with a pair of pliers or a hammer. The device is made in two sizes by Augustus H. Sell, 858 South 13th St., Newark, N. J.

INDUSTRIAL NOTES

Wilson Welder & Metals Co. have moved their general offices and [illegible] factory to 132 King St., New York.

[illegible] Baxter, formerly with the Kelly Filter Press Co., is now eastern representative for the Vallez Rotary Filter Press, with offices at 95 Liberty St., New York.

Gibbons Bros., Ltd., Dudley, Worcester, England, has been appointed as representative for the British Isles of W. S. Rockwell Co., furnace engineers and contractors.

The Carroll Chain Co., Columbus, Ohio, is specializing on steam-shovel leading chains designed to meet the requirements of open-cut mining. Daniel Carroll is president and general manager of the company.

H. B. Marshall, former manager of the St. Louis branch of the Electric Storage Battery Co., Philadelphia, Pa., has been placed in charge of railway battery sales, with headquarters in Philadelphia.

List prices for Hercules No. 6 blasting caps were reduced $3 per 1,000, effective Jan. 3. Hercules No. 8 blasting caps were also reduced $5 per 1,000 and Hercules electric blasting copper wires, $1 per 100.

The Bucyrus Co., of South Milwaukee, Wis., with northwestern sales office at 608 Pittock Block, Portland, Ore., announces the appointment of A. R. Hance as northwestern sales manager, succeeding L. T. Russell, who has resigned after ten years of service with the company.

Lippincott, Mills & Co., Inc., have been granted a New York charter to deal in coal, coke, ores, scrap, iron and steel products and ferro-alloys, and to do a general importing and exporting business. The new company has offices at 17 Battery Place, New York, and in the Hippodrome building, Cleveland. G. W. Lippincott is president and William H. Mills is vice-president and treasurer.

Four gifts from various manufacturing and mining companies have added to the equipment of the department of mining and metallurgy of the University of Wisconsin in the last year. A Diester sand-concentrating table, manufactured by the Diester Machine Co., of Fort Wayne, Ind., and a Diester slime classifier were presented to the department by the Burgess Laboratories, of Madison. The Mineral Point Zinc Co., Galena, Ill., donated a 10-in. rock breaker and a set of 18-in. crushing rolls to the equipment of the department.

C. B. Stranahan, of 82 Beaver St., New York, has been appointed sole agent in the United States for the Tharsis Sulphur & Copper Co., of Glasgow, Scotland, for the sale of lump pyrites, fine pyrites, both crude and washed, and morongo (roasted and [illegible] a high grade iron ore). The Tharsis company has one of the largest deposits in the Huelva district, Spain. Mr. Stranahan has been in the pyrites business for thirty years. He was connected with the old Davis mine, at Rowe, Mass., the first pyrites mine opened up in the United States. This property was closed down in 1912, when worked out.

TRADE CATALOGS

Lubrication—Steam valve and cylinder lubrication is very thoroughly covered in a well-illustrated booklet issued by the Vacuum Oil Co., New York, entitled "Stationary Steam Engines." Part 1 deals with reciprocating steam engines, and Part 2 with boiler plant and steam production.

Well Equipment.—Catalog 21, of the Parkersburgh Rig & Reel Co., of Parkersburg, W. Va., describes in detail the complete line of Parkersburg oil- and gas-well drilling equipment and wooden and steel tankage. The issue is bound in cloth, contains 506 pages, and is well illustrated. Many valuable tables are included.

Diamond Drills.—The E. J. Longyear Co., Minneapolis, Minn., has issued Bulletin No. 16, "Diamond Core Drills." This publication defines and illustrates the general features of Longyear drills. On page 18 is given a table specifying sizes, capacities, diameters, horsepower required, and shipping weights of the various types.

Heat Wastes.—The Uehling Instrument Co., Combustion Engineers, Paterson, N. J., has recently issued Bulletin 222, "Magnitude of the Power Plant's Chimney Loss," and Bulletin 221, "Relation Between CO_2 and Money Wasted Up the Chimney." These bulletins contain charts and tables descriptive of heat losses in the power plant and other interesting data.

Furnace Linings.—The Quigley Furnace Specialties Co., 26 Cortlandt St., New York, has issued a bulletin presenting information, with illustrations, regarding refractory linings and the use of "Hytempite" in power-plant work, as well as its uses in connection with "Carbo sand" for baffles, patching boiler settings, and other purposes. Information is also given concerning the uses of "Insulbrix."

Potash and Borax.—Weir Brothers & Co., 25 Broad St., New York, has issued an attractively printed fourteen-page pamphlet on the potash and borax industry of the United States. Particular emphasis is laid on the new discovery of a colemanite deposit in Nevada, recently described in *Engineering and Mining Journal*, and its exploitation by the West End Chemical Co. Much statistical and market information is supplied.

Centrifugal Pumps—Goulds Mfg. Co., Seneca Falls, N. Y., have issued Bulletin No. 123, which illustrates and describes Goulds steam turbine driven centrifugal pump units, consisting of centrifugal pumps connected to Lee steam turbines. Owing to its many advantages, the steam turbine driven centrifugal pump has practically become the standard type for boiler feeding in steam power plants of medium and large capacity.

Centrifugal Pumps.—An instruction book which covers the erection, operation, and repair of Worthington horizontal, centrifugal volute pumps has been issued by the Worthington Pump & Machinery Corporation, 115 Broadway, New York. Those desiring to secure a copy of the pamphlet should write for Bulletin 605 K. The book covers seventy-two pages, which, in addition to the instructions given, also contains diagrams, tables, and other useful information.

Car Unloaders.—The Jeffrey Manufacturing Co., of Columbus, Ohio., has issued Bulletin No. 360, which features the Jeffrey portable car unloader, for unloading coal from hopper-bottom or gondola types of railroad cars. The design of the unloader is such as to enable it to meet various conditions of unloading. It is so constructed as to require a minimum of space in which to operate and can readily be placed in between the car hopper door and the rails. Where conditions permit, a more permanent arrangement can be had by placing the unloader underneath the rails and thus eliminate the necessity of resetting it for each car.

Power-House Equipment.—The Jeffrey Manufacturing Co., of Columbus, Ohio., is issuing catalog No. 345, "Coal and Ashes Handling Machinery." Twelve distinctive types of Jeffrey power-house equipments for economically meeting a wide range of capacity requirements in various sizes of plants are illustrated and described in this catalog. It will undoubtedly be of valuable assistance in the selection of the proper type of equipment for new power houses, installation of new equipment which can later be extended as conditions warrant, making temporary extensions to present equipment, or replacing worn-out or inadequate handling machinery.

Water Wheels.—The Pelton Water Wheel Co., of San Francisco and New York, has issued Bulletin No. 17, "Pelton Water Wheels (impulse turbines) and Reaction Turbines." The bulletin describes the various types of hydraulic equipment manufactured by the company, and discusses their application both to the generation of hydro-electric power and to the direct operation of many different kinds of machinery. Some space is also devoted to governors and to pressure-regulating devices. The bulletin comprises forty-eight pages, and is illustrated by a number of drawings and photographs. Copies may be obtained upon application to either office of the company.

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Editor
G. J. YOUNG
Western Editor
D. E. A. CHARLTON
Managing Editor
A. H. HUBBELL
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Metallurgical Editor

Engineering and Mining Journal
A Weekly Journal of the Mining and Mineral Industries
METALS NON-METALS PETROLEUM

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Volume 113 New York, February 11, 1922 Number 6

The General Condition of Business

A RECENT ADDRESS by Herbert P. Howell, vice-president of the National Bank of Commerce, summarizes the present business situation as distinctly a "two-sided proposition," in which both the optimist and the pessimist can cite plenty of facts to prove their respective positions. He believes, however, that the favorable factors outnumber the unfavorable; and that although we are not going to experience a great business revival or boom, we can beyond question expect the gradual shaping of events toward improved and more stable business conditions. At the end of 1921 business conditions were in his opinion much better than they were at the beginning of the year; and Mr. Howell predicts that they will be better at the end of 1922 than they are now, provided always that common sense and conservatism govern business policies, all of which is entirely likely and, indeed, almost inherent in existing conditions.

Banking conditions are sound. The country has a sufficient gold reserve for its credit structure, under existing practices and theories. In view of the terrible lessons which have been so forcibly impressed upon the world by various conditions now existing on the Continent, as to the effects of abandoning a gold standard, there will doubtless be no danger of our bankers getting far away from a metal security.

During 1921, extravagance, private and corporate, has decreased, and there has been a tendency to return to the practices of economy. The public in particular has refused to buy at unduly high prices, and a lot of speculative middlemen have gone to the wall, thereby clearing up the industrial and financial situation. But the public will buy if it has reason to believe that it can get its money's worth.

The darker elements in the business complex, Mr. Howell points out, are the irregularly scattered too high costs and excessive wages which still prevail and which must yet be deflated. Then there is the burden of taxation, which, however, has become slightly ameliorated by the new tax law. Manufactured goods have not fallen so rapidly in price as have farm products, with the resultant period of difficulty and misfortune to those who till the soil and produce our food and the raw materials of our clothing.

Mr. Howell does not point out that the miner is in the same situation and for the same reason. Why is it that this one of the most essential elements in our industrial complex is ordinarily overlooked by our economists, business men, and bankers? We suspect that it is simply because we have a Department of Agriculture, but have as yet not been able to secure an adequate independent organization for mining, in our Federal Government representation. There is not only the Department of Agriculture but the "agricultural bloc" in Congress, which seems to be a better organized unit than the mining industry possesses.

Transportation and Mines

THE RAILROAD COMMITTEE of the U. S. Chamber of Commerce has recommended that the President appoint a Commissioner General of Transportation, such appointment to be confirmed by the Senate. His duties, as proposed by the committee, and as set forth in information received from Washington, would be as follows:

> To keep himself informed of the transportation needs of the country and make such recommendations as he may find will be for the public interest and that would tend to co-ordinate the administration of laws and that would make possible the articulation and economic use of all transportation facilities.
>
> To ascertain and report conflicting or inharmonious functions and rulings . . . that cannot be so reconciled by administrative practices as to promote the general development of the co-ordinated system.
>
> To be notified of all hearings, to be entitled to be heard and to produce evidence that will tend toward a result that will promote and facilitate the continuous development of interstate transportation adequate and efficient to meet the needs of the country.
>
> To render all possible assistance to the Interstate Commerce Commission in facilitating and advancing the consolidation of railroads.
>
> To be authorized to grant Federal charters to corporations proposing to engage in interstate transportation by land, water, or air, and to convert state corporations into Federal corporations.

Such functions, of course, involve funds, a working force, and adequate office arrangements; in fact, what is proposed essentially is a Department of Transportation, except that the head, instead of being called Secretary, will be called Commissioner General, a title which recalls that of Attorney General. Such a Commissioner General, it goes without saying, would naturally be, in effect, one of the President's advisors.

We indorse the recommendation of the Chamber of Commerce Committee. The transportation business of the country is too important to go without especial care and consideration. As we have remarked before, something like 60 per cent of the freight carried by American railroads is normally the product of our mining and mineral industries. We are, therefore, intensely concerned in anything which will promote better service and reduce its cost. It is interesting to note that the idea of consolidation of roads is advanced in one of the topics proposed by the committee. The pendulum is swinging back from the Roosevelt days of "trust-busting."

The recommendation as to the railroads applies, too, to the great mining business of the country, for which we are asking also special representation. And we are quite willing to follow the clever lead of the Chamber of Commerce and ask for the appointment of a Commissioner General of Mines, if that will make enactment of the necessary legislation any easier for Congress and the President. "A rose by any other name." It is the substance that we ask for, and that we are entitled to have.

Free Zones

AS A FURTHER STEP in promoting the foreign commerce of this country, bills are now before both houses of Congress authorizing the establishment of so-called free zones in ports of the United States. These are places of limited extent which are exempt from the customs laws as affecting goods destined for re-export. For instance, were there a free zone in the port of New York, a cargo of barytes might be received and trans-shipped to various countries in Central or South America without the payment of the customary duty. Only in case the material were to find an outlet in the United States would the duty be charged. Such free zones have proved great aids to commerce in Europe, where possibly the free port of Hamburg achieved the greatest prominence.

Among the advantages which are expected to result are an increased trans-shipment trade to American ports, with an attending improvement in ocean services; facilities for extensive consignment markets for dutiable raw materials and semi-manufactured goods; an improvement in port facilities; and a more workable and economical arrangement than is provided by the present system of bonded warehouses and drawbacks.

Opponents of the measure argue that the United States is so isolated from other large countries that the project would not be so successful as in Europe; that friction would arise as to the situation of the free zones; that such zones would promote commerce rather than manufacturing; and, possibly most important of all, that foreign producers would get business away from American producers by having stocks readily available in American ports.

Our mineral industries would probably not be affected directly to any extent, but we believe that this method of stimulating our foreign commerce is a sound one and that it is to be encouraged. A thriving foreign trade has helped to make Great Britain the great empire that she is, and had much to do with the prosperity of Germany before the war.

What Should the "Journal" Cover?

ONE OF OUR CIRCULATION MEN has just gone through *Engineering and Mining Journal* for 1921 to see what it contains and to classify its contents. As a unit of measurement, he reduced the total contents to the terms of textbooks of the standard-page size, and here is what he tabulated, stated in the order of volumes, showing what the *Journal* has most stressed: Current mining events, 6 books of 350 pages each; metal marketing, 3 books of 300 pages each; mining methods, 2 books of 350 pages each; mine legislation, economics, and statistics, 2 books of 325 pages each; milling and metallurgy, 2 books of 325 pages each; mining society meetings and transactions, 1 book of 450 pages; petroleum geology and production, 1 book of 425 pages; non-metallic minerals, their mining and marketing, 1 book of 350 pages; facts for the investor, 1 book of 300 pages; "Who's Who" in metal mining, 1 book of 272 pages; geology, prospecting, welfare, and safety, 1 book of 250 pages; new mining equipment, 1 book of 150 pages.

Now, this should mean something to you, as it did to us. It shows the volume of carefully selected and edited material we print, with an eye always to timeliness and authority. What about the proportionate space we have given to each subject? For we do not anticipate that any one will say that we have not given enough volume of material. In other words, are we properly balanced? We are studying the matter ourselves, and we would appreciate it if any or every subscriber who reads this editorial would write us his conclusions. Do we put too much emphasis on up-to-the-minute mining news? Are we going in too strongly on marketing problems and news, or should we go in more strongly for this? Have we not given enough stress to mining geology? In other words, how can we modify our current program so as to make a better all-round balance, considering always the wide diversity of material among the many groups that we represent? Have we given enough space to ore dressing and metallurgy—in proportion, we mean? Look over last year's menu and let us have your ideas as to the grub for 1922.

Economic Mineralogy

IN CERTAIN BRANCHES of Old World society there is a distinct line of demarcation between a profession and a trade. He who chooses a profession adds honor and dignity to his family name, but the one who follows a trade introduces a sordidness that brings blushes of shame to the countenance of his proud family. Is there not possibly a faint reflection of this same tendency in the distinction made between "pure science" and "practical science"? The use of the word "pure" in this connection indicates the once-prevalent idea that the practical application of a science to the solution of every-day economic problems hurls that science from its high estate and drags it in the mire. Thus the advocate of "pure" science throws up his hands in dismay when the word "economic" is placed before his favorite subject.

Fortunately, this idea of a study of natural science as an end in itself is gradually giving place to the broader concept of a double purpose, a means of mental discipline and scholastic attainment, and at the same time a means of rendering practical service to humanity in improving material conditions, thus elevating mankind to a higher plane of living. The tendency toward maintaining this so-called purity has led some institutions of learning to over-emphasize academic aspects of the natural sciences, with consequent neglect of practical application.

Mineralogy has suffered considerably in this respect. An elaborate classification scheme, based on chemical-morphological properties, is presented to elementary classes; then in order that no blank space be left in this outline, the course is made to include all the common minerals and many uncommon ones. Economic geologists and mining engineers of many years' experience have never seen, except in a museum or a college collection, many of the minerals studied during their first elementary course in mineralogy. Furthermore, so much ground is covered in a brief time that study is confined to a limited number of specimens of each variety. Thus a student may associate with a mineral certain features, such as color or form of the particular specimen studied, features which may be quite inadequate to characterize a mineral of diversified forms. Greater familiarity with a small number of the more important minerals would supply the student with a practical working knowledge which could readily be enlarged to embrace additional minerals as the occasion demanded.

A paper entitled "A Plea for Economic Mineralogy," presented at the recent meeting of geologists and mineralogists at Amherst, Mass., emphasizes some of the weaknesses that exist in teaching mineralogy. It was pointed out that the shortcomings fall in two classes. In the first place, insufficient emphasis is placed on the relative abundance or rarity of different minerals. In the second place, in dealing with those that are abundant, a marked failure is to be noted in sufficiently differentiating between those that are of great economic importance and those that have little or no commercial value. The standard textbook, Dana's "System of Mineralogy," affords abundant examples of these tendencies. As an illustration of the first, more descriptive space is devoted to sternbergite than to chalcocite; and, in the group of common and abundant minerals, the second tendency is in evidence where a space of three pages is devoted to the valuable kaolinite, and five pages to the worthless epidote.

From a strictly morphological point of view the complex crystal forms of epidote undoubtedly demand more attention than the simple and little-known crystal forms of kaolinite, but it is well to remember that the average beginner student, with no practical knowledge of minerals, may gain an ill-balanced concept of relative values from such disproportionate instruction unless an adequate explanation is given. Would it not be wise, even in an elementary course, to offset the dearth of morphology in kaolinite with a study of plasticity, fusibility, and shrinkage, a classification of clays by uses, and a brief outline of their tremendous importance in industry?

A further weakness is to be noted in the tendency to emphasize a study of specimens having striking crystal forms, colors, or other physical features of unusual interest, with consequent neglect of the commonplace types which are usually those of greatest economic value. Thus Iceland spar may be made to overshadow limestone or marble; beautiful purple interpretation cubes of fluorspar which are of relatively rare occurrence may hold the center of interest, while ordinary gravel spar, which is mined to the extent of thousands of tons, may be entirely omitted. Apatite, in hexagonal prisms and crystalline masses, which may be described in detail, is of little economic importance at the present time. Is it not remarkable that most textbooks and many teachers make but brief reference to phosphate rock under the heading of apatite, although it bears somewhat the same relation to the latter mineral that limestone does to calcite, and, like limestone, is the commercial form in which the mineral appears?

Is there not, therefore, some possibility of so modifying teaching mineralogy that the student who is not a specialist may gain a more practical knowledge of common and useful minerals, and that the specialist may start out with a properly balanced concept of mineral types and relative values?

The Preservation of Mine Timbers

ACCORDING TO A RECENT ESTIMATE by the U. S. Bureau of Mines, the annual consumption of timber at metal mines, for underground purposes, is placed at 80,625,000 cu.ft. We have at present no figures which show the average cost of timber per ton of ore produced; in fact, it is quite probable that such data would show little, on account of the variation of other items that enter into production costs in the different districts. But it is noticeable in this report that the per-cubic-foot costs of timber during the last fifteen years have doubled, and in some districts the expense involved in meeting this item has increased as much as five times.

Leaving out of consideration any limitations that may be placed on present growths of timber available for mine purposes, it is of no little importance that operators give some thought to such preservative measures as may be applied to supplies now available. In mines, especially where ventilation is difficult, timber is exposed to destruction principally by decay and insect attack, necessitating, in most workings, replacement, the costs of which mount rapidly. The latter, it should be remembered, include not only the cost of renewed timber but the expense of labor required for removing the deteriorated timber and installing the new, to say nothing of the losses of time and money that are incidental to such periodic interruptions to regular routine work.

We learn from Germany that chemically treated timber has been extensively used in German mines for a number of years. But in this country we have been slow in adopting any such practice in mining work. The railroads and some of the other industries have been fairly active since about 1902, and a patent for treatment with coal-tar creosote was applied for as early as 1838.

Among the many chemical materials which have been used as preservatives are copper sulphate, sodium fluoride, creosote, zinc chloride, and various combinations of these. In the consideration of the essential properties of an efficient wood preservative, the following should be kept in mind: It must be a sufficiently strong antiseptic to prevent fungus growth; poisonous enough to kill the wood-destroying insects; its ingredients should be in soluble form during the impregnation of the timber and when combined with the wood become sufficiently insoluble so that they are not lost when the timber is exposed to the action of water; and its active components must not evaporate when the treated timber is exposed to the sun. We have also called attention before to the use of the "cement gun" in the preservation of timber underground, and this practice has become quite general in many districts and has given satisfactory results.

In addition to the adoption of measures for preventing decay, the mine operator should also give attention to the proper selection of timber and its storage. Good results can seldom be expected from timber which has been picked at random and purchased at "bargain" prices.

The selection of mine timber should always be made with care, and by a person experienced in such work. So, also, should judgment be used in the storage of timber. Timber piles lacking the proper treatment (and few mine locations do not have them) which are permitted to be exposed to all sorts of weather soon deteriorate. In such circumstances "an ounce of prevention" should be used, for the cost of a proper shelter or storage is far less than the purchase price of the timbers necessary to provide a season's props and square sets.

Perhaps at no period in the American mining industry has there existed a greater incentive to the elimination of all waste and for the promotion of efficient administration and practice. In the slow but certain return to normal and prosperous operation, of which there are encouraging signs in not a few mining districts, no factor demands greater consideration than scientific conservation and preservation of mine timbers.

WHAT OTHERS THINK

The Mining Law Revision Bill

Many objections have been made to the new mining act; however, but few substitutes have been offered. Starting with square locations, best to cover the find, say 1,500 × 1,500 ft., in a new district, the first few only would be square. In an old district they would have to conform to the older locations, and respect their extralateral rights.) Then there would be claims between the first that would not be squares, and there would be unlocated fractions between them. These fractions if under, say, ten acres, could be subject to purchase by the locator whose ground they join, when he patents his claim. As vertical boundaries will govern, no parallel end lines are further required, and the real shape of a claim will be immaterial.

Prospectors are often not careful in putting up their stakes. Correct methods of location could be encouraged by printing on the back of location notice blanks (and there should be but *one* form of blank in use) instructions for the correct staking of claims.

It is argued that the size suggested is too large. When one now makes a discovery, dipping, say, northwest, he will make a technical location on that side of his claim, to protect his extralateral rights. His two claims will be nearly as large. By the new act, if the dip is vertical enough, he can, with ten-acre squares, take a piece 660 × 2,640 ft., giving him practically two claims for one location.

Herbert Moulton, in *Engineering and Mining Journal*, says, "the future prospecting and development of *mines* will be done more extensively and expensively," and "the importance of the individual prospector will not be so great." True, but the discovery and location of prospects will always have to be made first. Discovering an ore deposit and developing it are two separate matters. The discoverer, however, is seldom the one to develop it, and he should be encouraged to *discover;* and the vertically bounded location gives him a safer claim to offer the future operator, who follows in the wake of the prospector.

Paying cash instead of doing assessment work is wrong, because it does not develop the claims themselves. If any one wishes to hold a claim, he surely should develop it.

Location without discovery is unfair. Every bona-fide location would be surrounded by wildcats. Still, if a man is willing to back his judgment by going to the expense of prospecting underground, there should be a provision for his protection. It would be fair to allow a "provisional location" without discovery, provided work begins inside of thirty days, and that at least double the amount of assessment work be required to be done, to assure bona-fide locations. (This comes under Mr. Moulton's expensive prospecting, and is not likely to be undertaken by the individual prospector, and would be initiated only on the strength of some discovery near by.)

To locate ground for mining and metallurgical purposes in a square according to land surveys is wrong, because it would probably cover only part of the land desired. All unoccupied surface ground should be available for these purposes, either by purchase, or rental, or possessory right, and be taken up by metes and bounds, to suit the actual requirements.

Percy Barbour, in *Mining and Metallurgy,* says, "the agricultural locator has to conform to the Public Land Survey," and asks, "Why should not the miner?" Because the farmer *sees* just exactly what he is locating—the surface ground. What does the discoverer of a seemingly likely cropping see? A lot of hard costly work ahead to prove it; and then perhaps discover that his oreshoot dips into the other fellow's ground. As he is willing to take a hundred-to-one chance, he should be allowed to stake his claim to cover his find best.

When a farmer locates a piece of ground in the forest reserve surrounded by trees or on a bar along a river, he takes it by metes and bounds, to suit his purposes. Why should not the miner?

Ground surrounding a valid location is often taken up by technical locations for protection or for surface requirements, more than for the supposed ore it may contain, and for these reasons in a block or group.

By permitting only "discovery" and "provisional" locations, and allowing purchase (or other location) of surface ground for necessary purposes, technical locations, which only hold back development, would be overcome as no longer necessary.

Technical locations are also made to secure timber. In the forest reserve the locator can use timber from one location on half a dozen others, if they join and are owned (not patented) by one owner; but if separated he cannot use timber from one on the others. Why not correct such things by proper laws permitting the legitimate use of mining timber? EUGENE ANTZ.

Homestead, Ore.

Canada's Gold Potentialities

In your issue of Jan. 21, Canada and India are linked in an assumed decline in gold production. No two countries could be more absolutely dissimilar in point of natural resources. Practically all the gold of India is derived from the Champion reef, in the Kolar field. It is payable for a length of four miles and is approaching exhaustion. In Canada, however, there is no occasion for apprehension as to the end of production. Our concern is mainly as to when it will begin on a scale commensurate with our resources. It is 3,000 miles from the Atlantic to the Pacific, and gold is virtually continuous across the continent, extending also into the Arctic regions. It is 700 miles from the eastern to the western boundary of the Province of Ontario, and gold is found throughout the entire region. Since 1912 Porcupine has produced over $80,000,000, despite the tremendous handicap of the war. Furthermore, it is the only part of the world that made a distinct advance during that period of stress, and as soon as sufficient hydro-electric power and transportation are provided, northern Ontario will greatly increase its output.

Despite a power shortage, Hollinger Consolidated is now producing at the rate of $11,000,000 a year, and in two years or less this will be increased to $15,000,000. Forty million dollars have been taken above the 425 level, and including $6 ore an equal amount is still available in this part of the mine. We have also good authority for the statement that the ore deposits of Porcupine are deep-seated. See an article by Thayer Lindsley, E. M., in your valuable journal, Vol. 97, page 1,043.

Then there is Matachewan, forty miles southeast of Porcupine. It is in fact the western part of the Kirkland Lake field. Its ores are closely associated with granites, syenites, and porphyries. Here values are much higher than at Porcupine. One mine in Kirkland Lake has for several years milled ore running from $25 to $35 per ton, and the orebodies are quite as large as the average of those at Porcupine, though not usually as numerous. But in the Matachewan end of the belt there are four or five outcrops fully as large as any at Porcupine.

The *Engineering and Mining Journal* has on more than one occasion referred to Canada as an inviting field for exploration, and I hope that it will correct the impression created by Mr. Jennings' article.

Toronto, Ont. S. R. CLARKE.

Thoughts on Mining Education

The article, "College of Mining—University of California," by George J. Young, which appeared in the issue of Jan. 7, seems to me the most interesting and intelligent presentation of the subject of mining education that I have ever read.

The charts (1) and (2) are exceedingly interesting. Chart 2 seems to me a little misleading because I suspect that surveying includes not only classroom work but also field practice. There are also several points that would seem to me might well be discussed at greater length, and the most important one is the question of course content. I would point out that many things that are important for the young engineer are not included in this course, and you say this is the practical question of the utilization of his time. I think it is indeed a practical question, and it is just at this point that so many mining schools can be criticized, in that, like Topsy, "they just growed," and apparently have never been subjected by anyone to the critical scrutiny of the relation between manufacturing processes and markets that every commercial concern applies to its methods and practices.

You will remember that the first mining school in this country was modeled after the Ecole des Mines, of Paris, and nearly all the others that have since developed in this country seem to have followed largely in the footsteps of the first school. In the first place, the Ecole des Mines was preparing men for a place in the organization of society in France, which is quite a different thing from that in the United States; and, in the second place, at the time the first school was started in the United States, the needs of industry were quite different from what they are now. At that time, nobody knew much about the technology of either mining or metallurgy. The metallurgists of the day believed in "half slags" and "quarter slags," and, generally speaking, technology was in a rudimentary state of development. The industry was being developed by men of relatively simple technological knowledge, who dominated industry simply because of their superior mental capacity. Workmen, generally, were much less familiar with sound ideas of technology than they are today. It is perfectly true, however, that they attained a surprising degree of empirical skill, in the same way that the artisans of primitive countries did. The aim of schools in that time was to turn out men of the Rossiter W. Raymond and Pope Yeatman type, and the courses were so laid out as to familiarize these men with all the knowledge of mining, metallurgy, and geology that then existed.

In the fifty years that have passed, the amount of technical information in regard to mining and metallurgy and geology, especially metallurgy and geology, has multiplied enormously. It is impossible for a man to be thoroughly familiar with even the single subject of metallurgy. There is not a mining school in the whole United States in which there is given a metallurgical course that would prepare a man to take charge of a spelter plant, nor, I believe, any teacher in one who could teach such a course.

A young man entering a mining school, not being gifted with second sight, cannot foresee in just what phase of the mining industry he is likely eventually to land. Consequently, he cannot take a special course that would prepare him to enter the industry in a responsible position at the start, and the schools have not recognized this by changing their courses so as to concentrate on teaching general principles, allowing the man to learn details after he has found a place in industry where the details that he acquires will be useful to him.

One difficulty involved is that the schools have never been able to make up their minds to admit that there is not room in the mining industry for many men like Raymond and Yeatman, and that the major work of the industry is done by assistant superintendents, foremen and technically trained men of about the same relative rate of compensation, and who never, by any chance, will get to be captains of industry. Possibly the attempt to apply intelligence tests to students entering technical schools will eventually be successful enough so that men who are of the vocational type can be persuaded to take vocational courses, and men of the leader type can be given the course that is best for them.

Another point that could not well be brought into this article is the fact that teaching in technical schools is, on the average, of rather poor quality, and I am inclined to suspect that teaching in mining schools is below rather than above the average for engineering schools. The students, on the whole, have a fairly good index to a teacher's ability, but there is no way in which they can communicate their ideas to the university authorities, nor are the authorities in a position to tell a man that they do not consider him a good teacher or indicate to him in what way he is at fault or how the fault can be corrected. Of course, this is complicated by another factor—namely, that, under the present university organization, once a man gets on the faculty, there is no method by which he can be replaced by another, without raising a fearful row. This scheme was developed to protect really able men from being thrown out by those who disagreed with their political or social views. As a matter of fact, it frequently works out that men are kept on a staff who in a business organization would be quietly dropped and replaced by men who can give more satisfactory service.

Washington, D. C. T. T. READ.

Lehigh University, Bethlehem, Pa.

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3

4

LIBRARY BUILDING. 2 AND 3—PACKER HALL. 4—CHEMICAL AND METALLURGICAL BUILDING.

The Mining Curriculum at Lehigh University

Institution Privately Endowed Attendance Limited to Approximately 1,000 Students Compact Organization With Definite Objective. Well Circumscribed. Favors Both Students and Instructors in Their Work Prescribed Course Lecture System

BY GEORGE J. YOUNG
Western Editor, Engineering and Mining Journal

CHIEFLY ON ACCOUNT of the wholesome character of a few of the graduates whom I had met, I wanted to know something first hand about the mining school at Lehigh University. Accordingly I dropped down to Bethlehem, Pa., from New York. I was, I must confess, an absolute stranger to Bethlehem. As the train pulled in, I asked the brakeman of the train where Lehigh University was. In reply, he said: "Lehigh University? You have got me. I don't know. There's a place up on that hill. It may be a university, but I don't know." It was, as I subsequently found out.

South Bethlehem is a village. The smaller boys in the afternoons stand upon the street corners licking lollypops when they are not watching the cylinder press of the Bethlehem *Times* grind out its afternoon quota or when not engaged in delivering that quota to the *Times'* readers. The drug stores still flaunt their globes of colored waters in their show windows. It is true that there is only one globe, the last of the expiring decorations of an ancient and honorable art, in each of the two drug stores I chanced to notice.

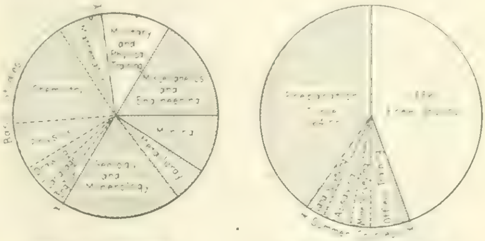
Gas is still used to a considerable extent for illumination. There is a quietness that seems especially appropriate to a university town. Not far from the university are the extensive works of the Bethlehem Steel Co. The environment of the university is thus in part industrial and in part the time-worn substantial Eastern village, which is, however, in this instance not without well-founded aspirations tending toward civic greatness.

COURSE COVERS GENERAL MINING FIELD

Pennsylvania is one of the most important mining states, its mining practice being predominantly in bituminous and anthracite coal mining and to some extent in iron ore and certain non-metallics. The school's environment is thus a mining one. One would suppose that Lehigh would have a mining course largely devoted to coal mining. This is not, however, the fact. The course in mining is a general one, covering broadly mining practice and metallurgy. In addition, there is a separate course devoted to metallurgy and an electrometallurgical course.

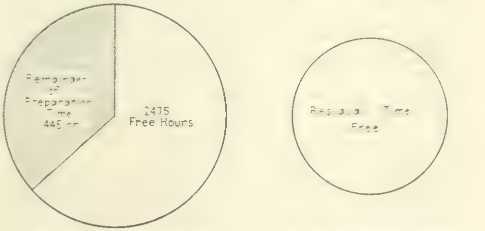
Lehigh is essentially a technical university. A course in arts and sciences and one in business are given; the remaining nine courses are technical. The number of students slightly exceeds 1,000, of whom more than one-half are residents of Pennsylvania. New Jersey, New York, the District of Columbia, Maryland, Connecticut, Massachusetts, and Ohio, in the order named, supply a considerable number. Seventeen foreign countries, with a total of thirty-six students, are also represented in the enrollment. The larger proportion of the student body is drawn therefore from the typically Eastern states.

The university was chartered in 1866 as the result of a movement initiated in 1865 by Asa Packer to provide an institution that would give training and education in the learned professions as then recognized and in technical branches, the importance of which was at the time becoming apparent. Asa Packer made the first donation, amounting to $500,000, and a large tract of land. Further donations by Asa Packer and others gradually supplied various buildings and appurtenances. Thus the university has been largely derived from private benefactions. An endowment of about $3,000,000 together with the tuition fees provides for its operating expenses. It falls into the class of private as distinguished from state-endowed and state-supported institutions.



Total 3740 hr - class and laboratory time in four years

Total 3304 hr Remaining time on basis of 34 hr week and total time in terms



3920 hr being the week-end time for 196 weeks at 20 hr per week

2156 hr Remaining on basis of 10 hr day, for 196 weeks

GRAPHICAL ANALYSIS OF ALLOCATION OF STUDENT'S TIME, LEHIGH MINING COURSE

The restrictions placed upon the institution by its limited resources have operated to bring about limitation in the number of students and in the number of courses. The result is the concentration of the effort of the university in definite channels, which are well developed. This is on the whole more advantageous to both the instructors and the students than where the administration problem becomes indefinite by reason of rapidly increasing numbers of students and promiscuous multiplication of courses.

The requirements for entrance are the studies embraced in a four-year high-school course, and in detail do not depart from the customary requirements found at most universities. The institution is not co-educational. The course in mining falls into the four-year class, consistent with the other courses. There is no attempt to specialize by giving separate courses in mining geology or petroleum engineering. The course in metallurgy is an entity and overlaps the mining course in only three subjects, mineralogy, general geology, and ore dressing. This is interesting, as in other institutions metallurgy students are required to take some of the mining courses. In all of the technical courses engineering degrees are given.

REVISION OF TECHNICAL CURRICULA

Recently there has been a recasting of the mining course. In attempting to get a sound basis an investigation was made of the time demand made upon the students by the various instructors. It was found that the classroom time plus the preparation time was prohibitively large. As a result, the subjects were co-ordinated on a definite time basis, and a schedule was prepared in which the clock hours and the preparation time required by an instructor are given. This reorganized course follows more or less the old course, and as it represents what will be followed, I have made a grouping of subjects and time analysis in the following:

	Class Hours	Preparation Hours	Total Hours	
[illegible]				
[illegible]	255	510	765	
[illegible]	85	136	221	782
[illegible]	561		561	
[illegible]	153	221	374	561
[illegible]	119	68	187	
[illegible]	119		119	
[illegible]	102	187	289	
[illegible]	68	102	170	
Total basic	1,462	1,224	2,686	
[illegible]				
[illegible]	102	51	153	
[illegible]	102		102	755
[illegible]	34	51	85	
[illegible]	119	136	255	532
[illegible]	34	34	68	
[illegible]	85	34	119	
[illegible]				
[illegible]	68	51	119	
Physiography	51	34	85	374
[illegible]	119	51	170	
[illegible]	510	391	911	
[illegible]	714	442	1,156	
[illegible]				
[illegible]	51	51	102	
[illegible]	68	68	136	
[illegible]	51	68	119	
[illegible]	34	51	85	
Total metallurgy	204	238	442	
[illegible]				
[illegible]	136	136	272	
[illegible]	51	51	102	
[illegible]	102	17	119	
[illegible]	17	34	51	
[illegible]nology	34	34	68	
[illegible]	340	272	612	
[illegible]				
[illegible]	68	136	204	
[illegible]	51	102	153	
[illegible]	51	...	51	
[illegible]	68	34	102	
[illegible]	102		102	
[illegible]	51	34	85	
[illegible]	102	204	306	
[illegible]	34	68	102	
[illegible]	34	68	102	
[illegible]	51	51	102	
[illegible]	612	697	1,309	
[illegible]	3,332	2,873	6,205	
[illegible]	408	136	544	
	3,740	3,009	6,749	
[illegible]				
[illegible]	107		107	
[illegible]	156		156	
[illegible]	107		107	
[illegible]	370		370	
[illegible]	234		234	
[illegible]	4,344	3,009	7,353	

Computed on a basis of seventeen weeks per term; for summer courses, thirty-nine hours per week is allowed.

The basic studies are as well developed as at similar schools, and some time is given to English and languages, but no special attempt is made at improvement in oral expression. No time is allotted to industrial economics or industrial sociology. Mining law appears to have been overlooked. A course of business engineering is indicated, but I have found no detailed description of what this is to cover. In the old course, finance, business law, industrial management, and contracts and specifications were covered. It is likely that these will be included under the subject of business engineering. Mine accounting as a separate subject does not appear, and is no doubt provided for in the mining subjects. The course as a whole is objective, but is relieved to some extent by a variety of subjects, such as geology of North America, physiography, forestry, metallurgical and chemical problems, business engineering and others.

GEOLOGY STRONGLY DEVELOPED

The geological element is strongly developed. Metallurgy, including ore dressing, is given the smallest proportion of time; nevertheless the attempt seems to be to sketch out a wide horizon. As it is well backed up by problems, the student's theoretical knowledge should be excellent. A modest proportion of time is given to mining subjects. Basic engineering subjects are provided in considerable variety. A course in mining design is given which threads several of these courses together, to some extent at least.

There is a close approach to an even division of time between laboratory and classroom. The engineering, chemical, and physical laboratories are moderately well equipped. The metallurgical, ore-dressing, and assaying laboratories are poorly equipped as compared to the others. Many of the buildings are old, and adequate lighting has been neglected. Apparently no attempt to develop a mining laboratory has been made.

The Fritz engineering laboratory sets a peculiar standard which by contrast makes the other laboratories, useful though they are, seem less desirable. Imagine finding an expensive Persian rug in a miner's rough cabin. You would marvel and perhaps seek an explanation. The Fritz laboratory presents a similar contrast to all of the other laboratories and is about as conspicuous as our Persian rug would have been in the miner's cabin. There are huge testing machines on a scale suitable for some national institution for the testing of full-size structural details. Necessarily, the use of one of these machines is an operation of magnitude and requires excessive time and expense in the preparation of specimens and testing. Though useful enough in important research, and perhaps more or less justified by the proximity of the important industrial establishments in Bethlehem, it is hardly suitable for ordinary instructional work in testing materials. Part of this criticism is relieved, however, by the presence in the laboratory of a few smaller testing machines which are of a size suitable for students' work.

ADEQUATE PREPARATION REQUIRED

The lecture system is pretty thoroughly entrenched, but the insistence upon a proper proportion of time in preparation and many problems removes some of the objections that would ordinarily apply. Dr. Miller, in his geological subjects, requires his students to write answers to a series of written questions in the first ten minutes of each classroom session. At the next lecture, part of the time is taken to correct erroneous points of view. This is an excellent plan. The close contact between faculty and students which is conspicuous contributes to an increased faculty efficiency in a small university such as this one is. Faculty and students to a considerable extent live on or close to the campus, and there is apparent a solidarity of interest that more than compensates for the lavish and more modern appurtenances of larger universities.

The mining course allows little option on the part of the student. It is a crowded course, both in the number of subjects and in the aggregate time demand. Apparently, its purpose is to prepare the student on a number of subjects, among which mining finds a place that to some would appear to be incidental. The "many-purpose course," which I shall call this, has undoubtedly arisen from the fact that mining graduates start in diverse lines, some in mining, some in surveying or in assaying, some in metallurgy, some in geology, and some in the petroleum industry; and other lines occasionally open out. This diversity of opportunity has militated against singleness of objective. The result is the "many-purpose course." To a student of considerable ability, such a course is of value, but to a student who has only a few strings upon his mental bow, there must be no little confusion. Very likely such students have difficulty in keeping up and are eliminated. The student who conscientiously stays with a course of this kind need have no special fear as to his success.

Of course, it hardly is necessary to say that the innate resistive powers of the average American student prevent him from being needlessly abraded or of endangering his health in the process of assimilating the generous educational menus placed before him.

Minerals Separation Flotation Progress in Other Countries

The chairman of the board of directors of Minerals Separation, Ltd., in his address at the recent annual meeting held in London, summarized the progress which that corporation made during 1921 in introducing its processes in various parts of the world. The North American business is in the hands of a subsidiary company, and so is not mentioned. We take the following from the London *Mining Journal*:

"In South Africa, flotation has for some months been in commercial operation at the Cam & Motor gold mine. We have also recently concluded a license agreement with the Transvaal Silver & Base Metals, Ltd., an important base-metal producer, and our plant is now on the point of starting operations. Our representative informs us that the keenest interest in our processes is being displayed by the gold-mining companies on the Rand. Preliminary negotiations have already taken place relative to the erection of flotation installations, and arrangements have been discussed with two leading undertakings for the carrying out of detailed examination of their ores, with a view to the installation of flotation on a large scale. I anticipate that we shall soon have a number of plants, large and small, operating in South Africa.

"As regards our operations in South America, we have had one of our technical experts stationed in Chile for the last twelve months. A preliminary examination of mine deposits has been made with a view to acquiring our own raw material in that country, and we have acquired a substantial interest in a copper property. The field for our processes in South America is undoubtedly one of great promise, particularly in regard to the later discoveries in the treatment of ores which we have made and in which we are interested, and I think we can feel satisfied that we have in that country made up a great deal of the ground which was lost during the war.

"In regard to Italy, where trade conditions have been particularly bad, there are now indications that our business is at last on the verge of making a step forward. The Societa Zolfifera Marchigiana, which is one of our licensees and in which we hold an interest, is about to start up an installation for the treatment of sulphur ore by our processes. Our representative informs us that several negotiations about which there had been delay are now being reopened, and also that an installation of our process for the treatment of zinc ores is about to be started at the property of the Gennamari Ingurtosu mine.

"In France our agents, Messrs. Minerais et Metaux, are receiving a considerable number of inquiries covering every class of ore, and their opinion is that in the near future our methods will be established on a firm footing in France and the French colonies. In Belgium, Messrs. La Societe Generale des Minerais are availing themselves of the laboratory of La Société Minerais et Metaux for the purpose of investigation of ores, and will eventually install in Belgium a fully equipped laboratory for this purpose, and a special department is being organized by them to deal with matters concerning our processes. The territories covered by these two agencies in France and Belgium embrace the French colonies and the Belgian Congo, and we have definite evidence that important business will soon materialize through the efforts of these two companies.

"In Spain our activities have been devoted chiefly to our coal business, but our representative in that country, Colonel Howard, has, under the most difficult conditions, succeeded in establishing the reputation of our processes, not only for the treatment of coal, but also for the treatment of ores, but we cannot expect that any business of importance in the treatment of ores is likely to arise until market conditions in Spain improve.

"The Real Compania Asturiana de Minas had a small plant for the treatment of zinc ores on their Reocin mine, and have now installed a larger plant for that property and for their Cartis mine. The Cartis plant was started up in the month of September, and has already begun paying royalties. The Reocin plant is probably in operation now. As regards the Penarroya company, a plant has been erected at San Quintin, and one is also under erection at El Soldado, and is almost ready to operate.

"A substantial interest has been acquired by our company in a new ore-reduction process, the owners of which possess the world's rights for it use. The experiments conducted by this process have been in every case successful, and a plant on a larger scale has now been erected, and important developments may be expected in connection with this invention in the near future."

The Copper Mine That Made The Snake Famous

In a letter from C. J. Kelley, published in *The Metal Industry*, the president of the Anaconda Copper Mining Co. tells how the company came to receive its name.

After the discovery and working of placer deposits in the vicinity of Butte, quartz mining became active about 1875. In this year the Anaconda mining claim was located by Michael A. Hickey, a pioneer miner, who also located the St. Lawrence and other adjacent claims. These mining claims were located at the summit of a rolling hill, along the surface of which the great Anaconda vein outcropped. Owing to the inequalities of the surface, the vein appeared to have a winding course or trend over the Anaconda hill across the gulch to the St. Lawrence mining claim, and thence easterly. The idea of naming the claim "Anaconda" was obtained by Hickey from the winding course of the huge outcrop of this vein, as described, so that it is apparent there was a correlation between the name as applied to this mining claim and the dictionary definition. Later, when the Anaconda mining claim constituted the principal basic element in the group claims that were consolidated and worked as a company, the name of "Anaconda" was applied to the company which secured these claims, and has been continued.

The Non-Metallic Minerals

Review of Domestic Market Conditions Indicates That a Downward Readjustment of Prices Was Progressive Throughout 1921 — Producers Generally Expect Improvement in 1922

By Warren M. Foote
President Foote Mineral Co., Philadelphia, Pa.

Written for Engineering and Mining Journal

IN THE PRODUCTION and sale of the non-metallic minerals throughout 1921, conditions in the various branches of the industry are respectively indicated by the following notes and data:

Pumice.—Competition among American grinders of Italian pumice was unusually keen during 1921, being even reported to have passed the limits necessary to assure an equitable distribution of the business.

The sales price on pumice stone during the year averaged around 3c. per lb. at the factory, in quantity lots, for the best grade of American-ground Italian. Domestic sold at a range as low as $15 per ton, depending upon grading. Both grades were in demand. Of the two, the Italian is used for finishing and the domestic for cleaning and scouring powders. The Italian is ground at Brooklyn and elsewhere and distributed direct to jobbers as well as to large consumers. The domestic is also sifted and purified and distributed in the same way. Practically no exports were made in 1921. All the material is prepared by refinement and separation of the various grades of coarseness. The volume of business in 1921 was probably about one-third of that in 1920, although 1920 was abnormal. No contracts are being placed for 1922 business.

A clash of interests has arisen between the dealers in Italian and domestic pumice. California, Nebraska, and Kansas owners of pumice deposits are asking the Government to increase the duty to 1c. per lb. However, the importers claim that the physical difference between the domestic and the Italian is such that the domestic product can never be substituted for Italian pumice, and that an increased duty will only penalize all the users of pumice to that extent. They claim that no pumice stone found in this country compares with the Italian.

The domestic side of the argument appeals strongly to all who desire to avoid the uncertainties of price and supply of imported materials. Only Congress can dissipate the din and smoke of battle. Meanwhile, as the pamphleteering proceeds, Mr. Consumer will decide according to his individual needs whether he can utilize the domestic.

Asbestos.—Asbestos, like almost all other products, experienced a considerable reduction in price during 1921. The best grade of crude No. 1 which, for many years prior to the Great War, sold at $250 and $300 per ton, reached during 1919 and 1920 a price of $3,000 per ton. This quotation was gradually reduced during 1921, so that at the close the price nearly touched $1,000.

Owing to the stagnation in business and the fact that most consumers of asbestos either had their factories closed completely or have been working only intermittently on short time, domestic sales were the lowest in the history of the industry, and export sales were likewise only a small fraction of what they would have been under normal conditions, owing mostly to the depreciation of European currencies.

By far the largest amount of asbestos consumed in the United States has come from Canada, but several promising mines have been opened in Arizona, which is now furnishing a grade of crude asbestos in quality claimed to be at least equal to the Canadian product, with the added advantage of being entirely free from iron, which makes it particularly adapted for electrical insulation purposes. This Arizona product commands a premium of from 10 to 20 per cent over the Canadian. Only the highest grade of spinning fiber is being produced in Arizona, owing to difficulties in mining and transporting, it being unprofitable to produce low-grade material.

Graphite.—The movement of Ceylon and "Madagascar flake" into the country has been greatly reduced by the lowered demand for refractories and lubricants. The general revival of industry now under way will, it is hoped, result in greatly improved tonnage for 1922 as compared with 1921, which was the poorest for many years.

Large stocks of imported crude have sought buyers, with the result that prices reached levels which shut down many of the American mines, notably in the South, with an accumulation of stocks. A tariff of 4c. per lb. is called for by home producers, to insure a resumption of operations.

Limestone (Crude).—Pennsylvania limestone may be taken as fairly typical of conditions throughout the country. The price range during 1921 was from $1.25 to $1.50 per gross ton f.o.b. quarry, which is below the cost of production. The grades most in demand are crushed fluxing stone for blast-furnace purposes and steel works, large one-man stone for openhearths, and run-of-quarry stone for cement mills. Sales were made direct to consumers through appointed agents. Sales for 1921 were only about one-third of those in 1920. Little change was noted in the character or volume of trade in the last quarter of 1921 as compared with the the three preceding quarters, but slightly larger volume of blast-furnace and steel works business has been obtained. Contracts are not being placed ahead for periods longer than three months, and in most instances they are for shorter periods.

Pyrites.—Little if any domestic pyrites was sold in the United States in 1921. Import sales were low, and it is expected that they will run well under the imports for 1920, which amounted to 301,692 tons. The ore is sold in bulk form in cargoes of from 3,500 to 6,000 tons. Few if any contracts were made in the last quarter of 1921 for future delivery. Deliveries were on old contracts which extended into 1921. During the year 1916, the imports of pyrites from Spain to the United States were 1,078,426 long tons, and from Portugal 39,542 long tons, making a tonnage from Spain and Portugal of 1,117,968 long tons. In 1917 only 665,713 tons of pyrites was imported; in 1918, 252,143 tons, and in 1919, 301,692 tons.

The drop in imports in 1916 and 1917, caused by the war, was directly due to the Government not allowing the American pyrites companies to employ steamers to move their foreign product to our shores. However, on entering the war, America's need of sulphuric acid caused the exploitation of the brimstone deposits of Texas. In consequence, the Texas Gulf Co. opened a large property, and after the war found no other outlet for brimstone (sulphur) except to capture the pyrites trade. To do this, the company cut its price on brimstone, and this competition accounts for the low importations of Spanish pyrites during 1919, 1920, and 1921.

Talc.—A large New York State producer reports, as is sadly true in nearly all commodities, that many consumers of talc in 1920, fearing to be cut short on their requirements, placed orders for considerably more material than needed on a normal basis. Before they could cancel, numerous shipments were made, and many concerns entered 1921 with an unprecedentedly large inventory. What they did not carry in stock they had obligated themselves to take. By friendly adjustment with producers, they were permitted to absorb in 1921 their commitments for 1920 delivery. Slow business during 1921 for these consumers compelled abstention from the market in many instances until late in the year. As a result, sales in 1921 were considerably below those in 1920, but there was a gradual improvement in volume after the month of June. One reason of the falling off in sales is the large outlet for some grades in paper making. Labor troubles closed down many of the paper mills for a long period. Moreover, the lessened export of paper has contributed to a smaller demand for talc where used as a paper filler. Some producers have been compelled to shut down in consequence.

In the main, sales of talc are made direct to the manufacturer by the miner who mills his product at the mines. A little is sold also through brokers. Prices range from $12 to $14 a ton for New York talc. Sales in October and November of 1921 showed a considerable increase over the other months of the year, and a big demand is looked for during January and February, 1922. There is a disposition among consumers to postpone the making of contracts for future requirements.

One of the largest American producers (situated in Vermont) reports a trying year, which in comparison with 1920 makes a sorry exhibit. Business was confined entirely to domestic trade. Practically all of the product is sold direct to consumers, of whom over 80 per cent are paper manufacturers, and most of the remainder to rubber-tire manufacturers. It is sold finely pulverized. Three leading grades are produced, which differ only in color and degree of fineness. The whitest and finest is made from rock selected for color to make it as white as possible. It is ground to about 250 mesh. The medium and lowest grades are ground to about 200 and 160 mesh respectively from the average run of rock as to color. Packing is done mainly in paper bags, though some talc is put up in burlap.

During the first quarter of 1921 there was virtually no demand for talc. This was followed by a slight improvement in the second quarter, and the remainder of the year witnessed a fairly substantial recovery. The total business for eleven months to Dec. 1 was about 50 per cent in tonnage and 10 per cent in value compared with the same period in 1920. A good share of 1920 business was covered by contracts, but no contracts were made in 1921, partly because buyers were disposed to purchase their moderate requirements for talc in the spot market and partly because the producers were not inclined to tie themselves up at the low prices prevalent, which were from 15 to 25 per cent under those of 1920. The outlook for talc business for 1922 is about as favorable as in most lines.

Prices for talc held fairly firm throughout 1921, although buyers generally obtained concessions and were especially favorable to new competition which is promised by large interests in several quarters, especially in the roofing grade. Prices ranged from $7 per ton f.o.b. domestic mines on heavy tonnage yearly contracts for the roofing trade, which uses the less pure grades, up to $50 per ton f.o.b. New York for the fine white gritless Italian grades imported for some paper making and the better talcum powders. The roofing-paper trades are estimated roughly to consume from 30,000 to 40,000 tons, and a canvass of this trade indicates that the final quarter of 1921 was one of the best in roofing history, and warrants a confident outlook. Hence the low-grade talcs are practically assured of a good year in 1922.

Clay.—Based upon prices at mine, as in Georgia, South Carolina, and Florida, the price range approximates $5.50 to $6.50 for crude broken lumps, bulk shipment, carload lots, and from $9 to $12, pulverized, air-floated, in carload lots, shipped either in paper or cotton or burlap bags. The trend of prices has been downward. Grades most in demand have been pulverized or crude. There has been some demand for washed clay, but apparently only for use by wall-paper manufacturers.

Exports have fallen to an almost negligible quantity, as English prepared clays, benefiting from lower freight rates and cheaper ocean rates, have taken the greater part of the foreign market served by American producers during the last few years. Imports, mostly from Great Britain, for the ten months ended Oct. 31, 1921, were valued at $1,069,887, as compared with $2,998,595 in the same period of 1920 and $1,609,266 in the same period of 1919.

Crude clay is purchased by concerns having their own pulverizing or washing equipment. Pulverized clay of fine mesh is more in demand. The consuming demand seems to be for the manufacture of cold-water paint, kalsomine, wall paper, lincrusters, fillers and the making of all paper classified mainly as No. 1 News, Rotogravure, and Book.

There was a decided decrease in sales in 1921 as compared with 1920. The volume of business in the last quarter of 1921 was considerably in excess of the three preceding quarters. As usual, some small clay producers who are not equipped to ship during the winter months secured business during the third quarter of the year at decided concessions in prices. There was a marked falling off in contracts as compared with 1920, due largely, perhaps, to readjustment of prices and expected freight reductions.

Silica.—Silica (silex, quartz, flint, or sand) is used in a great many different forms, the difference mainly being in the fineness of the grinding. The glass manufacturers use a pure silica of about 20 mesh for the manufacture of the better grades of flint glass. The range of price is from $2 to $5 per net ton in carload lots. The grade most in demand is what is known as No. 1 and No. 2 Dry Silica, or Melting Sand. Silica in a still finer grade of about 40 to 60 mesh is used by the manufacturers of hand soaps and pastes, and silica brick for smelting metals. The price range on this grade is from $4 to $6.

Silica in the finer grades ranges from 90 mesh to 250 mesh. The 90-mesh and 100-mesh grades are principally used in the manufacture of scouring powders and hand soaps. The 120 to 140 mesh is used by the potters and is known commercially as Potter's Flint. The finer grindings are used in the manufacture of metal polish and paints. The price range on these finer grades is from $4 to $30 per net ton, depending on the grade. The grades most in demand are 120 and 140 mesh. Sales are principally direct, and with the exception of a small tonnage shipped to Canada, the great volume of business is in the United States. Most of the output is prepared by crushing, washing, drying, and grinding. A decrease in the volume of business compared with the year 1920 from 25 per cent to 50 per cent was reported in 1921, with little tendency to place contracts for future delivery.

Bauxite.—As the production of bauxite rests upon three large industries, all of which have been affected by the general business depression, there was naturally a lower production for 1921 than in previous years. There has, however, been nothing approaching disorganization as in some industries. Hence the price at the mines in Alabama and Arkansas was approximately the same throughout the year, namely $9 to $10 per ton, with a downward tendency distinctly noticeable, especially for spot lots toward the end of the year. Slight quantities of bauxite were exported during the first half of the year, but little was reported for the second half.

The grades in demand in the order of their importance were: (1) For metallic aluminum; (2) for abrasives; (3) for chemicals. The all-important metal and abrasive grades require a low-silica ore, whereas the requirements of the chemical manufacturers are for a grade high in alumina, the specifications being 55 to 60 per cent, with no specification on the silica. All consumers require a low iron content except in one avenue of the chemical outlet—namely, where the sulphuric-acid process is not used but where the soda-ash fusion is employed.

Although sales are mainly made directly from the mine, considerable tonnage passes through the hands of jobbers. The product is sold entirely in lump, the various consumers having their own mills for pulverizing. With the decrease in consumption in 1920, came also a reluctance on the part of buyers to make long-time contracts, the term of the contracts being greatly shortened as compared with previous years. There is also noted on the part of buyers a rather hopeful looking toward foreign sources to satisfy an increasing proportion of their requirements in view of the greatly lowered marine rates.

Fluorspar.—The price movement of the different grades of fluorspar throughout 1921 is fairly typified for all grades in the course of prices of gravel spar, which during the first half of the year ranged around $20 per ton, during the third quarter about $18, and in the fourth quarter around $16, f.o.b. cars at the mines. Undoubtedly one of the influences to depress prices, apart from the overwhelming one of shutting down the steel mills, which use about 80 per cent of the fluorspar mined in the country, has been the lowering of freight rates, which has enabled English miners to lay down washed gravel spar, c.i.f. New York, Philadelphia, or Baltimore, duty paid, at around $18 per ton, which is several dollars under the price for which American miners can place it at the same points, the freight rate from the mines usually being about $5 to seaboard points.

The various grades used, in the order of their value, follow, the prices being approximate only for the end of the year, and f.o.b. mines:

Acid Grade, lump or ground, 98 per cent or better calcium fluoride. Sold to manufacturers of hydrofluoric acid at around $50 per ton.

No. 1 Grade, ground and washed, 95 to 98 per cent calcium fluoride. Goes to the glass trade at about $40 per ton.

No. 1 Lump, 93 to 96 per cent calcium fluoride. Sold at about $37.50 per ton.

No. 2 Lump, 88 to 92 per cent calcium fluoride. Brings about $30 per ton.

Gravel Spar, 85 per cent or better calcium fluoride. Goes to the steel trade and foundries at about $16 and constitutes about 80 per cent of the entire production of the country.

The bulk of the spar sold goes through the hands of a few large sales agents, about one-half of the entire production of the country coming from one producing company and about 30 per cent from another, with the remainder of the production scattered among many smaller miners. The glass trade absorbs about 70 per cent of the No. 1 Ground, with about 20 per cent going to the enamelers and the remainder to metallurgical users.

With the decrease in marine freight rates, the importation of English spar increased during the last quarter of the year, but the duty which it is believed that Congress will increase on fluorspar is expected to check the increase in imports and to equalize the prices along the seaboard, which are at present much to the advantage of the foreign miners.

Exports of American spar are almost nil because of English competition, which not only has the advantage of cheaper labor but also of low freight rates, as well as a short haul from the mine to the vessel, as compared with the long haul which American miners must make to reach the seaboard.

There was a great decrease in the consumption of fluorspar during 1921 as compared with previous years, largely because of the slump in the steel trade. It would be within safe bounds to say that the sales were cut down to one-third or less than one-third of those of 1920. There has also been noticed the greatest disinclination on the part of buyers to contract ahead as compared with former years.

Magnesite.—Raw magnesite is sold in a comparatively slight tonnage in this country except for calcining purposes, and practically all of the raw magnesite brought in to the Atlantic seaboard comes either from Venezuela or Greece. The price sagged from about $20 per ton at the beginning of 1921 to around $10 or $12 per ton at the close, in carload lots. This is for a guaranteed minimum of 93 per cent magnesium carbonate.

Calcined magnesite prices ranged from $40 to $45 per ton, f.o.b. California mines, in the first part of 1921 down to $35 or $40 per ton toward the end of the year for standard grades. This approximate drop of 10 per cent applies to all grades of calcined. Nearly all of the Tulare (Porterville) mines are closed down, owing to the general business depression, which closing down has tended to hold up prices. The importation of Grecian calcined increased throughout the year, with a depressing influence on prices. The demand in the flooring trade kept up satisfactorily, but has fallen off with stucco and other building lines. It was not until the last quarter of the year that the good demand for ship work fell off sharply. There is a hesitation on the part of both consumers and producers to contract ahead because of the uncertain influence of the impending duties on the future course of prices.

Dead-burned magnesite ranged in price in 1921 from $40 in the early part of the year down to $25 f.o.b. mines, the latter figures being due to a great weakness in the market under a practical withdrawal of the steel trade as buyers. The poorer grades produced in Canada sold as low as $18 to $19 per ton in the latter part of 1921. The high grades from the State of Washington have been most in demand. The Austrian magnesite came in rather briskly over the latter half of the year. Sales were made equally by jobbers and direct. The domestic magnesites are mixed with iron ore to bring the iron oxide content up to 6 or 8 per cent. Sales during the second half of 1921 were small, and in the first half much below those of 1920. Conditions latterly have been so bad that all domestic producers have ceased making the dead-burned. Contracts for future deliveries are rare.

Chalk.—Chalk continues to come almost wholly from England under the name of Cliffstone in its crude condition. It is refined in this country and sold under the following grades, the prices being approximate per ton for carload lots at the beginning and end of 1921:

Commercial whiting declined from $25 to $20 in 1921. This comprises about 35 per cent of the output, being used almost entirely for the manufacture of putty. Gilder's whiting declined from $27 to $22 and comprises about 20 per cent of the output, being used for gilding, paint, chemical, linoleum, and other manufacturing. Extra gilder's whiting declined from $28 to $23, and comprised about 25 per cent of the output. Paris White fell from $30 to $25 and is employed largely for special uses as moldings. This includes about 20 per cent of the total output. Sales are made both direct and through jobbers.

The demand for high-grade English whiting has been somewhat impaired by the introduction of crystalline or semi-crystalline whiting manufactured from domestic or imported limestone. The Belgian whiting is the only whiting which is imported already prepared, and is of inferior grade.

Sales in this country during 1921 of English whiting were about 50 per cent of those in 1920 and the whiting manufacturers ran between 30 and 40 per cent capacity through the year. Contracts are not being placed ahead and are not sought by the whiting manufacturers.

Sulphur.—Sulphur or brimstone fell from $19 to $20 at the beginning of 1921 to $17 or $18 at the end of the year, for the crude commercial grade, which runs about 99.7 per cent. The decline in the costlier products was proportionate. Little is sold through brokers, sulphur being marketed direct by the miners. The great bulk of the production is employed in sulphuric-acid manufacturing. The sales for 1921 showed a great decrease as compared with those of former years owing to the flat condition of the acid market. The last quarter, however, showed distinct improvement. Contracts are reported as being made ahead.

Emery.—The large number of grades of emery marketed are sold mostly direct to consumers by the American millers of crude lump emery. The Turkish and Greek products declined from a general average of about 7½c. per lb. down to 6c. throughout the year and the American emery from around 5c. per lb. down to about 3½c. The finer grades have been mostly in demand. There have been comparatively few importations of the ground emery, the Turkish and Greek coming in in the lump form. There have been few exports. Sales over 1921 declined approximately 50 per cent as compared with those of the preceding year, and production has been cut down in about the same proportion. A distinct improvement was noted, however, in the last quarter of the year, although no contracts are reported as being made ahead by buyers. The general condition is quiet, with a decidedly optimistic tone concerning the outlook.

Gypsum.—One of the few non-metallic minerals in which prices held fairly firm throughout 1921 is gypsum, in both the crude (crushed) form and also the prepared or powdered article. The crushed product brought in carload lots $10 per ton, f.o.b. New York, at the beginning of 1921 and at the end of the year was selling for about $8.70. The raw product went largely to paint and portland-cement manufacturers. The powdered or plaster of paris sells for about $20 per ton, f.o.b. New York, the bulk of which goes to the building trades and potters and some to the plate-glass manufacturers. Nearly all gypsum is sold direct from the mines or through established sales agents, brokers or jobbers getting only a small percentage of the trade. The domestic producers compete on a parity with the large importations from Nova Scotia and New Brunswick. There was a decrease of about 30 per cent in the sales in 1921 as compared with those of the preceding year. Contracts ahead for future deliveries have not been customary in the trade for five or six years, and no tendency has been observed to resume the practice. The outlook for 1922 business is regarded as being distinctly favorable.

Barytes.—The great bulk of the barytes imported or mined in this country finds its way in the crude lump form to the lithopone manufacturers, the price having dropped from about $18, f.o.b. mines, at the beginning of 1921 to $10 per ton for the imported German ore, f.o.b. Atlantic seaboard, this latter figure being well under the price demanded at the same points for domestic ore. This extreme softening of the market was due to the greatly decreased demand for lithopone, which leaves the barytes sales for the year about 25 to 35 per cent of normal. A distinct improvement was, however, noted during the last quarter of 1921, and it is hoped that the demand for barytes during 1922 may reach something like 70 per cent of normal. Contracts for future deliveries are few, as consumers were caught with large stocks and former commitments holding over to the present time. Sales are made direct by the mine owners to the larger consumers.

The break in price of the crude has not been shared by the various powdered grades, No. 1 water floated having maintained a fairly firm price per ton f.o.b., St. Louis, throughout 1921. The imported floated barytes may, however, be had at lower figures, for what is claimed to be a lower grade. Sales are made by the company direct or through their local agents to the paint and smaller consuming trades.

Borax.—The Pacific Coast Borax Co., which also operates mines in Europe, Africa, and South America, produces over 99 per cent of all the boric acid and borax produced in this country. Carload lots sold at the beginning of 1921 at 7¼ to 8c. per lb., according to the containers used, and dropped to 5¼ to 6c. at the end of the year. There are four grades, as follows: The powdered is in largest demand, being marketed in a commercial grade. The U. S. P. powder is also sold. Other grades are granulated, crystal, and borax glass.

All sales are made through district agencies in the marketing of package goods, and direct from New York in bulk goods. The year 1921 showed an increase in the tonnage but not in the value of package borax, due to increased domestic use. This improvement was especially noted in the last quarter of the year, when a heavy educational advertising campaign was initiated. The export ban on American borax was lifted in the third quarter.

Phosphate Rock.—Florida phosphate sold on yearly contracts at the beginning of 1921 at from $4.50 to $4.75 per ton, and despite a year of great depression and decreased sales, the price advanced by the end of the year to $5 or $5.25. This advance is explained by the fact that many of the miners closed down because their returns were not above cost of production, and on new demands they declined to resume at the old prices. Sales were made entirely direct by the miners to manufacturers of acid phosphate in cargo lots.

Exports have been seriously affected, and those well informed appear to feel that America's export trade of phosphate will be lost in a few years to the Moroccan deposits. Hundreds of millions of tons of rock which is said to be geologically the same as the Tunisian rock have been uncovered by the French government in Morocco. The French are hopeful of eventually controlling the entire European market, following their shipment about the end of 1921 of a first lot of 500 tons.

Though the main American deposits are in Florida and Tennessee, the new deposits which are being opened up in Idaho, Utah, and Montana are regarded as sure to eventually contribute a great tonnage to this country's output, deliveries having been made last summer for fall wheat. Sales of raw phosphate for direct application to the soil were almost entirely from Tennessee, where the high iron and alumina content makes it less desired for the manufacture of acid phosphate.

Exports to Europe were large during 1921, but they show a falling off over preceding years. There are also exports to the West Indies and some to Canada. Approximately 2,500,000 tons of acid phosphate was marketed in 1921, and possibly 75,000 tons of raw phosphate for direct use on the soil. The system of selling under yearly contracts continues to rule, and, in general, spot purchases may consist of distress stocks.

Mica. — The price of raw mica held fairly firm throughout the first half of 1921, but during the second half dropped approximately 25 per cent on the average for the different grades. For example, the No. A1 Clear India, which was sold around $5 per lb., f.o.b. New York, in case lots, the first half of the year, dropped latterly to about $4 per lb. Again, No. 6 Clear India dropped from about 60c. per lb. to about 28c. per lb. in case lots. The principal demand was for No. A1, No. 1, No. 2 and No. 3. Sales are made through jobbers. Domestic production provides for much less than one-half of the country's requirements. The electrical manufacturers consume approximately 80 per cent of the total of sheet mica used, the remainder going to the stove manufacturers.

Scrap mica sold in the beginning of 1921 for about $24 per ton, and at the close for around $20, f.o.b. mines, in carload lots. The decrease in sales during 1921 is roughly estimated at 50 per cent, with no tendency toward improvement noted toward the end of the year. The largest consumers were buying from hand to mouth at the close of 1921, as compared with a willingness to contract ahead during the first quarter.

Spanish Pyrites Imports Decline

The controlling elements in the pyrites situation are the price of domestic sulphur, Rio Tinto, and ocean freight rates. Domestic production of pyrites is possible only at inland points distant from the Atlantic seaboard. The trend of foreign imports is shown in the following table:

IMPORTS OF PYRITES (a)

	Spain, Long Tons	Canada, Long Tons	Total, Long Tons
1916	1,095,980	148,682	1,244,662
1917	747,830	210,615	967,340
1918	270,649	221,442	498,786 (c)
1919	280,725	84,761	388,973 (c)
1920	200,706	100,672	332,606 (c)
1921 (b)	132,754	7,000	156,008 (c)

(a) Bureau Foreign and Domestic Commerce and Mineral Resources. (b) First ten months. (c) Includes importation from other countries also.

The normal importation of foreign pyrites is roughly 500,000 tons per annum. The low price of sulphur following the war and the fact that many acid manufacturing companies had installed sulphur burners and found it inexpedient to return to imported pyrites resulted in the curtailment of market indicated in the figures given. Low-grade pyrites has almost disappeared, and only the high-grade Rio Tinto product holds a place in the markets.

At present the pyrites business is on a hand-to-mouth basis, and there are no stocks. On the other hand, the sulphur stocks are large and can be shipped by carload or cargo. With a decrease in ocean freight rates the competition between foreign pyrites and domestic sulphur will become keener. The importers of pyrites look hopefully for better business in 1922.

The industrial depression has also played an important part in restricting the market. The great majority of acid manufacturers have not dismantled their pyrites burners, and this has had its influence upon sulphur prices. If Rio Tinto decides to fight for its United States market, it will be at its own and the domestic sulphur producers' cost.

An important feature in the pyrites situation is the disposal of the cinder. About 70 tons of cinder containing from 2 to 3 per cent sulphur result from the burning of 100 tons of pyrite. By nodulizing or sintering, the sulphur content can be reduced and the product equals a bessemer iron ore, the phosphorus content being very low. An acid plant near a blast furnace plant can profitably dispose of this "waste."

Pyrites importers do not anticipate that the Spanish government will place an export tax on the lean pyrite, and as there is a tremendous potential supply in the Huelva region, it is expected that the United States market for pyrites will be retained in part at least.

Some Essentials for Success in Pyritic Smelting

Quartz Should Be Pure, Hard, and Coarse — Combined Silicates Deleterious — Manner of Feeding Important — Incrustation Hard To Avoid — Effective Means Necessary To Confine Corrosive Low-Grade Matte

BY A. J. BONE
Formerly, [illegible] Superintendent at Copperhill, Tenn., and
Anyox, B. C.

Written for Engineering and Mining Journal

THE OXIDIZING CHARGES which were formerly fed to copper blast furnaces are no longer common; changes in ore supply and advances in smelting practice have made the furnace an oxidizer instead of a reducer, and at times, under favorable conditions, a powerful one. Nearly all blast-furnace operators have to oxidize some iron, and many, with a thought for their converter departments, would like to do more of it.

The extent to which oxidation can be carried is influenced by many factors, chief of which are the relation of sulphide iron to the free silica on the charge, the nature of the gangue, and the amount of oxygen supplied by the blast. Best results, meaning high concentration and low coke, follow the use of pure materials such as heavy sulphide ore and quartz, or low-grade matte and quartz; but whether coarse Tennessee pyrrhotite and pure, lump quartz is smelted with 3 per cent of coke, oxidizing 90 per cent of the iron, or Sudbury pyrrhotite in a norite gangue is smelted with 10 per cent of coke, oxidizing only 35 per cent of the sulphide iron, the pyritic effect is equally desirable. In one operation the charge favors oxidation; in the other it is hampered by a refractory gangue and a high percentage of coke.

"Pyritic smelting," in a narrow sense, is associated with low coke ratios and implies a vigorous employment of the pyritic reaction. Guess defined it as "the art or practice of smelting a charge, in which all the iron present is combined with sulphur, to produce a ferrous-silicate slag."

The iron sulphides to be considered are pyrite and pyrrhotite. Pyrite loses one-half its sulphur by sublimation in the upper part of the smelting column, and both pyrite and pyrrhotite melt at a comparatively low temperature and enter the smelting zone approximately as FeS. The composition of the iron sulphide compound at its highest temperature is stated by Sticht to lie somewhere between FeS and Fe. FeS.

It is commonly held that the loose sulphur atom, for lack of free oxygen in the region of disengagement, escapes from the charge unburnt, and it is customary for this reason to deny to pyrite any credit for heat from this source. But such reasoning may not always hold; two circumstances challenge its soundness. First, some pyrite ores have the mineral scattered through the gangue in grains or patches, and, by means of the protection and insulation thus afforded during the early stages of the descent in the ore column, disengagement of the loose atom may be delayed until the smelting zone and an oxidizing atmosphere are reached. Second, the lack of free oxygen above the smelting zone is certainly open to question. It has been my experience that gas analyses from the pyrite charge show a high average oxygen efficiency, often no trace of oxygen being found, whereas, at a plant smelting an ore essentially pyrrhotite, an appreciable proportion of oxygen is invariably present, evidently because the pyrrhotite charge, unlike pyrite, lacks the abundance of liberated, elemental sulphur for cleansing the gas of oxygen unused in the smelting zone.

PURE QUARTZ THE BEST FORM OF SILICA

The character of the siliceous portion of the charge is of much importance. The silica should be free; silicates require heat for decomposition and are a detriment in several ways. A coarse quartz that does not break down easily on exposure to heat is the ideal reagent; fine quartz, or one crumbling badly under heat, lowers the ratio of concentration and causes more incrustation. This has been clearly shown in the concentration of low-grade matte where pure materials were used, matte, quartz, and lime rock, and results were not obscured by many qualifying conditions, as in ore smelting. At one plant, using a good lump quartz, a 10 per cent matte was readily concentrated to 40 per cent; at another plant where the bulk of the quartz was fine, about ¾ in. or under, it was difficult to raise a 10 per cent matte beyond 25 per cent, and incrustation was bad. In pyritic smelting, prime attention should be given to silica—to its physical as well as to its chemical nature.

Fine and waste have no place in the blast-furnace charge, and this applies with special force in pyritic smelting. Fine material, say that passing a ½-in. opening, if there is no reverberatory department, may be prepared for the blast-furnace by nodulizing, sintering, or briquetting. Nodulizing and sintering have the advantage that oxidation accompanies the physical preparation, and as oxidation is the prime object of pyritic smelting, preparatory processes should preferably be a step in that direction. A furnace, however, often does good work with all the fine left in the ore, and it may be difficult to show the need and justify the expense of screening and special treatment, as benefits to be derived from metallurgical operations are not always capable of exact expression in terms of money. If an ore with 20 per cent of fine is screened and prepared for the blast furnace at $1 per ton, the cost figured against total ore is 20c. per ton, a serious item for a low-grade ore; but on the opposite side of the ledger will be faster running, less crusting, longer campaigns, a decreased quantity of flue dust, and, if the preparatory process oxidizes, a higher grade of matte.

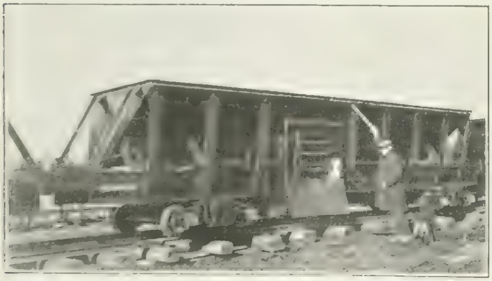
Waste rock, which is usually high in natural silicates, creates trouble and expense for the smelter. It is hard to estimate the cost of smelting waste. It entails the ordinary expense of transportation, bins, sampling, and charging, the same as ore; it increases the demand for coke, lime, or other flux; it is responsible for a certain amount of slag which carries a quantity of copper to the dump; but, what is far more serious and costly, is its deadening effect on the pyritic reaction. It retards the rate of smelting, depresses oxidation, and causes low-grade matte and sticky, dangerous slags. Waste in the ore should be eliminated outside of the blast furnace.

The pyritic furnace requires a careful balancing of reagents and maintenance of proper physical conditions. Frequent changes in the charge are necessary, and the metallurgist in diagnosing and prescribing should be able to feel confidence in the analyses and weights of charge components. Though the preponderance of tonnage has come from beds, provision must be made for a quick supply of any single material. An intimate bedded mixture is usually only necessary when conditions are particularly unfavorable.

METHODS OF MECHANICAL FEEDING

Two improved methods of mechanical feeding, both successful though widely different in principle, have been developed in pyritic plants. The Freeland feeder, described in the *Mining & Scientific Press* of March 22, 1913, has been used since 1902 in the smelter of the Ducktown Sulphur, Copper & Iron Co., at Isabella, Tenn. The Isabella furnaces have gas offtakes beneath the charge floor, and movable, water-cooled tops or covers. The feeding machine operates on a charge track that straddles the furnace lengthwise. It consists of a carriage supporting an apron conveyor of the same length and width as the furnace. Charge components are drawn through wide gates onto the conveyor in layers, as ore, quartz, slag and coke. The carriage engages the cover of the furnace and pushes it ahead, and as it moves over the opened shaft the conveyor distributes its burden uniformly not only lengthwise but from side to side. The carriage and conveyor each has a variable-speed, reversible-type motor, giving flexibility to the method.

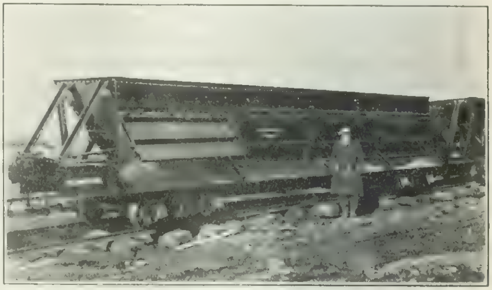
An adaptation of the system of feeding developed at Mount Lyell, Tasmania, is employed by the Granby smelter at Anyox, B. C. It was described in the *Engineering and Mining Journal*, Oct. 7, 1916. Extending along either side of a 30-ft. furnace, at a point 2 ft. 6 in. below the charge floor, is an iron ledge or shelf projecting into the furnace and overhanging the jackets 9 in. This ledge, which receives the charge from side-dump cars, is partitioned into six compartments, and each compartment is served by a pusher, actuated by compressed air, for moving the charge into the furnace. Thus, a furnace has twelve feeding units, and can be fed from any one, at any time, and in any quantity up to capacity, which is about 5,000 lb.



SCALE BEAMS ON BLAST-FURNACE CHARGE CAR

The British America Nickel Corporation, at Nickelton, Ont., used a combination scale-charge-car, which is of the same length as the furnace and is divided into four compartments to correspond with the four charging doors. The accompanying illustrations explain its construction and operation.

Continuous feeding has been suggested as a possible way of improving blast-furnace practice, and would indeed seem to promise certain advantages, such as steadier blast resistance, better utilization of heat in escaping gas for pre-heating the charge, and greater uniformity in gas temperature and composition. These latter considerations are of special value where gas is treated for its sulphur dioxide content.



BLAST-FURNACE CHARGE CAR, SHOWING DISCHARGE SIDE

Incrustation, an unavoidable evil, is of several varieties and develops from different causes. A scab or crust forms from sticky, semi-fused material adhering to the jackets and is aggravated by fine sulphide. It usually extends from the tuyères to the top of the charge and is entirely harmless at first, but must be taken in hand before growing too thick and restricting the descent of the ore. Undigested silica manifests itself in the form of heavy crusts. If it has accumulated gradually, the crust will be hard and dense, but if silica accumulates rapidly the crust will often be loose and porous, hardly a crust at all but rather a column of cold, raw charge that offers an easy escape for the blast. Barring down crusts gives only temporary relief unless they have been undercut. Lower crusts must be fluxed away if they are not to remain as foundations on which other crusts will soon spring up. A matte concentration charge can usually be counted on to relieve a badly crusted ore furnace by reason of its running with a cooler top and lower column. Soon after the charge is switched, crusts cool off and are more readily pulled down and broken up. In smelting crusts, allowance is made for their excess silica content.

Pyritic smelting campaigns are mostly terminated by incrustations, and are short, six weeks to two months being a common average, though occasional runs of six months or longer are recorded. Campaigns may be prolonged by freer use of coke, lime, or other flux, but such expense soon exceeds the cost of shutting down, digging out and starting up again. However, when the ore supply crowds the smelter, and the cry for tonnage is loud and insistent, the metallurgist is often forced to expensive measures to keep his furnaces in blast. To do the cheapest work the pyritic smelter should have spare units; the pyritic furnace should be of moderate length and provided with means for quick handling of jackets and ready disposal of furnace cleanings.

Several reasons favor having the slag and matte overflow at the end of a furnace instead of at the side, one being the securing of an equal number of tuyères on each side, thus promoting equal distribution of blast.

Another marked advantage is that both sides are free and cleared for action, in contrast with the other arrangement where the front side of a furnace is cluttered up with overflow spout, settler, launders, and other appurtenances, a serious interference in getting at a matte break-out, and a handicap in tuyère punching. No job around a furnace is more unpleasant than punching tuyères on the front of a side-discharging furnace, where the puncher has his choice of standing on top of the settler, hot under foot and limited as to headroom, or getting down into the congested space between settler and furnace, cramped and exposed to danger of spout explosions. Attention to the tuyères is a task of major importance, and, being laborious and disagreeable at best, requires proper working facilities.

Blast volume and pressure are valuable indices of internal furnace conditions. Where a furnace has its individual blower of known delivery, volume can be ascertained at the power house; otherwise it can be measured in the connection leading to the bustle pipe. For this purpose the Clark blast meter, a specially constructed pitot tube and Ellison gage reading "cubic feet of air per minute," has given satisfaction.

A common accompaniment of pyritic smelting is a heavy fall of low-grade matte that is thin and penetrating and has an unfortunate way of working to the very bottom of things and taking advantage of the slightest opportunity to escape. The furnace crucible cannot be lined with magnesite, owing to the destructive action of water from leaks in the jackets or the sole plate, and of course a magnesite crucible would preclude quenching a furnace with water before it is dug out. Chrome brick is best for this purpose, though a good firebrick will answer. Break-outs are most likely to happen between jackets near the sole plate, and unless checked at once nearly always result in a burnt jacket. The more jackets in the lower tier, the greater the number of potential danger spots. For instance, an end-dis

Domestic Sulphur Producers Face Strong Competition

Among the three important sulphur producers it is doubtful whether much money was made by operations in 1921. Both the Union Sulphur Co. and the Texas Gulf produced steadily throughout the year, but the Freeport closed down in the spring of 1921. The potential production of the three companies is probably twice as great as the world consumption. Competition between these companies and the competition from Spanish pyrites have combined to produce an exceedingly low price. Spanish pyrites can be placed upon the market at ruinously low prices; in fact, for slightly more than the ocean freight and commissions. As a result neither the sulphur or the pyrites shippers can make money. One fact that has militated in favor of the sulphur producers is that the acid companies would have to incur expense for repairs and rehabilitation of their pyrites burners if they returned to pyrites. As this requires ready cash, and money is hard to get, they have to a considerable extent continued to use sulphur.

At present sulphur is the cheapest basic commodity in the market. Sulphur prices on the Atlantic seaboard range from $18 to $20 per long ton, ex vessel, as compared with the pre-war price of $22 per long ton, maintained over a period of about ten years. Lower costs of production are not to be expected, and the methods of recovery will not be improved to any extent. Relief must come in higher prices, and 1922 will probably see price advances unless Rio Tinto fights for her American market by laying down pyrite at cost plus commissions.

The acid trade is depressed, owing to the fertilizer industry being in the doldrums. At present, 66 deg. sulphuric acid is approximately $17 per ton. Until farmers' credits have been covered, and they are in the market again, little help can come from this direction. However, necessity will probably bring the farmers back into the fertilizer market in 1922. The iron and steel pickling is slowly coming back. Petroleum refineries are somewhat below normal, and the chemical industry has been greatly depressed. It is believed that 1922 will be on the whole an improvement over 1921.

While the domestic market for sulphur has expanded at the expense of pyrites, the prevailing industrial slump has resulted in restricted demand for both. This apparently has found a similar reaction in the foreign demand. Exports have been extended to Australia, and the Pacific Coast has been supplied via Panama. Japanese sulphur formerly marketed on the Pacific Coast has been shut out. For the first ten months of 1921, according to the Bureau of Foreign and Domestic Commerce, the sulphur exports totaled 241,857 long tons, of a value of $3,840,908, as against 428,679 long tons, of a value of $8,170,527, for the same period in 1920.

The future of the domestic sulphur producers lies in the expansion of their international market and a more equitable price in their domestic market.

Russia Introduces the Metric System

According to a decree of the People's Commissars, published in official Soviet papers, the metric system of measures will be introduced in all Soviet institutions beginning with January, 1922, and from 1924 the metric system of weights and measures must be finally and universally adopted throughout Soviet Russia.

BY THE WAY

"The Engineer" Defended

One who styles himself "a goose-quill profit" writes as follows from Mount Pleasant, Tenn., regarding Mrs. Whitney's sculpture:

> Paw sez as how yer all wrong an' thet Aunt Harry mos likely seed [illegible] a-firing the famly still on a right smart hot day. An Paw sez that the Stiller has riz to the dignity of a chemical enjyneer. Keep the home brew fire burnin.
>
> I don't want no chicklets, I uses terbaccer strait.

The goose-quill prophet is undoubtedly an authority on home-brew and moonshine, so his comment is valued accordingly. Another defender of the noted sculptress is A. R. Elsdon, who writes from London thus:

> I fear that this letter will reach you too late in order to qualify for that box of chiclets, but I am surprised, sir, at your daring to cast doubt on the handiwork of a lady. The statue clearly represents an engineer, and I defy you to prove otherwise. Are there any laws in your country preventing an engineer from working in any position he pleases?
>
> In my opinion the correct title should read: "The Engineer, without clothes, lover of work, favours the short-handled shovel, very rare type."
>
> By the bye, what are chiclets—do they lay eggs?

Chiclets, Mr. Elsdon, are a form of "chewing sweets," under which name the stenographer's delight has recently been introduced in the British Isles. "Gum," we understand, is a term reserved there for overshoes, which are not at all affected by the ladies of the keys.

Still another knight errant, J. M. G., writes from Spain, though what he is doing there we can't imagine unless it be fighting windmills. After giving formal notice that he is in the lists for the chiclet prize, he says:

> Mrs. Whitney's right; sure, she's right. This represents an up-to-date "engineer." This is one of these new-fangled "Heating and Plumbing Engineers" digging a trench for a sewer pipe in some town like Phoenix, Ariz. The location accounts for getting down to his B.V.D.'s. Somehow you mining engineers take it for granted that this should be a representation of a *mining* engineer. Where do you get that stuff? Getting a swelled head because a couple of your number have visited in Washington recently? We are about to add another craft to the engineering list.
>
> As soon as the "Farmers' Bloc" is well organized and has more development work done, and the pay streak for the "Tillers-of-the-Soil" is in sight, we shall have a full-fledged "Agricultural Engineer" on every farm, wearing khakis and puttees to feed the grunts and milk "Bossy," while the Congressmen from the mining districts are writing to their underground friends making excuses for another term.
>
> That thing from M. W. Y. about engineers "digging in" and stripping for action is over-ruled. W. I. Schmidt may go up one level toward the head of the class on his "Home Brew" caption. I believe the mining engineer received a home brew kick from Hoover going to Washington, and has been asleep ever since. Send "chiclets" parcel post.

Possibly there is more than a word of truth in this. Then, again, possibly not. Other titles suggested are: "The Engineer Returns from the Service," by W. F. R., Los Angeles, who says that this is prompted by the similar "positions" which ex-service men have found waiting for them; and "He Stoops To Conquer" by M. W. von Bernewitz, who wants his chiclets too.

The whirligig of time keeps giggling and the contest is rapidly drawing to a close. In an early issue the name of the winner of the valuable prize will be announced.

Phenomenal

At the meeting of the Mining and Metallurgical Society of America recently, Sir John Cadman told a story of two countrymen, one of whom was much puzzled over the word "phenomena," which he had recently heard for the first time. The other volunteered as follows: "Do 'ee see that cow, John? Now that's no phenomena. Do 'ee see that thistle? That's no phenomena. Do 'ee see that lark? That's no phenomena. But if that cow should sit on that thistle and sing like that lark, that would be a phenomena." Sir John was a bit frank in acknowledging that the British government was a majority owner in the Anglo-Persian Oil Co. Then he skated out over thin ice when he said that the majority ownership carried with it no voice in the management. Having the countrymen in mind, we are tempted to say: "Sir John, the British government and the Anglo-Persian Oil Co. are not phenomena. Owning a majority of the stock in a company is also not a phenomenon. The possession or lack of a voice in a company's management is likewise not a phenomenon. But for the British government to be a majority owner in the Anglo-Persian Oil Co. and have no voice in its management—that, Sir John, is indeed a phenomenon."

The Harvard Handicap

At the Harvard Club, at one of the writing desks, we noticed where a perplexed letter writer had scribbled on a pad, one under the other, the versions "recieve" and "receive." Which shows the advantage of a Harvard training. After looking over the exhibit a while we had no further ideas as to which was wright.

CONSULTATION

Separating Platinum From Sand

"Can you tell me briefly the most economical practice of separating platinum from black sand, whether by Wilfley table, dry concentration, oil flotation or other means? Or can you tell me where I can obtain this information if you do not have it at hand?"

A great deal of mystery has surrounded the problem of recovering gold and platinum from so-called "black sand." Many believe that the precious metals therein contained are not in a form which can be determined by ordinary methods and that vast riches await the man with the proper process for their recovery. The gold and platinum really occur in fine thin scales, which can be assayed readily, but which, by their nature, are somewhat difficult to concentrate. The process generally used is some form of sluice box, shaking or bumping table, classifier, or special device invented for the purpose. Chemical means have also been used, but such methods are in the minority and are generally practiced in conjunction with gravity concentration.

As platinum does not readily amalgamate, the use of mercury is usually ineffectual in any separation process. The general procedure is to save all the heavy black-sand concentrate accumulating from placer mining or dredging operations and at stated intervals treat it for its platinum content. It has been the practice for some hydraulic miners to discard the black sand as valueless, but owing to the high prices of platinum prevailing during the last few years, attention has been directed from time to time to a recovery of the precious metal. Although the black sand usually contains most of the platinum, part of the metal may be recovered in the main operations with the amalgam.

The familiar Western long tom, a trough-shaped gold-washing device, may be used to handle the black sand, the platinum being recovered by panning the long-tom concentrate several times. Logan, in "Platinum and Allied Metals in California," from which the following details of practice have been taken, describes the procedure at Oroville, where the Natomas Consolidated black-sand concentrate and amalgam is collected in a box and run through a long tom until it is reduced to one-half a small bucketful. The long tom used is 1 ft. wide and 12 ft. long, and rests on the gold tables so that it has a grade of one inch to a foot. The upper 4 ft. of the long tom is covered with small iron riffles in solid sections 1 ft. long, the cross riffles being an inch apart and sloping back. The bottom is lined with coco matting under expanded metal.

From the long tom the concentrate is taken to the clean-up room. The bulk of the amalgam is separated easily and retorted. The black sand, containing platinum, a small amount of amalgam and rusty gold, is washed several times in a miniature long tom and the bulk reduced to about one pint, which contains the gold and platinum-group metal. The surplus quicksilver is drawn off and the concentrate subjected to a boiling motion imparted by pouring it back and forth between two ordinary crockery bowls to remove nearly all the black sand. Concentrated nitric acid is applied to remove any base metal and to brighten the rusty gold so that it will amalgamate. The platinum can finally be cleaned by magnet and blower.

The platinum in the Oroville district is generally fine as flakes or grains. Logan states that the best results are probably not obtained where panning and the long toms are used. Dredging superintendents generally are satisfied with any results which approximate the usual yield of platinum, reasoning that the platinum is in such small quantity at best that more careful work is not justified.

Yuba Consolidated Goldfields employs a different method of recovery. Each dredge supplies about three tons of concentrate per week, and a total of sixty to seventy tons of this product is treated monthly. The sand handled is the black sand from the long toms, one of which is used on each dredge to recover as much gold and platinum as can be got in a rich concentrate of small bulk. The sand is ground in batches for two hours in a steel ball mill with a weak cyanide solution to brighten the rusty gold. The slime is then discharged into a well, from which it is pumped into a small settling tank and subjected to cyanide treatment in a miniature plant housed in the same building. Leading from the ball mill is a string of sluices 40 ft. long and 1 ft. wide, with a grade of one inch to the foot, which contain a mercury trap, 2 ft. of silverized amalgamating plate, 3 ft. of iron cross riffles such as are used in long toms, 5 ft. of coco matting, and 8 ft. of wooden riffles loaded with mercury, the remainder of the sluice being covered with coco matting under expanded metal. After the slime has been drawn off, the mill is allowed to run open and the sand discharges into the sluice. About $40 per ton in gold and platinum is recovered. The gold extraction is nearly perfect.

The Marysville Dredging Co., after recovering the hard amalgam in a long tom, sacks the black sand and transfers it to a clean-up room, where it is run through a long tom 12 ft. long fitted with iron riffles. The sand is then rocked in a common rocker. A 3-ft. arrastre is next used to grind the sand in small portions. A little sulphuric acid is used to brighten the rusty gold, most of which is caught in the arrastre. The sand is finally washed through a Colorado amalgamator and the rocker and arrastre concentrate panned several times.

In the Natoma district, according to Logan, "It is stated that the Neill jigs do not save any platinum, although successful in gold saving." Senn pan-motion bateas are used for the final recovery. Small Hardinge mills grind the sand, and the sand passes from the mills onto an amalgamated plate 2 ft. wide and 10 ft. long and thence to the Senn machine operated at 160 r.p.m. The concentrate yielded is 10 to 30 per cent black sand, the gold is practically all amalgamated on the batea, and the platinum caught in the bowl at the center. In finally separating the platinum the batea concentrate is screened, as it has been found to be much easier to get the platinum from sand of its own screen size than from sand of all sizes. Some sand stops on a 40-mesh screen; some of the platinum and sand grains are fine enough to pass 100 mesh. The material entering the Hardinge mill carries about $75 per ton in metals, and the tailing from the batea assays about $1 gold and $1 platinum.

Other methods also are practiced. A submerged table as the chief concentrating unit in the Huelsdonk Submerged Table Concentrator is used successfully at the La Grange mine. It is a compact unit that can be adapted to small operations.

We do not know of any operation employing dry concentration, oil flotation, or the Wilfley table as such.

HANDY KNOWLEDGE

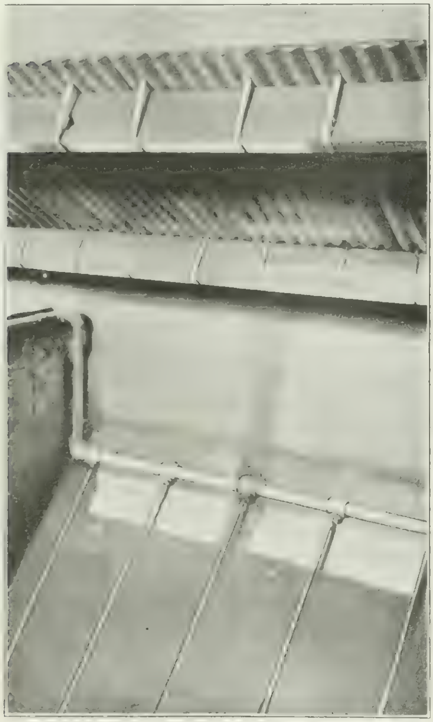
Discharge Device for Fine Ore Bins

By H. H. Hunner

Written for Engineering and Mining Journal

The ore pocket in which the method for discharging fine ore here described is used was built with a bottom slope of 45 deg. The bins are about 16 ft. long on the slope and 10 ft. wide, with no partitions between bins. The bottoms are of steel plate. The bins are filled to a level about 2 ft. above the top of the slope plate.

When the bins were new the ore slid out without much labor on the part of the two loaders. As the plates became rough and rusty, the ore hung up and it took considerable time and labor to clean the sheets. If a bin was cleaned down to the plate daily for a week it would become smooth and the ore would slide freely. As the tonnage requirements were intermittent, and cleaning a bin down to the sheet entailed considerable extra time and labor, this was seldom done. The result was that a third of the capacity was inactive.



ARRANGEMENT OF PIPING FOR DISCHARGING FINE ORE FROM BINS

As a rule only about one-third of a full bin would slide without use of blow hose and punch bars. The most effective aid was a $\frac{1}{2}$-in. pipe connected to a jack-hammer hose using air at 90-lb. pressure.

Winter conditions were much worse than those in summer, and snow and freezing weather, together with the moist fine ore, gave a great deal of trouble. The building was fitted for steam heat under the fine-ore bins, but this did not suffice during the coldest days.

The accompanying cut shows the method of air or steam piping used to discharge the bins. The main line is of 2-in. pipe and is laid down the center of the building conveniently near the runway. From this branch off lines $1\frac{1}{4}$ in. in diameter, which are tied to the cross braces between bins and run from the main line to the side walls and down to the headers as shown. The bottom pipes are $\frac{1}{2}$ in. in diameter and are plugged at the lower end and drilled with a row of $\frac{1}{8}$-in. holes every 16 in. The $\frac{1}{2}$-in. pipes are spaced 16 in. apart and are bolted to the bottom sheet with three U-shaped clips of $\frac{1}{2}$-in. round holes, all facing down.

Steam coils below the bins are no longer used, but whenever ore is frozen to the sheet, steam is first run into the blow lines for fifteen minutes or longer and followed by air at 90 lb. The air blast quickly sweeps down the pocket if the ore is not frozen.

As will be noted, the upper portion of the $\frac{1}{2}$-in. pipes does not lie directly on the bottom plate, so that they are subject to considerable vibration as the ore from the transfer car falls onto them. Three bins have been in use for over a year, and the expense from broken or twisted pipe has been small.

A Compressed-Air Paint Gun

By W. R. Wade

Written for Engineering and Mining Journal

An effective paint or whitewash gun can be made from pipe fittings. The one shown in the cut is in almost daily use and will put on as much paint in a day as a dozen men by hand. Such a gun will whitewash a large shaft station in an hour. It will suck vertically a heavy mixture of red lead and oil at least 6 ft. and will paint ceilings 4 to 6 ft. above the reach of the operator. By adjusting the paint valve the coat may be put on thick or thin. It has been found desirable to thin all paints with plenty of gasoline. By proper thinning the gun will cover as much surface per gallon as brush work will. The air consumption of the gun shown is 18 cu.ft. of free air per minute, when operated with 80 lb. pressure.

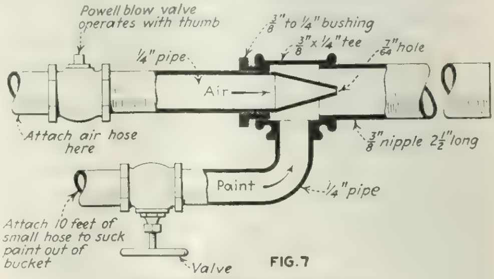

Powell blow valve operates with thumb
$\frac{3}{8}$" to $\frac{1}{4}$" bushing
$\frac{1}{4}$" pipe
$\frac{3}{8}$" x $\frac{1}{4}$" tee
$\frac{7}{64}$" hole
Air
Attach air hose here
$\frac{3}{8}$" nipple $2\frac{1}{2}$" long
Paint
$\frac{1}{4}$" pipe
Attach 10 feet of small hose to suck paint out of bucket
Valve

FIG. 7

COMPRESSED-AIR PAINT GUN

THE PETROLEUM INDUSTRY

Greatest Petroleum Producing Year in U. S. Was 1921

Production of petroleum in the United States in 1921, as indicated by the quantity transported from producing properties compiled from company reports to the U. S. Geological Survey, amounted to 469,639,000 bbl., representing an estimated value at the wells of $753,300,000. These figures will be increased somewhat by the quantity of petroleum consumed for fuel on the leases and by the net change in storage held on producing properties at the beginning and end of the year, when results of a canvass of the many thousand producers become available. This is the greatest quantity ever produced in the United States in any one year, representing an increase of 26,237,000 bbl. over the production of 1920, and is more than double the quantity produced in the United States in 1912. World's production figures for 1921 are not yet known, but preliminary estimates indicate a total not far from 750,000,000 bbl., as compared with 695,000,000 bbl. produced in 1920.

Imports of crude oil into the United States during 1921 amounted to 125,307,000 bbl., as compared with 106,175,000 bbl. in 1920 and with 52,822,000 bbl. in 1919, these figures corresponding respectively to 27, 24 and 14 per cent of the domestic production of the last three years. Exports of crude oil during 1921 amounted to 8,940,000 bbl. and during 1920 to 8,757,000 bbl.

Estimated consumption (deliveries to consumers) of domestic and imported crude oil during 1921 amounted to 525,407,000 bbl., as compared with 530,474,000 bbl. in 1920. Consumption for the year just ended therefore amounted to 55,768,000 bbl. more than the country produced.

Stocks of crude oil increased 60,599,000 bbl. during the year, as follows: Net pipe-line and tank-farm stocks east of California, 42,142,000 bbl.; gross pipe-line and tank-farm and producers' stocks in California, 12,359,000 bbl., and stocks of Mexican petroleum held in the United States by importers, 6,098,000 bbl. On Dec. 31, 1921, stocks of crude oil, exclusive of lease storage and of stocks at refineries, amounted to 183,890,000 bbl., equivalent to 119.3 days' supply at the current rate of consumption. On the last day of 1920 similar stocks amounted to 123,291,000 bbl., equivalent to eighty days' supply.

The year opened with record prices—$6.10 per bbl. at the wells for Pennsylvania grade and $3.50 per bbl. for Oklahoma-Kansas grade, which had held for several months despite rapidly increasing stocks. Soon after the beginning of the year, however, prices began to fall, and within a few months Pennsylvania grade had declined to $2.25 per bbl. and Oklahoma-Kansas grade to $1 per bbl. These low prices held until the rate of rapidly increasing stocks eased off somewhat in September and October, and the year closed with Pennsylvania grade at $4 and Oklahoma-Kansas grade at $2 per bbl.

Low prices were reflected in a marked curtailment of field activity, and 15,012 producing oil wells are reported to have been completed during 1921, as contrasted with 24,222 in 1920. Despite this fact, however, a number of important new pools were opened up, among which were Haynesville, La.; El Dorado, Ark.; Burbank, Okla., and Pierce Junction and Mexia, Tex., and extensive new developments were made in the Elk Hills and at Huntington Beach, Cal. The labor strike in the oil fields of California cut down the production of that state, which nevertheless produced a record output of approximately 114,000,000 bbl. Oklahoma also established a new record, for almost 114,000,000 bbl. was reported as removed from producing properties. The relative standing of the two states cannot be established until the final figures are received. Texas also produced more than 100,000,000 bbl., and in De-

PETROLEUM PRODUCED IN THE UNITED STATES IN NOVEMBER, 1921, DECEMBER, 1921, AND DECEMBER, 1920.

Barrels of 42 U. S. Gallons

State	November, 1921 (a)		December, 1921		December, 1920	
	Total	Daily Average	Total	Daily Average	Total	Daily Average
Central and Northern Texas	5,908,000	196,933	7,478,000	241,226	6,749,000	217,710
Coastal Texas	2,813,000	93,767	2,635,000	85,000	2,517,000	81,193
California (b)	8,804,000	293,467	10,092,000	325,548	10,038,000	323,806
Oklahoma	9,374,000	312,467	9,715,000	313,387	8,742,000	282,000
Kansas	2,726,000	90,866	2,717,000	87,645	3,044,000	98,194
Northern Louisiana	1,757,000	58,567	2,316,000	74,710	2,434,000	78,516
Coastal Louisiana	115,000	3,833	120,000	3,871	164,000	5,290
Wyoming						
Salt Creek	1,049,000	34,967	1,503,000	48,484	827,000	26,677
Big Muddy	132,000	4,400	128,000	4,129	158,000	5,097
Rock Creek	89,000	2,967	96,000	3,097	191,000	6,161
Grass Creek	94,000	3,133	95,000	3,065	124,000	4,000
Elk Basin	36,000	1,200	44,000	1,419	69,000	2,226
Other districts	104,400	3,480	70,000	2,258	55,000	1,774
Total Wyoming	1,504,400	50,147	1,936,000	62,452	1,424,000	45,935
Arkansas (c)	1,250,000	41,667	1,200,000	38,710		
Illinois	837,000	27,900	809,000	26,096	840,000	27,097
Kentucky	717,800	23,926	762,400	24,594	740,000	23,871
West Virginia	607,000	20,233	674,000	21,742	748,000	24,129
Pennsylvania	594,000	19,800	590,000	19,032	624,400	20,143
Central and Eastern Ohio	409,000	13,634	414,000	13,355	466,000	15,032
Northwestern Ohio	157,000	5,233	173,000	5,581	172,000	5,549
Montana	143,000	4,766	149,000	4,806	86,000	2,774
Southwestern Indiana	70,000	2,333	68,000	2,194	61,000	1,968
Northeastern Indiana	16,000	534	20,000	645	23,000	742
New York	68,000	2,267	80,000	2,581	79,000	2,548
Colorado	8,600	287	8,000	258	9,000	290
Tennessee	1,200	40	600	19	600	19
Totals	37,880,000	1,262,667	41,957,000	1,353,452	38,961,000	1,256,806

(a) Revised. (b) Average of figures reported by Standard Oil and Independent Oil Producers' Agency. (c) Estimated in part.

center, as a result of developments at Mexia, ranked first among the producing states.

The new year began with production, imports, and stocks the greatest on record, and with consumption not much below its peak but yet insufficient to prevent a continuous addition to stocks.

The figures in the table on page 253, from company reports to the U. S. Geological Survey, show the quantity of petroleum transported from producing properties. Oil consumed on the leases is not included. This item and net changes in producers' stocks at the beginning and end of the year are obtained by annual canvass and are included in the final statistics of production.

Geological Survey Condemns Waste in Oil Drilling

The attitude of the U. S. Geological Survey toward waste in oil-drilling operations is set forth in a letter sent by Director George Otis Smith to certain oil operators. The letter follows:

"With reference to the sample from your well, recently received at the U. S. Geological Survey: This sample, coming from a depth of 3,000 ft., is composed essentially of quartz, orthoclase, microcline, biotite, apatite, sericite, zircon, calcite, and very minor amounts of other minerals. These constituents must come from a granitic rock.

"I note from previous correspondence regarding this well that you first encountered granite at about 1,400 ft.; that you were informed that you had encountered granite; and, furthermore, that the Survey pointed out to you that deepening the hole after granite was encountered was merely a waste of money.

"This was on May 9 last, and again on Aug. 20 and on Sept. 17, the same identification of the crystalline rock from deeper levels was made and the same good advice offered. It appears that in spite of this information you have persisted in drilling through 1,600 ft. of the hardest rocks you could find in the state, in which there is not the slightest possibility of the presence of any appreciable amount of petroleum.

"If, in this venture, you have been following the advice of a geologist, you have been duped by an ignoramus or a crook; if you have opposed your own judgment to that of expert petrographers and geologists in such a matter as the identification of a granitic rock and the known impossibility of oil occurring in quantity in rock of that type, you are to be pitied. In either event, it is to be hoped that you have wasted the money of no one but yourself, but in reality the general public has lost the money you have thus wasted."

Colorado Oil-Shale Analyses

At the Boulder laboratory of the U. S. Bureau of Mines, work on the elementary analyses of oil shale is being continued with the standard Colorado shale. Some work was recently done with a sample of rich oil shale obtained from the southern side of the Grand Valley, Colorado. In connection with this study many tests are being made with the small assay retorts. The bench of assay retorts has been somewhat remodeled, equipment being installed which insures more definite control of retorting conditions. In all future runs with these retorts the permanent gases will be scrubbed and the amount of scrubber naphtha estimated. Gas samples from each series of runs will also be taken in an attempt to correlate the results of assay retorting tests with the elementary analyses of the shales. The value of the assay retorts has again been shown in that the [illegible] oil thus far produced from the standard Colorado shales has been made with these retorts.

Possible Indications of Oil in Mississippi

Observations made by the U. S. Geological Survey and the Mississippi State Geological Survey in the vicinity of Yazoo City, Miss., have thrown new light on the question of the possible presence of oil in Mississippi and on the location of points that may be favorable for test drilling. No anticline or dome was mapped, and it is uncertain whether the facts noted afford adequate ground for the location of the axis or highest point of a fold in the strata, for the region is thickly covered with loess, bedrock is exposed at only a few localities, and the identity of the beds as seen from place to place is not certain.

However, it is held that folding appears to be indicated by the reversal of dips of Eocene beds in the basin of Tesheva Creek near Free Run, an abandoned post office about ten miles in an air line northeast of Yazoo City. The reverse dips, which appear to amount to 40 or 50 ft. to the mile, are shown by lignite seams belonging to the Yegua formation, the uppermost formation of the Claiborne group, and by associated irregularly bedded, poorly exposed sands and clays, along several small tributaries of Tesheva Creek east and northeast of Free Run.

Owing to the thick covering of loess in the vicinity of Free Run, the geologic structure cannot be mapped from surface observations, but the apparent dip of the strata indicates that the crest of the fold lies probably within a mile or two miles southwest or south of the ravines in which the lignite seams were noted. The succession of beds to be drilled through would probably be similar to that penetrated at Jackson, Miss., where two test wells, respectively 3,043 ft. and 3,079 ft. deep, were drilled. These wells penetrated a succession of clays and sands and toward the bottom several hundred feet of chalk. According to the interpretations placed upon their logs, they are supposed to have penetrated all the Tertiary formations below the Jackson formation and part of the underlying Upper Cretaceous beds and were abandoned before they passed through the Selma chalk. They failed, therefore, to test the sands of the Eutaw and Tuscaloosa formations, which underlie the Selma chalk.

Although neither the thickness nor the geological character of the deeply buried Tertiary and Cretaceous strata in the vicinity of Free Run are known, the section there doubtless does not differ greatly from that at Jackson, and if this assumption is true, a 4,000-ft. well would probably be deep enough to test all of the Eocene section and most of the Upper Cretaceous section, including the sands of the Eutaw and Tuscaloosa formations.

Oil has not yet been found in commercial quantities in the Coastal Plain of either Mississippi or Alabama, although a number of wells have been drilled there on pronounced anticlines; and their failure to obtain oil discourages optimism concerning the presence of oil in the Coastal Plain of Mississippi. Showings of both oil and gas, however, have been reported in this region, and it is by no means certain that even the folds which have been drilled are in fact adequately tested. It may therefore be justifiable to prospect at places in Mississippi where good anticlinal structure occurs, although the risk of failure in such operations is admittedly high.

Book Reviews

SEVERAL BOOKS have reached us recently; possibly owing to the fact that things have been so slack in the mining industries that technical men have found time to put some of their knowledge in permanent form. We hope soon to review "Mineral Land Surveying," by James T. Underhill; DeWolf and Larison's "American Sulphuric Acid Practice"; a fourth edition of Ketchum's "Steel Mill Buildings"; "Sketches of Butte," by George Wesley Davis; a third edition of Dana's "Textbook of Mineralogy," revised by Prof. William E. Ford, of Yale; and a third edition of "Determinative Mineralogy," by Professor Lewis, of Rutgers, one of our consulting editors. The field of mineralogy has certainly not been neglected in the last few years.

USUALLY we confine this page to technical publications, but we cannot refrain from quoting from an advertisement in a recent number of *Life*: "Michelin has produced a regular size 32 x 3½ cord tire that costs only 5 per cent more than good fabrics, but gives 30 per cent more mileage, thus reducing tire bills 25 per cent." Now, either arithmetic has become a disgustingly simple subject since Miss Galusha tried to teach it to us at the Cortland Central school in 1901, or else there is, or ought to be, an opening for a good consulting mathematical engineer with the Michelin company. Some of our little group of serious thinkers who are out of a job might apply.

WE HAVE just glanced over one book which will not be found on any of the technical lists, but which many of our readers will buy nevertheless. We refer to the World Almanac for 1922. This is an encyclopedia of statistical information and data on hundreds of interesting and varied subjects, and, with its 858 pages is perhaps the biggest money's worth on the market today. It is published by the New York *World* at 50c., postpaid, for the paper-bound edition, and 90c. for that bound in cloth. Incidentally the *World* has improved in recent years, in our opinion, and now deserves ranking, with the *Times* and *Tribune*, as one of New York's best three newspapers.

Earth Evolution and Its Facial Expression. By William Herbert Hobbs. Cloth, 6 x 9½; pp. 178; figs. 89. The Macmillan Company, New York. Price, $3.

This unusual type of book exploits three outstanding conceptions: the explanation of a metallic earth core, this explanation so framed as to be in harmony with the planetesimal hypothesis, or the theory of the origin of the earth by the building up by gravitational attraction from a vast number of meteorites; the theory that all igneous rocks are derived from the fusion of [illegible] under certain conditions, such as at the axes of anticlinal folds; and the explanation of the arcs or festoons of mountains and of volcanoes, which in part manifest themselves as islands, and which, for example, surround the Pacific, as due to the thrust from the oceans toward the land masses. Much interesting discussion, clever argument, and erudite reference make these demonstrations attractive. The net result on the mind of the thoughtful reviewer, however, is that a clear and scientific imagination takes too little heed of the safe anchorage of facts; that we have here an example of the danger and disaster resulting from the deductive method of scientific investigation, which postulates a theory and deduces the phenomena which are the logical results of the theory, and then endeavors to marshal the actual natural phenomena as coincident and identical, falling into the danger of mentally forcing them to fit, through already-formed prejudice.

A striking and sufficient example is the theory of the origin of all igneous rocks from the fusion of shales. The observations of experienced field geologists will at once inform them that this theory is beyond peradventure wrong — the mere fact of the presence in the pre-Cambrian complex in many places of intrusive rocks of periods as recent as the Tertiary forbids the otherwise totally unjustifiable speculation. Professor Hobbs finds that the analyses of shale are very similar to those of igneous rocks, and therein thinks to have found some demonstration of the origin of the latter from the former; yet we know, and Professor Hobbs will admit, that the shales have been derived from the destruction of rocks, chiefly igneous rocks, from which follows the noted similarity of comparison. But mere geological facts do not dampen Professor Hobbs' vital imagination. For example, he does not wish the pre-Cambrian granite of Colorado to be pre-Cambrian; and, presto, by a wave of the wand in the hand of this library-geologist, it is no longer pre-Cambrian (page 59). A single trip to Colorado, or a perusal of the literature, would have supplied him with a thousand proofs; but he will none of it.

Examples like this show how idle it is to examine carefully every theory in the volume. To the reviewer, Professor Hobbs' explanation of the origin of the differences in the earth's composition by a change in the character of the meteorites garnered by the growing nucleus of the earth seems highly fanciful; but as there are no facts available, the whole discussion is in the unsubstantial realm of imaginings.

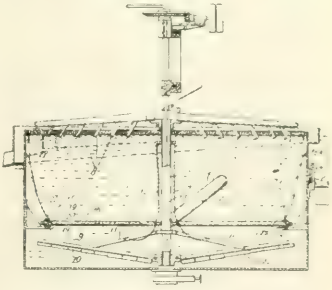
While rejecting the Kant-Laplace nebular hypothesis of the earth's origin by condensation and progressive cooling from a nebulous and heated condition, Professor Hobbs does embrace the theory of the progressive shrinking of the earth, and collapsing of the earth's surface, which was put forward by Suess as in harmony with the nebular hypothesis. J. E. S.

Recent Patents

Slag Granulation — No. [illegible] Friedrich Riedel, Duisburg, Germany, assignor to The Chemical Foundation. A device for blowing air or other gas against a falling stream of slag from a launder, a cooling wall being provided against which the slag particles, so broken up, are forced. The granulated slag escapes through a delivery chute at the bottom.

Reducing Ores—No. 1,403,576. Alfred Stansfield, Montreal, Que., Canada. The process of reducing ores to the metallic state without fusion, consisting in mixing the pulverizing ore with carbonaceous material, partly reducing the mixture first in a muffle furnace at a temperature not exceeding 800 deg. C., and then completing the reduction in a furnace without a muffle, in which a reducing or non-oxidizing flame is maintained at a higher temperature, the gases from the second furnace supplying the heat to the flame tube of the muffle furnace.

Flotation Apparatus—No. 1,398,394. H. R. Robbins, Manchester, N. H. The illustration best depicts the idea embodied in this patent. The flotation air is introduced about one-third the distance from the bottom of the tank, and the froth is skimmed off by rabbles at the surface.



Molybdenum Extraction—No. 1,403,477. F. M. Becket and J. A. Holladay, Niagara Falls, N. Y., assignors to Electro Metallurgical Co., Niagara Falls, N. Y. Molybdenum-bearing ore or concentrate is leached with an alkaline sodium compound, and the molybdenum afterward precipitated as calcium molybdate. The impurities remain in the gangue, which may subsequently be smelted.

Slag Casting—No. 1,402,363. W. T. Hurst, Pittsburgh, Pa., assignor to Slag Rock Machine Co., Pittsburgh, Pa. Molten slag is poured in shallow water-cooled molds, and as soon as the surface has solidified, the entire mass is quickly cooled with water, thus producing a dense hard slag.

Casing-Pulling Apparatus — No. 1,398,822. J. H. Wilson, Burkburnett, Tex. An apparatus for withdrawing oil-well casings.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Bureau of Mines and Forest Service Investigate Decay of Mine Timbers

Chemical Treatment of Wood Cuts Operating Costs and Decreases Heat and Vitiation of Air in Working Places

The annual underground consumption of timber by the mining industry of the United States amounts to 293,365,000 cu.ft., according to an estimate just made by the U. S. Bureau of Mines. Of this amount, 151,140,000 cu.ft. are used in the bituminous coal industry; 61,600,000 cu.ft. in anthracite mines; 31,500,000 cu.ft. in iron-ore mines; and 49,125,000 cu.ft. in mines producing other ores. The increase in the annual timber consumption in mines since 1905 amounts to nearly 46 per cent.

A serious problem now confronting the mine operator in the important coal- and metal-mining regions in both the East and West is the noticeable decrease in the supply and quality of the timber in many mining regions, coupled with marked increase in cost, declares the Bureau.

The consumption of round timber in the Lake Superior iron mines has increased from slightly more than 12,000,000 cu.ft. in 1905 to 27,500,000 cu.ft. in 1920, or two and a quarter times. During the same period the average cost rose from 5c. per cu.ft. to 24c. per cu.ft., or nearly five times.

Throughout nearly all the metal-mining districts of the West, the consumption and cost of mine timber has materially increased in the last decade. Likewise, the more durable varieties of timber are becoming scarcer and the source more remote from points of consumption, and consequently in many localities the less durable varieties must now be used. It is obvious that one of the rapidly increasing items of expense in mining operations is the cost of timber, leaving out of consideration the labor cost of installation.

Mine timbers are destroyed by four principal agents—decay, insects, fire, and mechanical abrasion. In general, more than 50 per cent of the timber used in the mines is destroyed by decay and insect attack, but perhaps not to exceed 15 per cent of the total is subject to replacement—that is, where the working place will be kept open longer than the natural life of the timber.

The most effective means of timber conservation is by treating the timber, to prevent decay, with some standard preservative before it is placed in the mine. It is needless to point out that only those timbers should be treated that will be used in working places which are to be maintained for a period of years sufficiently in excess of the natural life of the timber to warrant the use of treated timber. Neither should treated timber be used in places where it would be subject to destruction by crushing rather than by decay.

The Bureau of Mines, in co-operation with the U. S. Forest Service, has recently undertaken a systematic investigation of the decay of mine timbers, and its causes and prevention. The Bureau's observations to date have led to the conclusion that not only may important savings in the cost of operation be realized by the use of treated timber, but also that the prevention of mine-timber decay will remove one of the principal sources of heat and vitiation of mine air.

Colorado Section, A.I.M.E., Elects Officers

Colorado Section of the American Institute of Mining and Metallurgical Engineers held its annual meeting at the Albany Hotel, in Denver, on Saturday evening, Feb. 4. Robert Hursh was elected chairman, Dr. J. C. Roberts, vice-chairman, and Horace F. Lunt, secretary-treasurer. Max Ball and Charles N. Bell were elected members of the executive committee.

At the conclusion of the business meeting and dinner, Mr. Hursh, the manager of the Empire Zinc Co., spoke on "The Application of Zinc to Modern Industry."

Dredge Operators of California Meet in Oakland

On Jan. 27, the dredge operators of California were guests of the American Rubber Co. at a luncheon given at the Hotel Oakland, Oakland, Cal. About forty were present, and in place of the usual papers, everyone adjourned at the conclusion of the luncheon to the Emeryville plant of the American Rubber Co.

Gold dredges require rubber conveyor belts, belting, and hose, and the dredge operators were consequently greatly interested in the process of manufacturing them. The preparation of the rubber was shown, and then the process of coating a large conveyor belt, with its outer layer of rubber, was demonstrated. Another large conveyor belt was shown in the vulcanizing or seasoning process. The manufacture of ordinary hose and fire hose was next inspected. The weaving of the cotton jacket used for fire hose elicited much interest and also the details of drawing the rubber lining into the outer jacket and the forcing of it into place by internal pressure.

Oregon Section, A.I.M.E., Favors Revision of Mining Law

In Accord With General Principles of H.R. 7736, With Reservations Respecting Technical Procedure in Making Locations

The Oregon Section of the A.I.M.E. held an annual meeting and election of officers at the School of Mines, Oregon State Agricultural College, on Jan. 21. H. M. Parks was re-elected chairman, and P. R. Hines was elected secretary.

The principal subject of discussion at the meeting was the provisions of the proposed new mining law. The section declared by resolution that it is in favor of a revision of the statute but believes that provision should be made for acquiring mineral rights on such withdrawals of public land as would not be injuriously affected thereby, this suggestion being offered by Mr. Woodward, a mineral examiner for the U. S. Forest Service. The section also indorsed numerous other changes in the bill as originally drafted.

F.A.E.S. Appoints Licensing Committee

The Federated American Engineering Societies has appointed a new committee on registration of engineers. The personnel of the committee is as follows: A. S. Dwight (chairman), of New York; Gardiner S. Williams, of Ann Arbor, and Philip N. Moore, of St. Louis.

A new Federal water-power committee has also been named. John H. Finney, of Washington, is the chairman. Other members are Calvert Townley, of New York; G. S. Williams, of Ann Arbor; Gano Dunn, of New York, and A. P. Davis, of Washington.

Southwestern Division, A.A.A.S., Meets at Tucson

At the second annual meeting of the Southwestern Division of the American Association for the Advancement of Science, held at Tucson, Ariz., Jan. 26 to 28 inclusive, eight technical papers were presented by the members of the faculty of the University of Arizona.

Arthur L. Flagg, of Phoenix, Ariz., presented a paper on the "Sources of Radium," this contribution being offered in conjunction with a paper on "Radium: Its Action on Human Tissue Cells," by Dr. W. W. Watkins, who is also a resident of Phoenix.

MEN YOU SHOULD KNOW ABOUT

George H. Garrey has gone to Tonopah, Nev.

D. E. Sutherland has gone to Palm Beach, Fla., for a month's vacation.

J. P. Gordon was in New York last week, en route for northern Manitoba.

B. Prescott is making geological examinations in the Sierra Mojada district, Mexico.

John A. Fulton, manager of the Idaho-Maryland Mines Co., was recently in San Francisco.

John Knox, superintendent of the Calumet & Hecla Mining Co., has gone to Havana, Cuba, on a vacation trip.

J. H. McLean, general manager of the Oliver Iron Mining Co., Duluth, Minn., recently made a business trip to Chicago.

W. D. Jenkin resigned as foreman of the West End Consolidated Mining Co. on Jan. 15. He was succeeded by **Martin Evensen.**

Charles E. Bunnell, president of the Alaska School of Mines, is in Washington conferring with officials of the Interior Department.

Harold A. Linke has returned to Salt Lake City from Hidalgo, Mexico, to resume private practice, with an office in the Dooly Building.

F. W. Paine, of Boston, secretary-treasurer of the Copper Range Co., is in the Lake copper district on a visit to the company's properties.

Bulkeley Wells left Denver on Feb. 1, for the San Francisco office of the Metals Exploration Co., where he will remain for the next thirty days.

Frank M. Smith, smelter director of the Bunker Hill & Sullivan M. & C. Co., has returned to Spokane after an extended visit to the Eastern states.

A. G. Wood, hydraulic engineer for the Oliver Iron Mining Co., Duluth, Minn., has resigned and has accepted a position with the Chile Exploration Co.

L. D. Gordon, president and general manager of the Round Mountain Mining Co., arrived at the property at Round Mountain from San Francisco, on Jan. 25.

H. B. Goodrich was elected chairman of the Tulsa section of the A.I.M.E. at a meeting held Jan. 27. **R. F. McFarland** was elected secretary and treasurer.

S. F. Shaw, manager of the Cia. Minera La Constancia, Sierra Mojada, Mexico, has also been appointed superintendent of the properties in the same district controlled by the Cia. Minera de Peñoles.

R. M. Wolvin, president of the British Empire Steel Corporation, has returned to Canada from a visit to England and Germany, where he had been negotiating for the sale of iron ore from the Wabana mines of Newfoundland.

Daniel Harrington, of Denver, supervising engineer of the U. S. Bureau of Mines, in charge of metal-mines ventilation investigation, is in the Michigan copper country, where ventilation tests are being conducted.

A. J. May, superintendent of the Tintic Standard mine, has resigned his position to take up professional work in the Tintic district. **James V. Wade**, who formerly operated the Scranton mine, in North Tintic, will succeed Mr. May as superintendent.

O. F. Riser, formerly superintendent of mills, and **H. M. Merry**, formerly chief engineer for the Chino Copper Co., Hurley, N. M., have established a mining and milling supply business at 111 Dooly Building, Salt Lake City, Utah, under the title of the Riser-Merry Co.

Dr. F. W. McNair, president of the Michigan College of Mines, recently was tendered a banquet by the alumni association of the college, at Hibbing, Minn. Dr. McNair made the principal address in the dedication of the Keewatin High School to the memory of Robert L. Downing, a late resident and mining engineer on the Mesabi Range.

William Kelly, of Vulcan, Mich., has been reappointed a member of the board of control of the Michigan College of Mines at Houghton. Mr. Kelly has been a member for more than twenty-five years and has presided as chairman the greater part of that time. He has also been appointed a director of the fifth district for the American Institute of Mining and Metallurgical Engineers.

A. G. MacGregor, of Warren, Ariz., has been appointed a member of the Arizona Resources Board by **Governor Thomas E. Campbell** and has gone to Washington to attend the Interior Department conferences relative to the disposition of the hydro-electric power and water storage on the Colorado River above and below the Grand Canyon.

Mining and metallurgical engineers visiting New York City last week included: **A. H. Means**, Chicago; **Eugene Lilly**, St. Paul, Minn.; **L. J. Griffiths**, Newcastle, N. S. W.; **John A. Dresser**, Montreal, Quebec; **E. H. Dickenson**, Philadelphia; **H. A. Kee**, Cobalt, Ontario; **Toner Antisell**, Rocky Mount, Va., and **Charles E. Lawrence**, Caspian, Mich.

SOCIETY MEETINGS ANNOUNCED

The twenty-fifth annual meeting of the **American Society for Testing Materials** will be held June 26 to July 1, at Atlantic City, N. J., with headquarters at Chalfonte-Haddon Hall Hotel.

The Northwest Mining Association will hold its twenty-seventh annual convention at Spokane on Feb. 14-18. Details of the program are nearing completion. A special effort is being made to make the mineral products display as comprehensive as possible. A feature of the convention will be the use of motion pictures showing various phases of mining operations in other fields. Many matters of vital moment to the industry are slated for discussion.

OBITUARY

Harry Frankel, president of the Frankel Connector Co., died on Feb. 3.

Robert E. Christiansen, former superintendent of the Bunker Hill mine, died recently in San Francisco.

James P. Cole died Jan. 30 at Globe, Ariz., at the age of eighty-four. Mr. Cole was a pioneer locator in Colorado.

William Arthur Bostwick, president of the International Nickel Co., died at his home in Bronxville, N. Y., on Feb. 4.

George Madeira, Sr., retired mining engineer and mineralogist, well known throughout California, died last week in San Francisco.

Hubbard Wilkins Reed, vice-president and general manager of the Utah Fire Clay Co., died Jan. 31 in Salt Lake City. Mr. Reed was seventy-two years old and had been general manager of the Revenue Tunnels mine at Ouray, Col., for thirty years.

Dr. Charles Baskerville, chemist and mineralogist, died on Jan. 28 in New York City. Dr. Baskerville was a graduate of the University of Mississippi and of the University of Virginia. In 1904, he was appointed professor of chemistry in the College of the City of New York, which position he held up to the time of his death. Dr. Baskerville belonged to a large number of scientific societies as a fellow or a member, and has published many valuable papers on zirconium, thorium, praeseodymium and other metals. He was the discoverer of the elements carolinium and berzelium.

R. W. Thomson, resident mining engineer in charge of the Central Mineral Survey district of British Columbia, died recently at Kamloops. Mr. Thomson was graduated from the Toronto University in 1893. From 1895 to 1907 he was employed in all departments of mining work in South Africa, progressing from a sampler to a mine manager. His South African experiences included service with the British in the Boer War. Coming to Canada in 1907, he was engaged for two years in operating and reporting upon properties in the Cobalt district and from 1909 to the time of his death he had been identified with the mining industry of British Columbia.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

Stockholders of the Hecla Mining Co. ratified the proposed Star deal, immediately following the dissolution of the temporary restraining order by the Spokane court.

Resumption at the Douglas smelters of the Phelps Dodge Corporation and the Calumet & Arizona company has been effected. Mining operations will start soon.

The outlook for mining in the Guanajuato district, Mexico, has greatly improved. The cost of machinery and supplies has lessened greatly, owing, it is said, principally to German competition.

Great activity in gold mining in the Oatman district of Arizona is reported. New discoveries of ore are said to have been made.

Work of rebuilding at Britannia Beach, B. C., has been started, contracts having been let for the various jobs.

Hecla Stockholders Ratify Star Mining Co. Deal

Court Dissolves Restraining Order—Testimony on Fraud or Negligence Expunged From Records

Stockholders of the Hecla Mining Co., of Wallace, Idaho, formally ratified the Star deal on Feb. 4, following the sudden ending of the Smith-Day injunction proceedings on Feb. 2, when Judge Huneke, upon motion of defendant's counsel, dissolved the temporary restraining order and expunged from the records all testimony as to fraud or negligence by the Hecla directors. It is understood that the plaintiffs will appeal to the Supreme Court on the [illegible] question only. Ratification of the arrangement by Hecla stockholders representing 70 per cent of the stock was unanimous. Mrs. Smith and Eugene Day were not present. The total cost of the litigation is reported as being about $200,000. President Bradley of the Bunker Hill & Sullivan has announced definite plans for proceeding with the construction at an early date of an electrolytic zinc plant at the Bunker Hill smelter.

Utah Consolidated Appeals to Supreme Court

The statement in *Engineering and Mining Journal* of Feb. 4, p. 217, under the heading "Utah Consolidated Gets New Trial" was incorrect. The facts are as follows:

The litigation between the Utah-Apex and Utah Consolidated mining companies, both of Bingham Canyon, Utah, consists of six suits; but, as the same fundamental question is involved in each, it was decided by mutual consent that the court should try two of the cases, decision on which would govern the rest.

The U. S. District Court, in October, 1920, decided five of the cases in favor of the Utah-Apex, and in one unimportant case the opinion of the court was that the Utah-Apex had not proved its contentions.

In the accounting stage of the case, which followed, the court awarded the Utah-Apex the sum of $1,154,928.98 besides costs. In the meantime, the Utah Consolidated appealed on one case (the Yampa) which governs three others; and on Nov. 14, 1921, the U. S. Circuit Court of Appeals confirmed the decision of the trial court. On Feb. 1 the Utah Consolidated filed a bond with the American Surety Co. of New York as surety for $1,300,000, covering damages and costs, this bond serving as a *supersedeas* on the Utah Consolidated's appeal to the Supreme Court in the Highland Boy case.

Suit Over Utah Copper Tailings To Be Appealed

Salt Lake County To Take Taxation Case to Higher Court

An appeal to the U. S. Circuit Court of Appeals will be taken by Salt Lake County, Utah, in the suit brought by the Utah Copper Co. to recover taxes aggregating $160,000, paid by the company under protest for the years 1917 and 1918. A final decision in favor of the Utah Copper Co. was handed down by Judge Tillman D. Johnson, of the U. S. District Court at Salt Lake City. The tax assessment was made by the county on tailings at the Magna and Arthur mills. The assessed valuation was $2,430,000 and the total tax each year was $80,000. The attitude of the court in a written decision overruling a demurrer filed by the county held that the tailings were still a part of the mine, regardless of the fact that they had been moved a distance of 20 miles to the mills, and that they could not be assessed by the county.

In the case of the South Utah Mines & Smelters against Beaver County last fall, in which the same point of law was involved, Judge Page Morris, of Duluth, who presided temporarily in the Federal Court at Salt Lake City, ruled the same as Judge Johnson, holding the tailings to be a part of the mine. In the latter case, however, the decision was in favor of Beaver County.

Copper Queen and C. & A. Smelters Resume

Phelps Dodge To Start Mining Ore March 1—Metal Production To Be Increased "Cautiously"

Three blast furnaces are being operated in the Phelps Dodge Corporation's Copper Queen smelter at Douglas, Ariz., and two reverberatories have been started at the Calumet & Arizona plant. Resumption of operations came almost unexpectedly Feb. 1, after a shutdown since last April. The Phelps Dodge furnaces are to be operated only until the stack and flues of the reverberatory furnace section can be repaired. The force of 250 men that has been busied in the plant on repair work has been increased to about 500. The furnaces at the Calumet & Arizona are expected to turn out about 3,250,000 lb. a month, with 320 men employed.

G. H. Dowell, speaking for the Phelps Dodge, and John C. Greenway, for the C. & A., emphasized the fact that a sufficient labor supply is to be found in this locality and that old employees will have the preference. It is assumed that wages will be cut, as copper is considered as being on a 14c. basis and the last wage scale was based on 18c. quotations. The bins are full at both smelters, where, it is understood, ore will not be needed for a month.

The Copper Queen has announced that ore production will be resumed March 1. There is to be a gradual increase in the mining force of the Calumet & Arizona. Colonel Greenway is credited with the observation that copper production in Arizona is to be resumed "cautiously."

American Valuation Plan Urged by Colorado Operators

The Colorado Metal Mining Association joined with Colorado manufacturers in presenting a memorial to the tariff conference of the National Association of Manufacturers, urging the Senate to accept the American valuation plan, as embodied in the Fordney tariff bill now before the Senate Committee.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Mexican Conditions More Stable, Says Commerce Department

Trade Increase Predicted — Large Quantities of Mining Machinery Recently Imported

Conditions in Mexico have improved so rapidly during recent months that the Department of Commerce is predicting a material increase in the trade between that republic and the United States. Mining activities particularly are responding to the more stable state of affairs. It is pointed out that any increase in mining activities in Mexico must call for material purchases of machinery in the United States. During the long period of instability, purchases of machinery have been confined to the most urgent requirements. Many properties have been idle for years, and extensive replacements and repairs must be made before operations can be resumed. The Department of Commerce points out that Mexico, for several months, has been absorbing important quantities of American machinery, and that though there are some difficulties in the matter of terms of payment, it appears that certain manufacturers are securing a considerable volume of business in that country on a satisfactory basis.

Unemployment Decreasing in Mining Centers

Reports to the United States Employment Service for January indicate that there is less unemployment in the principal mining centers. This is due largely to increased activity in the mines, although some of it is attributed to the absorption of mine workers by other activities. The telegraphic report from Butte is to the effect that copper mining and industries depending on it show a marked improvement. A gradual resumption of full-time operation is anticipated. Advices from Nevada are that gold and silver properties are now operating at practically the normal rate. It is pointed out, however, that this does not apply to copper and lead mines. Arizona reports increased employment in copper mining. Neither Colorado nor Utah expects any material bettering of the metal mining situation in the near future, to judge from opinions expressed.

So far as mining activities are concerned, the brightest indications come from the iron-ore producing districts. The official reports, as well as informal advices, indicate that plans are being laid for operations on an increasing scale.

Hearings on Mine Law Revision Deferred

Must Wait Until Government Fuel Yard Bill Is Disposed Of—May Come in March

It is probable the House Committee of Mines and Mining will not be able to take up for hearing the proposed mine revision bill until late in February or early March. The committee has been waiting on Secretary of Interior Fall for his views on the bill and consideration of the Government fuel yard bill also has tended to delay the hearings. It was stated at the committee meeting on Feb. 4 that the hearings would not be had until after the coal bill is disposed of, hearings on the latter being assigned for Feb. 15, with a possibility that they will be extended, owing to opposition of coal interests to the Government continuing in the fuel business in the National Capital.

Drawing Plans for Rolla Station

An architect now is making the plans for the building to house the mining experiment station at Rolla, Mo. The building will be unique in that zinc will be used in its construction wherever it is possible.

NEWS BY MINING DISTRICTS

London Letter

Electrolytic Zinc Co. Provides Further Capital—Bantjes Consolidated Quits—Diamond Mining in Brazil—The Situation on the Rand

BY W. A. DOMAN

London, Jan. 27—Apparently the Electrolytic Zinc Co. of Australasia has got to work in earnest. Early in December a cable dispatch was received in London from the head office, giving details of plant construction, and pointing out that half of it was already in operation. To the present generation the possibilities of the company seem almost unlimited. The chief operations of present interest are largely investigation and development work. Expenses naturally have been heavy and constructional costs have exceeded the original estimates, necessitating the provision of additional capital.

The announcement is now made that the directors have sold to E. L. & C. Baillieu, of Melbourne, who are acting on behalf of London and Australian interests, £400,000 of 8 per cent first mortgage debentures at 95 per 100. The debentures will run twenty years, and there will be issued option certificates giving the right until the end of next year to take up a similar number of preference shares. The scheme is not yet fully worked out, though it appears to be probable from the particulars available that ample funds will be forthcoming.

London takes a serious view of the strike position on the Rand. The decision to close down in order to place the industry on a sound basis was not made without careful consideration of what a tussle with the white miners involved. To date, approximately 30,000, or, say 16 per cent, of the natives have been repatriated. Those recruited in Beira object to leaving the mines. One question uppermost in the minds of investors has been whether the December half-yearly dividends will be paid, or whether the funds will be held for contingencies. On Jan. 26 the Central Mining & Investment Corporation and the Johannesburg Consolidated Investment Co. announced officially that the dividends would not be withheld. When it is remembered that before the war the "Houses" were straining every nerve to reduce working costs to 12s. 6d. a ton to bring under profitable treatment hundreds of millions of tons of rock at present waste, and it is now found that the average is double the hoped-for figure, an idea can be gained of the disappointment that has followed. The low costs per ton policy had its opponents as well as its adherents, and so long as there remains a chance of money being made by putting it forward as against the cost per ounce policy it will recur.

The Bantjes Consolidated Mines has thrown up the sponge. It has laid out large amounts in endeavoring to prove the property from the neighboring Consolidated Main Reef, and all to no purpose. Having given the matter full consideration, the directors are satisfied that there is no hope of discovering payable values. The mine itself was closed down at the end of 1918, and the expense of unwatering it to extract the ore reserves would not be warranted. A similar fate will befall some of the mines that are now filling with water as the result of the strike.

A short time ago the Mason & Barry directors were negotiating for the sale of the company's properties, and it was generally understood that the Portuguese syndicate which was reported to be negotiating would acquire the property, and that the purchase price would be more than £2 per share. It is now officially announced that the negotiations which have been in progress for five months have failed.

As I understand an attempt has been made to interest New York financiers in an alluvial diamond property on the Jequitinhonha River, Diamantina, Minas Geraes, Brazil, it is perhaps as well that I should draw attention to a statement which has been made by the managing director of the Cascalho Syndicate. The property to which I refer has been before the public in one way and another for some months, and according to C. S. Richardson, who is trying to get money for working it, is of even greater richness than the neighboring ground belonging to the Cascalho Syndicate. C. S. Richardson points out that the Cascalho Syndicate is treating gravel exceeding the $3.50 mark. According to a statement made by H. Stanhope Galloway, the managing director of the Cascalho Syndicate, this value is too high, although he states that "the area and values proven on this particular flat are very satisfactory." Mr. Galloway further states that the claim to have proved 5,000,000 cu.yd. of pay gravel returning in values $3.50 in diamonds, and $0.50 in gold, is incorrect. He further points out that of late years the alluvials have not been worked in a scientific manner on any other area sufficiently large to prove such figures as are quoted. Mr. Galloway draws attention to what he calls the inaccuracies of Mr. Richardson's report to warn all those whose interest might be aroused as to the commercial possibilities of these alluvials against entering into any scheme for development without first subjecting the matter to the strictest investigation. The Cascalho Syndicate is the pioneer British concern in developing these alluvials on a scientific basis, and has been the primary cause of drawing attention again to the commercial possibilities of the deposits, for the district, previous to 1915, had suffered vicissitudes. The Cascalho Syndicate is winning an excellent class of diamonds, which are readily sold in Diamantina, and at better prices than could be obtained if the stones were brought to Europe. I have seen shipments from the bulk of the South African mines, and have also inspected a consignment from the Cascalho Syndicate, and judging by my experience, the latter stones are excellent.

Johannesburg Letter

Industrial Federation Confers With Transvaal Chamber of Mines Over Labor Crisis

By John Watson

Johannesburg, Dec. 27—At the conference last week, the Industrial Federation asked the Chamber of Mines to amplify the latter's proposals. On Dec. 23, a letter in reply was sent by the Assistant Secretary pointing out that the average cost of production had increased from 54s. 10d. per oz. of fine gold in 1914 to 77s. 6d. in 1920 and that the average cost per ton milled has increased from 17s. 1d. in 1914 to 25s. 8d. in 1920. It was also pointed out that during November last no less than twenty-four of the gold mines were working at a cost exceeding the normal realizable price of gold, namely about 84s. per fine ounce. At nine of these mines, employing 4,144 Europeans, the cost of gold production is already in excess of its present realizable value. In another statement there was a comparison between 1914 and 1920, showing that there had been a decrease of close on 2,000,000 tons of ore milled per annum and that the increase in salaries and wages had been nearly £9,000,000 per annum. Another statement gave details of seventeen Rand mines which had been compelled to close down since June, 1915.

In 1915, these mines crushed nearly 5,000,000 tons of ore, and employed 3,547 Europeans and 35,639 natives. A further report showed that in June last the underground contractors numbered 2,441 and received on an average 50s. 11d. per shift worked. The classes affected by the abandonment of the *status quo* agreement, in addition to pump attendants, cleaners, and greasers, rough pipe-fitting, sanitary services and waste-packing, already mentioned, would be certain men now employed on tramming, track and drain-cleaning, drill-sharpening machines, rough timbering and pig-sty building, stone-wallers, haulages, a few redundant men employed as boiler attendants and firemen, change-house attendants, compound clerks, drill collectors and jumpermen, motor and meter attendants, at rough painting and white-washing, simple screwing machines (bolts and small pipes), and others. The Chamber had no intention of assailing the position of the man who had served an apprenticeship, but objected to a redundancy of white men who have failed in other occupations becoming fastened upon the industry by the *status quo* agreement.

Two South African Gold Mines Closed

By Cable From Reuters to "Engineering and Mining Journal"

Johannesburg, Feb. 1—Provisional notice has been given of the closing down of the mines of the New Goch Gold Mines Ltd., and those of the Roodepoort United Main Reef Gold Mining Company.

CANADA

British Columbia

Premier Tramway Handling 100 Tons of Ore Daily — Granby To Build Restraining Dam — Britannia Company Starts Rebuilding

Stewart—Dale L. Pitt, superintendent of the Premier mine, at Salmon River, is quoted as stating that the new aërial tramway is handling 100 tons of ore a day. Later it is planned to double the amount being delivered at the dock at Stewart, lower grade ore being shipped to the smelter at Anyox. In addition to ordinary shipments, the Premier is sending out 100 tons of concentrates a month, the same being the output of its stamp mill.

Alice Arm—The Homestake Mining Co. is planning to resume development work in March on its property on the Kitsault River. A small compressor will be shipped to the property.

Anyox—H. S. Munro, general manager of the Granby Consolidated, has announced that the company is planning to build a 25,000-acre-foot storage dam at an estimated cost of $35,000. This will supplement present power needs and assure sufficient power at all seasons. About 930 men are employed at Anyox, and production per month averages 2,500,000 lb. of copper. When copper reaches 14c. a lb. there will be a general increase of wages averaging 60c. a day, according to the agreement now in effect and which expires on April 1. Mr. Munro denies the report that the company intends to build a smelter at Stewart.

Vancouver—The work is under way of re-establishing the buildings and plant of the Britannia Mining & Smelting Co., which were wiped out by fire and flood. The Canadian Northwest Steel Co., of Vancouver, B. C., has the contract for the supply and the fabrication of the steel frame work of the concentrator. Messrs Hodgson, King, and Marble, also of Vancouver, have been given the work of rebuilding of a railway bridge that was destroyed. The supervision of the erection of the concentrator will be in the hands of Richard Trench, who has had experience in similar work at Trail, B. C., and who expects to be able to start on his task early next March. J. L. Walsh, a construction engineer of San Francisco, has been retained as consulting engineer in its rebuilding program. E. J. Donohue, general manager of the Britannia Mines, is in general charge of work at the mines as well as of the reconstruction operations.

Kaslo—Cork-Province Mines, Ltd., owning extensive holdings on the South Fork of Kaslo Creek, has issued a report to stockholders stating that improved marketing arrangements may make possible a resumption of operations this year, provided some way can be found for financing the company.

Greenwood—Foreclosure proceedings are threatened against Providence Mining Co., Ltd., in the event of its being unable to meet a demand for payment of bonded indebtedness of $50,000 and accrued interest amounting to $24,723.82. Other indebtedness brings the total amount owing up to $85,024.48. Recent operations proved unprofitable, it is stated, due largely to leasing operations, which depleted ore without compensating development. These operations extended over a number of years, and proved profitable to the leasers. An effort is being made to raise $20,000 to protect interests of the stockholders, and if this is done the bondholders will grant an extension. The majority of the stock is held by Chicago interests.

Nelson—Production will be resumed at the California mine in about two months. Changes are being made in the mill by G. A. King. It has been found that a satisfactory saving can be effected by cyaniding the product of gravity concentration and flotation.

Beaverdell—Good silver ore has been found by P. J. Crane and Duncan McIntosh on the Bell property, adjoining the Sally mine. Shipments will be made this winter. The Sally mine is also being developed by a Penticton syndicate, and with results which are regarded as promising.

Grand Forks—The last railway link with the old Granby smelter site has been removed, with the dismantling of the Canadian Pacific bridge between Grand Forks and the smelter. This work was completed the latter part of January.

Ontario

Cross Lake Sues Nipissing, Coniagas and Others—Kirkland Lake Operators Post Wage Cut—New Power Company Organized

Cobalt—The Cross Lake Silver Mines has entered suit against the Coniagas, Nipissing, Mining Corporation, O'Brien, and Bailey companies for $250,000 damages. The action arises from the flooding of the plaintiff's property by Cross Lake waters, due to the depositing of tailings by the defendant companies. The Cross Lake mine is a property which has been worked intermittently for fourteen years.

The Victory has struck ore running as high as 1,000 oz. to the ton on the 300 level. The shaft will be sunk to 500 ft., as it is believed that values will be better close to the contact.

The annual report of the La Rose for 1921 will show a production of 636,000 oz., and net profits of $126,000, which is the greatest production and the largest profit for several years.

The Kerr Lake mine has stopped all underground work. For the last year the company has been developing, but has shipped little. A large tonnage of mill ore is available for treatment.

The Colonial, which adjoins the O'Brien mine, and which has been closed for a number of years, has been bought by New York interests and will be reopened.

The Genessee, which has been closed for over a year, is to be reopened.

On Jan. 27 the Nipissing shipped 403,000 oz. of bullion, the largest single shipment of silver which ever left the Cobalt camp. Four days later another shipment of 100,600 oz. was made.

Shortage of power has resulted in the closing of the Miller Lake O'Brien mill, in Gowganda.

Kirkland—Following the action of the Porcupine Mines late last December, the Kirkland mines have posted a notice of a cut in wages of 50c. a day, effective March 1. To partially offset this reduction, board has been reduced 15c. a day.

The Comfort property has been closed. The company was exploring from the 150 level in an effort to pick up the extension of the Ontario veins.

It is understood that the high-grade ore cut on the 600 level of the Teck Hughes brought mill heads up to $20 a ton for January.

During January, recovery at the Lake Shore averaged about $35 a ton.

Arrangements have been made to finance two properties in the Matachewan gold area, and work will be started this spring.

Porcupine—A company is being formed by J. H. Black and associates, of the Northern Canada Power Co., to acquire from the McIntyre Mines the power rights at Sturgeon and Lower Sandy Falls on the Mattagami River. These falls have a capacity of 8,000 hp., and their development, which is expected to start at an early date, would provide an ample supply of power for the Porcupine district. According to the terms of the agreement, McIntyre power requirements will be protected by a first call on the new supply.

During January Dome heads have been running close to $10 a ton, and the profit for the month will be about $145,000. On account of the grade, tonnage is down to 900 tons a day.

Judgment has been given in favor of the Trust & Guarantee Co. against the North Crown Porcupine Mines for foreclosure of the mortgage on the company's property. The amount, including mortgage, interest and costs, is $105,000. The bonds were taken by the Porcupine Crown when that property was amalgamated with the Thompson Krist, so that the entire property will now go to the former company, which is controlled by the Crown Reserve mine, of Cobalt.

MEXICO

Coahuila

Torreon Smelter Remodeling Completed

The smelter at Mapimi, of Cia. Minera de Peñoles, S. A., a subsidiary of the American Metal Co., Ltd., has now been definitely abandoned, and the furnaces, furnace building, and much other equipment have been removed from that plant and installed in the Torreon plant, which has been completely remodeled and modernized.

The decision to dismantle the Torreon plant and move the Mapimi furnaces there was taken on Sept. 6, and the fact that the work was finished in less than four months is considered by engineers familiar with conditions in Mexico as a notable achievement on the part of the company's staff.

Guanajuato

Conditions Improved—Germans Underbidding Americans on Mining Supplies—Guanajuato Cons. To Start Pastita Plant

By KEITH A. CUNNINGHAM

Guanajuato—It is a rare treat these days to be able to write optimistically of mining, especially of silver mining, and still more especially of silver mining in the State of Guanajuato, Mexico, where that industry has been under a cloud for many a day. Pessimism has been the prevailing note among operators since October, 1919, when the fall in the price of silver began. Between a decreasing income and war-high working costs, complete paralysis was at one time believed inevitable. As it was, much work was stopped, plans for new work were abandoned, production was curtailed, and some mills were entirely shut down, and those that continued to run were able to do so only by great efforts. Today, though silver remains at a comparatively low figure, working costs are falling. There have already been notable decreases in the prices of such supplies as steel, heavy chemicals and lumber, all large items in costs. Much of the reduction is due to very active German competition, which bids fair to oust American manufacturers from Mexico. Krupp shoes and dies, as an example, are being offered at just about half those of American make—namely, at less than four cents per lb. The astonishing feature about the German bid for trade is the extraordinarily high cut on current prices, apparently as if to eliminate all competition at one blow. Here is another instance. A friend of mine, in need of a 5-in. centrifugal pump and 5-hp. motor, asked for quotations from two firms, one American and the other German. The quotations of the American firm was about 800 pesos; that of the German firm 496 pesos, each being f.o.b. Mexico City. The German firm got the order, and the articles supplied are of first-class quality.

Political conditions in the state remain entirely quiet, and in consequence, the industrial and commercial activities of the community are receiving an impetus that promises a prosperous future.

There is little at the moment in the labor situation to cause uneasiness. The men have been unusually quiet, and no agitators seem to be at work. It is feared by some that this quietness is caused by the fact that there is a surplus of labor on the market, and that as soon as there is a greater demand, which will be before long, there is likely to be trouble, as has been the result of late in other industrial centers of the country. The Councils of Conciliation and Arbitrage continue to sit, but as yet no decisions have been given, although some of the pending cases have been pending for five and six months.

The Guanajuato Reduction & Mines Co. continues to operate its two plants at full capacity. In December, nearly

25,000 tons of ore was milled and treated, 19,500 of this at the Guanajuato plant, and about 6,000 at the La Luz plant. This was a record month for the company as far as operations are concerned.

The Guanajuato Consolidated Mining & Milling Co. proposes to resume operations at its Pastita plant, the capacity of which has been increased to 12,000 tons monthly. During the shut-down, many important alterations and additions have been made. In the mines of the company, at the southeast end of the central portion of the Mother Vein, much exploration, development and preparatory work has been done in the last year. A new compressor of large capacity has been installed, and all necessary work has been done to eliminate, as far as possible, any mining of ore by any but up-to-date methods.

The Cubo Mining & Milling Co. is treating about 1,500 metric tons monthly at its Tajo de Dolores mill and cyanide plant. The ore is good and a high recovery is being obtained, no less than 90 to 91 per cent on the silver and 96 on the gold being reported by Irving Herr, general superintendent. Much work is being done in the mines belonging to the company, and more is planned. An interior three-compartment shaft has been started to take care of the ore being opened up below the tunnel level. The shaft is an incline being sunk in the foot wall, and is already down about 150 ft. It is proposed to unwater and explore this year the Capulin and Fortuna mines, two *antiguas* included in the company's holdings.

The United Mines Co. has completed its Kingsmill shaft down to 450 ft. and is crosscutting from the bottom toward the Joya vein, about 500 ft. away. The shaft is on the Puertecito and La Joya mines, from which in days gone by considerable quantities of high-grade ore were taken out. The veins opened up in these mines are in a zone where the gold contents, as compared with those of silver, are higher than in most mines in the camp. The ore from these mines will probably be treated in the Melladito mill, belonging to the company.

About 40 tons of ore daily is being treated in the plant belonging to the company leasing the San Cayetano mine, which is located in the La Luz district.

The Pasadena Mining Co., in a crosscut from its shaft, at the 1,200 level, has cut a vein, said to be the San Juan vein, which near the outcrop yielded a good deal of ore. Nothing is known locally of the value of the vein thus cut, but the fact that the company has bought a new hoist would indicate that enough has been found to warrant further work and expenditure of more money.

The Asuncion mine, at San Nicolas del Monte, is being worked by the old system of "*buscones*," and a fair amount of ore of good grade is being obtained.

ARIZONA

Old Dominion To Start Furnace—U. V. Extension Resumes Mining—Oatman Camp Active

By James H. McClintock

Phoenix—At Tucson, because of a settlement outside of court, the suit of F. M. Farrell against the Arizona Copper Co. has been dismissed. Farrell sought about $25,000 for a quantity of iron balls and liners alleged to have been ordered of him.

Articles of incorporation of the Pilares Extension Mining Co., a $1,000,000 corporation, backed by Shelby McCall and other Douglas mining men, have been filed. The property lies near Nacozari, Sonora.

A suit has been instituted here by the Amalgamated Copper Mines Co. against Gilmore Goodland, former superintendent of the property, for return of tools valued at $5,000 and of $750 company funds. The corporation has settled its claim against the interests that are preparing to build a check dam on its property, for protection from flood of lands near the western edge of Phoenix.

Globe—The Old Dominion will start one furnace soon and will give employment to 700 men in mine and on surface.

Twenty men have been employed by the Van Dyke Copper Co. on its Miami property, where a 1,700-ft. shaft passed through a dipping orebody at 1,200 ft.

J. B. Toomey, of Fort Worth, has sold to the El Capitan Mines Corporation all machinery, equipment and buildings on the El Capitan property in the Pioneer district, for a stated consideration of $27,000.

Jerome—Mining has been resumed with a small force at the United Verde Extension. A reverberatory was started at the company's Clemenceau smelter Feb. 10. United Verde has started a steam shovel on its pit work above Jerome.

Kingman—The last few months has witnessed a marked revival in mining activity throughout Mohave County, the most important new undertaking being the transfer and financing of the McCracken property. This group includes the Signal, Alta and Senator mines, on McCracken Mountain southeast of Yucca on the Santa Fe. They are adjoining claims on two great parallel ledges. About Jan. 1 L. D. Adams took over this property from Frank A. Garbutt, of Los Angeles. Prior to the transfer thorough metallurgical tests had been made and the new operators are moving rapidly.

Grading for the mill is completed, forms are up, and concrete is being poured for mill and machinery foundations. Complete new equipment for mine, mill and camp has been purchased. This will amount to about 350 tons of freight, the major part of which has already arrived at Yucca.

New camp buildings were bought at the coast in portable form. A 16 by 70 ft. modern bunk house has been built. A mess house and family houses are following rapidly. The domestic water supply is three miles from the mines. Pumps, pipe line and tanks have been installed. As soon as the compressor is mounted, deepening of the present 600-ft. shaft will be started, for the development of more water for milling purposes.

About twenty men are busy, and more will be put on as accommodations are completed. Four trucks are hauling eighteen tons of freight daily from Yucca, forty miles distant.

It is hoped to have the mill producing by May. Joseph C. Buchen is the engineer in charge of the surface construction. M. A. Keily is underground superintendent.

Oatman—Oatman is extremely active. At the Oatman United diamond drills have proved the existence of a large body of excellent milling ore. A new deep working shaft has been started.

Leasers at the Tom Reed have opened up a new body of rich ore. The mill being in the market for milling ores, a number of operators have started work. The United American can now dispose of its ore. All this has created much interest on the outside. Trading in all Oatman stocks is active, with a number of soaring quotations. Claims are changing hands as in the old days. Appearances indicate another Oatman boom.

White Hills now has about thirty men at work. All supplies, including fuel oil, are trucked from Chloride. Sinking of the Occidental shaft continues, and the stamp mill is almost ready.

Chloride—The Brunswick has resumed operation and the Dardanelles expects to begin the installation of new equipment this month.

Tucson—T. N. Stanton and W. M. Macdonald have secured from the Steinfeld interests and the Consolidated National Bank of Tucson an option to purchase the Eclipse patented claims in the Helvetia district. This property will be worked in conjunction with their personal holdings, which include the famous Narragansett mines.

Stanton is credited with opening up the orebodies in the Pilares mine, at Nacozari, Sonora. He was later superintendent of the Greene-Cananea and more recently general superintendent of the Cia. Estanifera Llaugua of Bolivia, S. A., the world's leading tin mine. He visited the mine recently with William B. Gohring, formerly chief of staff of the Calumet & Arizona interests, who expressed himself as pleased with the property, especially the ores of the sulphide zone. A force is at work repairing buildings and overhauling mechanical equipment.

Magma—The Sacaton Copper Co. has one Star drill and a force of men prospecting its holdings about four miles south of Magma on the Arizona Eastern. One hole has already been completed to a depth of over 600 ft. Drilling is being done on three shifts.

CALIFORNIA

Complaint Against George Graham Rice Dismissed

Salt Lake City—The trial of George Graham Rice on the charge of selling stock without a permit, a violation of the "Blue Sky" law of California, was called in the Oakland police court on Jan. 30, where it was dismissed for insufficient evidence and because of the desire of the complaining witnesses not to carry the complaint past its initial stages. The complaint was sworn to by J. H. Harrison and F. Wespiel in July, 1921, in Oakland. In the charges it was alleged that Rice falsely represented to them that they could recoup their losses in Broken Hills mining stock by purchasing Bingham-Galena stock.

The Pacific Coast Borax Co. is reported to have acquired a tract of land at Wilmington, Cal., upon which it will begin the erection of a borax refinery on May 1.

Wheatland—A carload of copper ore is being shipped from Sheridan daily to the Tacoma smelter. This ore is part of a dump which consists of approximately 70,000 tons and was produced by the Dairy mine. The mine has been abandoned and there is little likelihood of it ever being reopened. Present work is restricted to cleaning up this dump which was held to await more favorable conditions for its trans-shipment.

Nevada City—Local reports credit the Kate Hardy mine, at Forest, with having high-grade ore. The new mill is operating steadily. The mine is reported to be under bond. Producing properties in the contiguous district of Allegheny are the Tightner, the Sixteen-to-One, the Twenty-to-One, and the Mugwump. There are many other smaller properties, and the district is active.

Sonora—There is promise of some activity in the channel mines of Table Mountain. Options have been secured by M. E. Layne upon certain properties there, and reports indicate that drainage and further work are to be undertaken.

Boarding and bunk houses and other necessary equipment have been erected at the Parole mine, and development work will be started with about twenty men. The mine is three miles north of Soulsbyville, and is locally owned and is under bond to the Parole Mining Co.

The Verdon mine, near Stevens' Bar, is to be prospected under a bond given by A. G. Mahan and associates, of Los Angeles.

Randsburg—The Kelly mine has produced better than $1,000,000 in the last year, has built a mill and flotation plant, paid its stockholders 62½c. per share on a capitalization of $1,250,000, and has a surplus or working capital of $400,000. It is making a regular shipment of ten forty-ton cars of ore per week that averages better than 90 oz. of silver per ton.

NEVADA

New Ore Discovered in Con. Virginia—Tonopah Company Examining Orleans Hornsilver Mine

By Our Special Correspondent

Virginia City—A discovery with possibilities of importance has been made on the 1,650 level of the Consolidated Virginia mine about 90 ft. south of the old bonanza orebodies. An east crosscut from a foot wall drift cut the ore after only a few feet progress had been made. North and south drifts have been started, and the ore as broken is said to average $60 per ton. The crosscut is to be continued through the vein, about 300 ft. wide at this point, in the hope of encountering other orebodies. Gross production of the Consolidated Virginia mine in 1921 was $339,000, and the ore averaged $9.80 per ton. Development totaled 5,000 ft. for the year covered by the report.

Eureka—A crosscut has been started from the Catlin shaft of the Eureka Croesus Mining Co. to cut the ore exposed on the 800 level of the Atlas shaft. The crosscut will also develop the orebody on which a winze was sunk in 1920 about 200 ft. from the shaft. All underground work at the Eureka Holly and Bullwhacker mines has been temporarily suspended. The Eureka Holly plans to begin remodeling its mill in March.

Battle Mountain—The main drainage tunnel of the Betty O'Neal mine is now in 1,250 ft. from the portal, leaving 650 ft. to go to connect to the 300 level of the shaft. The last 200 ft. has been in wet and heavy ground, which delayed progress materially. The ground at present is firm and good progress should be made. Very satisfactory ore developments are reported from Tunnel No. 4, both in the drift and raise, and on the 150 level from the main shaft. Plans are being made for building a 100-ton concentrating and flotation plant, the plant to be located at the portal of the drainage tunnel.

Tonopah—Bullion shipments from the Tonopah mills, representing clean-up of operations for the first fifteen days in January, were as follows: Tonopah Belmont, $88,310; West End, $42,000; Tonopah Extension, $60,000, and Tonopah Mining, $50,000. The West End reports favorable developments in low-grade ore from the 800 and 960 levels. Mine production continues normal, or about 240 tons per day. The Halifax is developing the Halifax vein from the 900 level, a raise on the vein to the south shows a full face of ore of good grade with only one wall in sight.

Hornsilver—In the Orleans Hornsilver mine, work has been temporarily suspended in the southeast drift on the 700 level and a winze started on the vein 100 ft. southeast of the main shaft. It is reported that the engineers of the Tonopah Mining Co., under direction of the general manager, W. H. Blackburn, are making a detailed examination and sampling of the mine.

OREGON

Wage Reductions Cause Gold Miners To Work for Themselves

Grants Pass—Recent reduction of wages are responsible for the general resumption of gold mining in Josephine County. The major part of the mines in this region are held by miners of limited means. While wages were high the miner worked for someone else, but under present conditions these owners of mines are returning to their properties, which they can now operate at a profit. There are now 49 active mines in this district, quartz mines leading by two-thirds over placers. Normally there is received at the Grants Pass bank $150,000 in virgin gold annually. Placer mining received an impetus last fall and up to the holidays was showing up well, but since then lack of normal rainfall will reduce the season's output. Outside mining men are coming to this region quietly seeking properties.

The Siskron mine, a new property, recently shipped a $2,000 gold brick from twenty-five tons of ore. This mine is near the Boswell and is equipped with a two-stamp mill.

The East Boswell and the East Boswell Extension group are being reopened with a small crew. Construction of a reduction plant under way.

WASHINGTON

Addison Copper Levies Assessment—Idaho-Montana Tunnel Near Objective

Keller—The Addison Copper Mining Co. has levied a 5-mill assessment. The funds will be used on development.

Chewelah—Preliminary reports covering operations of the United Silver-Copper Mining Co. during 1921 were presented at the recent annual meeting. With a small crew employed throughout the year, and no effort made at milling, the company shipped 1,335 tons of ore, which yielded 68,538 oz. of silver, 253,781 lb. of copper, and some gold, the total gross value being $88,699, and the net, $72,411. General operating and other expenses left a net profit on operations of $9,882. Indebtedness was reduced by $8,000 and is now $82,164, $64,500 of which is in bonds.

The Washington Marble Products Co. recently has been incorporated by local men for the manufacture of terrazzo flooring from marble deposits of this vicinity.

Adair—The deep development tunnel of the Idaho-Montana Copper Co. is now in over 8,600 ft. and is within a few hundred feet of its objective, a point directly underneath the greatest depth attained in the upper workings of the mine. The driving of the tunnel will have taken six years when the objective is reached.

Colville — Peter Ziehen and others are asking the superior court for foreclosure of six labor liens held by them on property of the Liberty Copper Mining Co., at Chewelah.

COLORADO

I. C. C. Hears Applications To Discontinue Railroad Service

From Our Special Correspondent

Denver—A hearing upon the application of the Silverton railroad company to abandon and dismantle its road extending from Silverton to the Red Mountain mining district, and of the Colorado & Southern Railway Co. to abandon and dismantle its branch line extending from Buena Vista to Romley, in Chaffee County, was held in Denver Feb. 2, 3, and 4, before P. F. Gault examiner for the Interstate Commerce Commission.

Application was made to the Interstate Commerce Commission for permission to abandon these lines in October of last year, but was resisted by the Colorado Utilities Commission, which claimed jurisdiction, particularly in the case of the Silverton line, which it is claimed is wholly an interstate road. A hearing was held in Washington upon the question of jurisdiction, but the petition of the Colorado Commission was denied and a hearing set for Feb. 2 and 3 in Denver.

Complete abandonment at this time is being resisted by the Colorado Metal Mining Association and the Metal Mining Board on the ground that conditions in the mining districts are abnormal and that, though discontinuance of service may be justified, complete abandonment should not be permitted during present unfavorable economic conditions, and that facilities for operation should be left in existence awaiting a return to normal conditions.

Ouray—The Welch-Worland Mines Syndicate recently made its second payment on the Wanakah mine. Mining has continued steadily since the company took over the property a few months ago, and the mill has been operating full time. Amalgamation is being used with success, accomplishing a great improvement. It is followed by table concentration and will soon be supplemented by oil flotation. A small Marathon mill has been received. It will regrind the stamp product, giving feed for tables and flotation. The company is developing the mine and expecting to improve its milling process.

The Hidden Treasure Mines Co. is curtailing operations greatly. Shortage of water and the difficulty of transporting concentrates and supplies over the trail to Ouray have been largely responsible. It is likely that this will continue until spring. A small mill was erected last fall and has been in operation until now. Flotation apparatus was being tried out at the time of shutdown and was expected to make a decided improvement, as the ore is a heavy lead-zinc sulphide carrying considerable silver.

Development by the Whitecloud M. & M. Co. on the Mona's Queen, though proceeding slowly by hand, is continuing to show a good streak of silver-lead milling ore. The company expects to push this development with the hope of opening a large enough body of ore to justify the erection of a small mill this summer.

The mail route between Silverton and Ouray was re-established as far as the Barstow mine, beginning Feb. 1. This is a great help to the entire Red Mountain and Ironton sections, as they have been practically snowbound all winter.

Alma — The Lincoln Consolidation Mining Co., has made connections through the new Hoosier tunnel with the old Russia workings, and is developing a recently discovered orebody, the limits of which have not been established. Samples taken for assay gave 0.1 oz. gold and 284.5 oz. silver.

The Pulaski Investment M. & P. Co. has connections with the electric lines of the Colorado Power Co. and has installed an air compressor. This company is developing a mineralized vein system 24 ft. in width, assaying from $4 to $20 per ton, which it expects to mill.

The Colorado-Alma Mining Co. has been organized and has purchased the Oxide group of claims on Mosquito Range, about one mile northwest of the North London mine.

The Fanny Barrett property, on Mount Loveland, one of the old-time producers of high-grade silver ore, has been bonded and leased to Denver interests, which have a crew of men cleaning up and retimbering the old workings.

A 3-ft. vein of quartz was cut on the Hard To Beat recently, assaying 1.80 oz. gold and 8.80 oz. silver. This is the third vein found in addition to the high-grade gold vein opened in September, 1921.

MONTANA

Anaconda Planning Extensive Ore Development—Barnes-King Reports

By A. B. KEITH

Butte—The Anaconda Copper Mining Co. appears to be considering one of the most extensive ore development programs in its history, as an outgrowth of the company's recent deal with American Brass. The Anaconda has a large area of undeveloped territory in the Butte district, well traversed by fissures, which show a silver-lead-zinc character near the surface. In view of some deep developments in the northwestern part of the district in the last year it would not be surprising to find copper ore here, particularly below the 2,000 level.

Probably the next step of importance in which the Anaconda will engage will be that of manufacturing brass at Great Falls, where it has a copper refinery and an electrolytic zinc plant.

Davis-Daly is reported unofficially to have been offered by East Butte a $5 smelting rate on first-class copper ore.

The Barnes-King Development Co. reported its bullion output for December at $39,322.79, with the Shannon mine only showing any tonnage, from which 3,294 tons was mined averaging in value $11.79 per ton. A winze has been started from the lowest level of the Shannon, the 600 level.

UTAH

Silver King Coalition at Park City Opening New Ore

From Our Special Correspondent

Park City—Shipments for the week ended Jan. 27 totaled 2,049 tons, as compared to 2,024 tons the week preceding. Shippers were: Silver King Coalition, 816 tons; Judge companies, 798; Ontario, 435.

New ore developments are being made by the Silver King Coalition in opening up the O'Brien fissure system, which is an ore channel parallel to the original Silver King oreshoot north of it, and in opening and further developing the M. L. M. territory in the western part of the property, parallel to what was known as the American series of stopes. The O'Brien channel is being developed from the 1,100 level, and new ore has been opened several hundred feet in advance of the area, which is furnishing the present production. The stopes are equal in size to those of the old Silver King channel and the ore is of the same grade, running especially well in silver. Some of the better ore recently opened carries as high as 105 oz. silver and around 27 per cent lead, in addition to gold and copper. A drift is being driven on the 1,300 level to develop the ground below the old Crescent stopes, where the only development heretofore has been in the Thaynes or upper limestone formation. The new drift has crosscut fissures in the underlying quartzite carrying ore with an unusually high gold content. Raises will be driven on the fissures to develop the Park City limestone above the quartzite, the former being the main ore-bearing horizon in this camp.

The new mill is nearing completion. The crushing section is being limbered up, and the tables and jigs will be in operation soon. A large amount of second-class ore has been stored in the mill since the old mill burned on Jan. 27, 1921. The new mill will have a capacity of 450 tons a day, and will be in operation in February.

Eureka—Ore shipments from the Tintic district for the week ended Jan. 27 totaled 141 cars, as compared with 145 cars the week preceding. Shippers were: Tintic Standard, 59; Chief Consolidated, 35; Eagle & Blue Bell, 11; Victoria, 8; Colorado, 6; Iron Blossom, 6; Swansea, 4; Bullion Beck, 3; Centennial-Eureka, 3; Dragon, 3; Gemeni, 2; Grand Central, 1; Shipments from the Grand Central were held back by tramway repairs.

WASHINGTON

Magnesite Company at Chewelah Working Twenty Men

Valley—A resumption of operations on a small scale by the American Minerals Production Co. has been announced by Howard F. Wierum. It is believed about twenty men will be employed in the quarries and in other operations incidental to magnesite production for the present.

MICHIGAN

The Copper Country

C. & H. Preparing To Resume in Seven Conglomerate Shafts—Mayflower's Showing Encouraging

By M. W. Youngs

Houghton—Seven Calumet & Hecla conglomerate shafts are being put in condition for resumption of production. There is much work to be done, as the ground in the lower workings has badly crushed in places. Good progress is being made in the cleaning-up process, and the rock being taken out is being stocked at the mine, to be shipped later to the mills. The removal of rock, straightening out of the skipways, retimbering, and shaft repairs will keep several hundred men busy for some time. Repairs in the Calumet & Hecla mills have not yet been started. It is expected, however, this work will be given attention soon.

A number of former Copper Country residents, in many instances accompanied by their families, are returning from the industrial districts of Michigan and Wisconsin, where they went during the last year in the hope of improving their lot. Announcement that the Calumet & Hecla mines would resume production about April 1 is the magnet that has brought these people back, but their return has been accelerated by the fact that industrial conditions in the manufacturing towns are in many districts far from normal. Return of former workmen will be of great assistance to the mining companies which will have to rebuild their organizations.

New Arcadian, which recently reached a depth of 1,100 ft. in its New Baltic shaft, is now drifting north and south. The north drift is in the vein, in good milling ground. This drift will be pushed a reasonable distance to prove up the lode on that side of the shaft. All efforts will then be centered on the south side of the shaft, where the drift will be pushed toward the New Arcadian shaft. The south opening is not yet in the lode, but contact is believed to be near. Work is being pushed in the drift south from the 942 level, which has now reached a length of 900 ft. No more faulting is in evidence, and the ground is well mineralized. The management is much encouraged with developments.

It is expected Seneca will be in readiness to resume sinking in Gratiot No. 2 shaft late in the spring. Work on the power plant and the building to house the new hoist will be started soon, and rails will be laid to the shaft as soon as the snow is off the ground. Work of repairing the shaft is proceeding, and good progress is being made. Concrete for the shaft collar has been poured, and the shaft has been cleaned out and retimbered to below the 6th level. The shaft will be sunk to a depth corresponding with the 3d level of the Seneca shaft. Connection between the shafts will be made and the 3d level drift from Seneca is now well toward Gratiot property. The several drifts in the Seneca end of the mine continue in good milling ground.

Mayflower's showing in the north drift from the 1,450 level continues encouraging. The vein is well mineralized, and there are no signs of faulting. The work to date in this drift tends strongly to confirm the belief that the disturbed area encountered in the lower level is centered below the 1,450 level openings. Mayflower is steadily collecting data which will aid it materially in future development work, inasmuch as this information will determine the faulted areas with a positive degree of definiteness.

JOPLIN-MIAMI DISTRICT

Missouri-Kansas-Oklahoma

Crescent Mine and Mill Sold—Producers-Hopkins Property Changes Hands—Big Elk Officers Re-elected

By P. R. Coldren

Joplin—Announcement has been made of the sale to Oklahoma interests of the Crescent mine and 500-ton mill, situated in Kansas about six miles west of Baxter Springs. The purchasers are represented by L. P. Crose, of Carnegie, Okla. The mine was developed and the mill built about four years ago, but was completed only a short time before zinc ore prices started downward. The property has never been a steady or large producer. The original owners were forced to turn it over to the Joplin company that had fitted out the plant and to the mill builder, J. T. Chapman, of Baxter, who were the sellers in the recent transfer. James Morgan, a mine operator of Duenweg, Mo., is to be manager. The plant is to be started soon.

The Producers-Hopkins mine, near Picher, was sold at sheriff's sale at Miami on Jan. 31 for $12,500.

Officers of the Big Elk Mining Co. were re-elected at an annual meeting of directors held at Miami on Jan. 28. J. T. Whaley, of Oklahoma City, is president adn J. R. Simpson, of Miami, secretary. The mine was one of the steady producers in the Tri-State field during 1921 and one of the few to show a fair profit. A dividend was declared at the annual meeting.

On the theory that the gross-production tax, which has been the basis of taxation on which owners of zinc and lead mines in the Oklahoma district, have paid thousands of dollars in state taxes assessed on ore in bins, is a property tax, county officials of Ottawa County believe that the recent decision of the U. S. Supreme Court, holding the taxation of incomes derived solely from oil and gas leases on Indian lands invalid, will invalidate the Oklahoma law and relieve the zinc producers of the tax.

It has already been held at Washington that the exemption to oil and gas Indian lands applies with equal force to mineral land in the Supreme Court's decision, and therefore it would seem to apply to the zinc lands of the Quapaw Indians in Ottawa County.

ALABAMA

Indicated Iron-Ore Output in January 300,000 Tons—Pocahontas Graphite Plant Resumes—One Mill of Quenelda Co. To Be Started

By George Huntington Clark

Birmingham—Iron making in Alabama at the close of January maintains the slow but steady progress evidenced in the closing months of 1921, with possibly some small increase. Local consumers have been steadily increasing their melt, taking more than a fourth of the probable make for the month, which will run in excess of 115,000 tons.

The amount of contributory ore raised is not ascertainable, but the January make of iron, if the ore was altogether mined, and none taken from stock, would represent a probable mine output in excess of 300,000 tons.

The business of the district is now believed to be on a 120,000-ton basis, and four or five additional blast furnaces are in condition for almost immediate resumption. A small increase in market demands will bring about the lighting of these idle stacks. It is hardly possible for pig-iron prices to show further decline, as the cost mark has been approximated.

At least two groups of Alabama ironmaking properties are still persistently spoken of as likely to be included in proposed new steel mergers—namely, those of the Republic Iron & Steel and of the Gulf States Steel companies.

Announcement has been made that the Great Southern Steel Co., recently incorporated, and capitalized at $105,000,000, intends to develop the 100,000 acres of mineral property acquired i Alabama, and will spend $10,000, on them. Two blast furnaces ar mill for the manufacture of fin steel products are included in the

Resumption of operation is nounced at the graphite plant of t Pocahontas Graphite Co., situated near Ashland, in Clay County. It is reported that after some improvements on the property have been completed, at least one of the plants of the Quenelda Graphite Corporation will also be started again.

Also, as soon as conditions will admit, it is indicated that building of the $3,000,000 cement plant at Village Creek will be started.

Now that the Ford proposition regarding the Muscle Shoals project has become a matter solely dependent on favorable Congressional action, a whole train of new mining developments awaits the final outcome of this matter.

Wallaroo & Moonta Decides To Keep Running

By Cable from Reuters to "Engineering and Mining Journal"

Adelaide. Feb. 3—The Wallaroo & Moonta Mining & Smelting Co., of South Australia, announces that it will reopen its mines (recently shut down), the men having accepted a reduction in wages.

The Situation at the Mines in January

Copper Companies Resuming—Wages Drop in Utah, Porcupine, and Butte—Ore Freight Rates Studied; Some Relief Appears To Be Assured—Activity Increasing in Joplin-Miami District—Zinc Mining in Wisconsin Quiet

COPPER PRODUCERS turned the corner in January as regards operations. The resumption of work at Butte by Anaconda and others was speedily followed by news that Calumet & Hecla was preparing to resume. Other announcements ensued: Phelps Dodge, Calumet & Arizona, Old Dominion and Iron Cap were about to start; Inspiration taking on men and Cananea getting things in condition; U. V. Extension was mining ore, and United Verde ready. Indications were that early spring would see all producers working. Elsewhere, the copper situation was little changed: The Jackling porphyries remained idle; Miami and New Cornelia produced as usual, the latter much curtailed; Engels, in California, and Granby, at Anyox, continued busy. The latter's smelter and that at Miami were the only Western copper plants in operation.

Northern Michigan smelters, with ten to eleven furnaces in blast, had a production of refined copper about 40 per cent of normal. In Tennessee, the Ducktown S. C. & I. Co. ran at capacity and Tennessee Copper produced about 556,000 lb. of copper, against 8,081,322 for 1921.

Aside from copper camps, the general situation showed little change from December. Demand for skilled labor naturally increased where operations were resumed or resumption was anticipated, this relieving the unemployment situation to some extent in Montana and northern Michigan. Unemployment was still acute on the Lake Superior ranges.

Wages continued their downward trend, dropping at Butte, in various Utah camps, and at Porcupine, Ont. Operators in Colorado announced a cut effective in March.

Lower freight rates on bullion from Washington, Idaho, and Montana smelters were established. Likewise, a more favorable schedule on ores from Pioche to the Salt Lake Valley was announced. Hearings on the matter of lower rates on ore were begun by the Interstate Commerce Commission. The smelting situation remained unchanged.

Gold mining in the Black Hills of South Dakota continued on a par with the two months preceding. Homestake's tonnage was 140,000, valued at $5,000,000. Trojan's output was 6,700 tons, yielding $30,000 in bullion. These were the only gold producers, against twelve four years ago. Both ran at capacity. A few small properties were active in development.

In Colorado there was a noticeable revival of interest in mining, and announcement was made that several large properties would resume in San Juan, Saguache, Clear Creek counties, and elsewhere. Fifteen hundred more men were employed in metal mines than a year ago. A 50-cent wage cut, effective March 1 in all districts save Cripple Creek, was announced.

Activity at smaller properties continued to increase in California. Grass Valley kept up its stride, and gold mining improved at Plymouth, Sutter Creek, Jackson and Carson Hill, on the Mother Lode, with the outlook for 1922 bright. Northern California remained quiet except in alluvial mining. Silver mining retained its pace at Randsburg. Gold dredging progressed at its usual rate.

Mining was unchanged in Nevada. Deep snows interfered with operations in remote districts. Tonopah's output dropped slightly to about $550,000. Royston and Hornsilver, both new camps, were active. Virginia City was busy.

Shipments decreased somewhat in Utah in January. Park City's output was normal, about 900 miners working. Bingham produced about 15,500 tons of milling lead ores and fluxing iron ores as in December. Tintic's output was almost normal, with 27,455 tons, against 35,577 the month before. Prevailing conditions permitted shipment of better-grade silver ores only for the most part. About 130 operators were working, or about 60 per cent of the number in 1913 it was estimated. Midvale ran three furnaces on lead and one furnace on matte; Murray three on lead; and Garfield (normally copper) two reverberatories and one blast furnace, chiefly on siliceous silver ores. Possible resumption by the International smelter, at Tooele, was rumored. Utah's lead production was about a quarter less than normal, owing to the low price and high costs. Wages fell to $3.75, Park City excepted. This is the normal pre-war level. Smelter wage scales fell 25c. to 50c. a shift. A surplus of labor existed.

In the Pacific Northwest, cold weather interfered somewhat with operations. In the Coeur d'Alenes, the Bunker Hill & Sullivan, the Morning, and the Hecla produced about 15,000 tons of lead-zinc ore and concentrates as in December, these being the only producers. The labor situation was unchanged, with enough men for all demands, about 2,500 being employed. Success of the Bunker Hill and Hecla in the litigation brought by the Day-Smith interests insured the carrying out of the important Star enterprise. In British Columbia, the new Silversmith mill was started. The Trail smelter handled a normal tonnage, Tacoma ran curtailed and Northport remained shut down.

In Joplin-Miami district, a number of lead-zinc mines resumed, including some in the Picher section; also the Oronogo Circle. The Kanok Metal Co. prepared for work near Crestline, Kan. At the end of January about eighty mills were working, ten of these on part time, compared with about fifty-four months ago and sixty-five or seventy in November. About 4,000 miners were employed, against 2 000 two months ago. Shipments totaled 28,432 tons of blende (29,598 in January, 1921) and 6,651 tons of lead ore, against 4,777 a year ago.

In the Wisconsin zinc-lead district, five producers and four mills were active. One roaster, one acid plant, and one oxide plant operated, and four roasters and one acid plant were idle. In 1919, forty-two mills and five roasters worked. The month's total output varied little from the average for the second half of 1921, being 2 500 tons crude blende concentrates (2,740 shipped), 1,000 of roasted blende (1,403 shipped), and 250 tons of lead ore (273 shipped). The output of crude blende concentrates given was only 19 per cent of the district's monthly average for ten years previous to 1921. The stock in bins was equivalent to 25,000 tons of roasted ore.

Operations in the southeast Missouri lead district continued at about two-thirds capacity, wages being about 30 per cent above the pre-war normal. Zinc operations in the Mascot district, Tennessee, remained much curtailed, the output going entirely into oxide.

Iron mining in the Lake Superior region proceeded at about 25 per cent of normal, the number employed having been increased somewhat to relieve distress. Several small mines resumed on single shift. No ore sales were made, and contract prices remained uncertain. Wages in general were reduced. Fight on the tonnage and occupational taxes began in Minnesota.

Iron-making in Alabama increased somewhat to over 115,000 tons (estimated), indicating an ore production of over 300,000 tons. Four or five additional furnaces were ready. The recent slow but steady improvement continued. One graphite plant resumed.

In Ontario, the Sudbury district remained dead save for Mond's limited output. More nickel was sold, however. Cobalt maintained its production. Nipissing shipped 403,000 oz. silver to China, a record for the camp. Kirkland made a record output, Teck Hughes' heads running $20 and Lake Shore recovering $35 per ton. Porcupine's output broke the record. Mines at Porcupine cut wages 50c. but Kirkland retained its scale. The number of employed increased slightly, there being, however, still considerable unemployment. A gold rush to Elbow Lake in Manitoba is in progress.

THE MARKET REPORT

Daily Prices of Metals

Feb.	Copper, N. Y., net refinery* Electrolytic	Tin		Lead		Zinc
		99 Per Cent	Straits	N. Y.	St. L.	St. L.
2	13.25	30.875	31.75	4.70	4.375@4.40	4.45@4.50
3	13.20	30.625	31.50	4.70	4.375@4.40	4.45@4.50
4	13.20	30.625	31.625	4.70	4.375@4.40	4.45@4.50
6	13.125	30.625	31.75	4.70	4.375@4.40	4.45
7	13.125	30.875	31.875	4.70	4.375@4.40	4.45
8	13.00	31.00	31.875	4.70	4.375@4.40	4.50

*These prices correspond to the following quotations for copper delivered: Feb. 2, 13.50c.; Feb. 3 and 4, 13.45c.; Feb. 6 and 7, 13.375c.; Feb. 8, 13.25c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Feb.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
2	62⅜	63⅜	69	156	157⅞	21⅝	21½	24½	25
3	61⅝	62½	69	154	155⅞	21¼	21¼	24⅛	24⅝
4			...					...	
6	61½	62½	68	154¼	156¼	20⅞	20¾	24	24⅝
7	61⅜	62⅜	68	155¾	157¾	21¼	21⅛	24⅜	25
8	61½	62½	67	157¼	159	21¼	21⅛	24½	25¼

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Feb.	Sterling Exchange "Checks"	Silver			Feb.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
2	429¼	99⅝	66½	35⅛	6	431½	99⅝	66	34⅝
3	429½	99⅝	66⅝	35⅛	7	433¼	99⅝	65⅝	34⅜
4	432¼	99⅝	66½	34¾	8	433½	99⅝	65⅝	34⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Metal Markets

New York, Feb. 8, 1922

The decline in copper has been the feature of the week's market activities. Lead remains steady, zinc shows but little change, and tin has come up in price, owing to the advance in London. Among the precious metals, platinum has dropped from the spectacular high reached a week ago. Transatlantic freights to Hamburg, Bremen, and Liverpool are $4 per long ton, to Havre, $5; to Rotterdam and Antwerp, $3.50; and trans-Pacific rates to Hongkong and Kobe are $5. A wide difference between rates to the United Kingdom and the Continent, as under the old conference arrangements, no longer exists.

Copper

Domestic business has been small and so has export trade, and the decline which was in progress last week has not been arrested. Consumers have not been tempted by the low prices, although today an inquiry for a 1,000-ton lot was made. Copper was sold during the week as low as 13.00c. refinery, but the large bulk of the business was transacted at a higher level. As usual, intending purchasers have been reluctant to enter a declining market. The larger producers have been keeping out of the market, but an occasional sale has been made to customers at 13.50c. delivered. On the other hand, a few producers have been active in meeting any business that developed during the week. The decline is attributed partly to an overbuying earlier in the season, to the unsatisfactory condition of export trade, and to the resumption of copper mining by several copper companies. The sales of the Copper Export Association have been small, whereas those of outside interests have been more active, netting about the same as domestic business. The strike in Germany, which is now reported terminated, has undoubtedly held up buying from that quarter.

Aluminum producers and manufacturers are reported to be active in competing with the copper-wire manufacturers, which is natural, considering the relative difference in price of only about 4c. between the two metals.

The London market has dropped three pounds sterling since Feb. 1, and although the decline has been partly compensated by the sharp advances in sterling exchange, movements in both markets have closely paralleled each other.

Lead

The official contract price of the American Smelting & Refining Co. continues at 4.70c., which is the level at which the metal is also available from other interests. Little change is to be noted in the market. Sales have been well diversified, lead going to pipe manufacturers, electrical-goods manufacturers, storage-battery companies, and others. Production and consumption seem to be nicely balanced, so that trading has had but small effect on prices for many weeks. Lead was sold in St. Louis at both the 4.375c. and the 4.40c. level. Although some lead is being held at 4.40c., today it can still be obtained at concessions. The market has been remarkably stable for many weeks, in strong contrast to the behavior of other metals, a stability that has worked to the advantage of both producer and consumer.

Zinc

The market, judging from last week's trading and the sentiment among producers, has apparently reached its low on the present swing. Galvanizers are reported to be taking a slightly greater interest in the market, but their operations have had no effect on prices. The metal is generally offered at 4.50c. in the Middle West today. The decline in the American markets and the higher prices in London once more create an interest in the probability of exporting zinc, but it seems that the London market is watching that in New York as closely as London movements are observed here. At the critical moment, the spread between the two markets narrows to such an extent that exports are not feasible. High-grade zinc has been sold in good volume during the week at the price prevailing for many weeks, 6c. with freight allowed. Several zinc producers have been entirely out of the market at its present level.

Tin

The market has been exceedingly dull for most dealers, although buying was expected to be stimulated by the rise in London. Consumers seem to be well satisfied and still uninterested, although reports have come to hand of improvement in the tin-plate trade.

Straits tin for forward delivery is quoted as follows: Feb. 2, 31c.; 3d, 31c.; 4th, 31c.; 6th, 31.125c.; 7th, 31.375c.; 8th, 31.375c.

Arrivals of tin, in long tons: Feb. 1, Havre, 50; 2d, Straits, 300; 4th, London, 50, Straits, 35; 6th, Liverpool, 10; Straits, 200; 7th, London, 25.

Gold

Gold in London: Feb. 2d, 95s. 9d.; 3d, 95s. 8d.; 6th, 95s. 5d.; 7th, 95s.; 8th, 94s. 9d.

Foreign Exchange

Sterling has continued to show unexpected strength. Various causes are assigned, among them the contraction of British imports, the presence of a short interest in the market, and the improved international sentiment brought about by the successful outcome of the Washington conference. There has been no marked change in other European exchanges, but the tone is somewhat stronger. On Tuesday, Feb. 7, francs were 8.46c.; lire, 4.7775c.; and marks, 0.49⅜c. New York funds in Montreal, 5 5/16 per cent premium.

Silver

Buying by the Indian bazaars ceased at the end of last week, and this week opened with both the bazaars and China selling in London, and China refusing to buy at current levels in our market. The result was a fall in price, and this fall would have been more pronounced in New York had it not been for the continued advance in sterling exchange. Until China begins buying again, or at least discontinues selling, there can be no firm undertone to the market, although any buying by the Indian bazaars will undoubtedly steady prices.

Mexican Dollars—Feb. 2d, 50½; 3d, 50⅝; 4th, 50½; 6th, 50⅜; 7th, 50; 8th, 50.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 4.45c.; market dull. W.C.C. brand, 5¼@5⅜c. per lb. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—7½c. per lb. Strong.

Bismuth—$2@$2.10 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Iridium—Nominal, $170@$190 per oz.

Nickel—Standard market, ingot and shot, 41c.; electrolytic, 44c. Small tonnages, spot, nominal at 32c.

Palladium—Nominal, $60 per oz.

Platinum—$90@$95 per oz.

Quicksilver—$48 per 75-lb. flask. San Francisco wires $47.30.

The prices of **Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of Feb. 4.

Metallic Ores

The prices of **Chrome, Manganese, Tungsten, Molybdenum, Tantalum, Uranium, Vanadium,** and **Iron Ore, Zircon** and **Zirkite** are unchanged from the prices in the issue of Feb. 4.

Zinc and Lead Ore Markets

Joplin, Mo., Feb. 4—Zinc blende, per ton, high, $29.80; basis 60 per cent zinc, premium, $26; Prime Western, $25; fines and slimes, $24@$20; average settling price, all grades zinc blende, $26.78.

Lead, high, $64.35; basis 80 per cent lead, $60; average settling price, all grades of lead, $62.19 per ton.

Shipments for the week: Blende, 6,495; lead, 1,506 tons. Value, all ores the week, $267,600.

An effort was partly successful to lower prices another dollar this week, but a stronger demand at the week end held prices on late sales without change. Production is estimated around 7,000 tons per week, with purchases this week, 6,540 tons. Strenuous demand for lead keeps that mineral above par with the metal market. Shortage of Western and Southeast Missouri production of soft lead has placed a notable premium on the ores of this district.

Platteville, Wis., Feb. 4 — Blende, basis, 60 per cent zinc, $28. Lead ore basis 80 per cent lead, $60 per ton. Shipments for the week: Blende 148, lead ore 37 tons. Shipments for the year: Blende, 1,551; lead ore, 310 tons. Shipped during the week to separating plants, 365 tons blende.

Non-Metallic Minerals

There are no price changes from those indicated in the report of the issue of Feb. 4 covering **Asbestos,** Barytes, Bauxite, **Borax,** Chalk, **China** Clay, Emery, **Feldspar, Fluorspar,** Fuller's Earth, **Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur** and Talc.

Mineral Products

The prices of **Copper Sulphate, Potassium Sulphate, Sodium Nitrate,** and **Sodium Sulphate** are unchanged from the issue of Feb. 4.

Ferro-Alloys

Ferromanganese—Domestic, 78 to 82 per cent, $59@$60, f.o.b. furnace; English and German, $58, c.i.f. Atlantic seaport. Spiegeleisen, 18@20 per cent, $25@$27 per gross ton, f.o.b. furnace.

Ferrovanadium—$4 per lb. of V contained, according to analyses and quantity.

The prices of **Ferrotitanium, Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotungsten** and **Ferro-uranium** are unchanged from the issue of Feb. 4.

Metal Products

Copper Sheets—Current New York list price, 21.25c. per lb.; wire, 14@14.25c.

The prices of **Lead Sheets, Nickel Silver, Yellow Metal** and **Zinc Sheets** are unchanged from the issue of Feb. 4.

Refractories

The prices of **Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick,** and **Silica Brick** are unchanged from the issue of Feb. 4.

The Iron Trade

Pittsburgh, Feb. 7, 1922

Though the finished-steel markets have in general presented the appearance since the first of the year of being exceedingly dull, the crucial test of mill operations shows that there has been a fairly steady increase, whereby the rate of steel production is nearly back to the rate of 23,000,000 tons of ingots a year shown in October and November. In the last week of December the rate was under 18,000,000 tons.

The strenuous price competition for orders of even decidedly modest proportions has given the market the appearance of presenting a lighter tonnage demand than actually existed. Extreme prices are probably no lower than a month ago, but are being named on smaller-sized orders than formerly.

Generally speaking, the buying of steel is widespread and in small lots, with mixed specifications. Lines of consumption that are subject to seasonal influence are seasonally dull—the oil-country trade in tubular goods, for instance. Spring is expected to bring heavier demand all around, with a higher steel producing rate than for a twelve month.

Pig Iron—The market continues dull. Prices, at $19.50 for bessemer, $18 for basic, and $19 for foundry, are not quotably altered, but do not seem firm. Inquiry continues light.

Iron Ore—January shipments from Lake Erie docks were 211,533 tons, against 723,294 tons a year ago, leaving 8,223,216 tons on dock, against 9,217,089 tons in January, 1921.

Coke

Connellsville—Furnace, $2.75; foundry, $3.75@$4.25.

COMPANY REPORTS

Tonopah Divide Mining Co.

A report of operations of the Tonopah Divide Mining Co. for the period from Dec. 31, 1919, to Dec. 31, 1921, shows a net profit of $10,897 for 1920 and a net profit of $101,559 for 1921. Profit and loss statements and balance sheets appear in the accompanying table.

Actual mine operations ceased on April 16, 1921, due to a walkout of all classes of mine labor on that date, and work was not resumed until July 20, 1921.

The deepest lateral work, which is on the 1,000 level, has proved the vein to be more persistent than on the upper levels. It is therefore the intention of the management to rush the sinking of the shaft until it reaches water level in order to reach the sulphide zone.

From Jan. 1, 1920, to Dec. 31, 1921, about 22,752 tons of ore, having a value of $26.48 per ton, was mined and shipped, in addition to 6,346 tons of second-class ore of average value of $11.54, which was mined and added to the stockpile of mill ore at the mine.

No engineer's estimate has been made for the new ore that has been opened up as a result of the devlopment work that has been done since E. A. Julian made his report, but according to the report, considerably more ore of shipping and milling grades has been developed by this work than the tonnages mentioned above as having been extracted in the course of the mining operations since Mr. Julian's report of 52,000 tons of ore, averaging 20 oz. silver and 0.08 oz. gold, was made. The report further states:

"At the present time the higher-grade ore mined is shipped by auto truck to one of the mills in Tonopah. As the cost of transporting the ore by auto trucks is almost prohibitive, it is hoped and expected that a sufficient supply of water will be developed with depth to simplify the milling problem, and to justify the erection of a mill for the treatment of the ore at the mine, so as to make feasible the mining and milling of the large tonnages of $8 to $15 ore which are now developed in the mine, but which will not stand the shipping costs.

"With a mill upon the company's own claims, the second-class ore which has been mined and accumulated in a stockpile on surface near the shaft, and which at present consists of 22,346 tons of ore averaging $8.73 per ton, could also be treated to advantage."

PROFIT AND LOSS STATEMENTS, 1920 AND 1921

Earnings:	1920		1921	
Tons treated (value)	$266,254.18 (*a*)		$336,275.30 (*b*)	
Metallurgical loss	27,168.00		34,411.91	
Net recovery		$239,086.18		$301,863.39
Rentals		3,921.66		2,800.00
Transfer fees		791.65		176.57
Discount		88.18		20.71
Miscellaneous		6.25		34.58
Total earnings		$243,893.92		$304,895.25
Expenses:				
Mining, including development	$111,525.43		$73,916.40	
Ore transportation and treatment	86,354.54		98,469.38	
General	30,438.68	228,318.65	25,791.41	198,177.19
Balance		$15,575.27		$106,719.06
Depreciation		4,677.81		5,159.98
Net profit		$10,897.46		$101,559.08

(*a*) 9,989 tons. (*b*) 12,763 tons

BALANCE SHEET:

Assets	Dec. 31, 1920		Dec. 31, 1921	
Mines and mining claims as of Jan. 1	$867,712.00		$798,732.47	
Depletion, 1919	35,066.42			
	$832,645.58		....	
Deduct depletion of ore	33,913.11	$798,732.47	$47,930.34	$750,802.13
Mine buildings, equipment, at end of year	$24,675.37		$33,634.74	
Additions	12,901.62		9,611.81	
	$37,576.99		$43,246.55	
Deduct depreciation	3,942.25	33,634.74	4,463.06	38,783.49
Office building and equipment at end of year	$15,669.69		$15,147.23	
Additions	213.10		8.00	
	$15,882.79		$15,155.23	
Depreciation	735.56	15,147.23	696.92	14,458.31
Real estate		780.35		780.35
Stock discounts		129,799.20		129,799.20
Stocks and bonds		2,000.00		2,000.00
Storehouse supplies		9,961.19		6,504.20
Stock in Tonopah Divide Mercantile Co.		1,650.00		1,650.00
Prepaid fire insurance		307.30		307.30
Accounts receivable		916.66		1,664.14
Prepaid capital stock tax		657.00		552.00
Prepaid liability insurance		200.00		200.00
Meter deposits		25.00		25.00
Cash in bank		27,383.41		126,944.91
		$1,021,194.55		$1,074,471.03
Liabilities				
Authorized capital stock 1,250,000 shares at $1 par value	$1,250,000.00		$1,250,000.00	
Less unissued 235,200 shares	235,200.00		235,200.00	
Issued and outstanding		$1,014,800.00		$1,014,800.00
Taxes, accrued		278.33		
Accounts payable		73.93		
Surplus at end of year	$29,057.94 (c)		$6,042.29	
Add net profit	10,897.46		101,559.08	
	$39,955.40		$107,601.37	
Deduct charge for depletion	33,913.11	6,042.29	47,930.34	59,67[illegible] 03
		$1,021,194.55		$1[illegible]74,37[illegible] 03

(*a*) Depletion for 1919 included.

Mount Lyell Mining & Railway Co., Ltd.

A report of operations of the Mount Lyell Mining & Railway Co. for the year ended Sept. 30, 1921, states that the working account shows a profit of £133,531 3s. 9d. After deducting £4,459 10s. 4d. for prospecting and development, and £48,590 7s. 8d. for depreciation of mine plant, the net profit from all sources amounts to £51,830 2s. 3d., as compared with £76,007 11s. 1d. for the previous year.

Mount Lyell Mine—The ore mined was 91,421 tons, all of which was won from the underground workings. The assay values were 0.40 per cent copper, 0.91 oz. silver, and 0.01 oz. gold.

North Mount Lyell Mine—The ore won was 98,556 tons, of which 29,653 tons, assaying 8.76 per cent copper, 1.68 oz. silver, and 0.013 oz. gold, were sent to the smelters; 50,224 tons, assaying 6.50 per cent copper, 1.21 oz. silver, and 0.012 oz. gold, to the sorting plant, and 18,679 tons, assaying 3.72 per cent copper, 0.59 oz. silver, and 0.009 oz. gold, to the concentrating mill. The average assay value of the whole of the ore was 6.66 per cent copper, 1.24 oz. silver, and 0.012 oz. gold. The increase in output as compared with the previous year was 24,775 tons.

Lyell Comstock Mine—The ore won was 6,452 tons, assaying 3.27 per cent copper, 0.34 oz. silver, and 0.031 oz. gold, all of which was sent to the flotation plant. Ore is still available for extraction by open cut from this property, but at present the lower-grade ores from the North Mount Lyell Mine are sufficient to keep the whole of the concentrating plant running to full capacity.

The following summary gives the position of the reserves as of Sept. 30, 1921:

	Tons Dry	Average Assay		
		Copper, Per Cent	Silver, Oz.	Gold, Oz.
Mount Lyell Mine, including South Lyell Mine	1,711,088	0.50	1.50	0.04
North Mount Lyell Mine	1,095,981	6.00	1.33	0.005

Attention is directed to the fact that, prior to the installation of the flotation plant, the then reserves of Mount Lyell pyrites appeared to be sufficient only to provide the necessary quantity for the treatment of the company's developed siliceous ores (North Mount Lyell and Mount Lyell Comstock). The effect of the flotation plant was to reduce considerably the pyrites required for smelting. The introduction of the sorting plant, coupled with the completion of the flotation plant extension, has further reduced the requirements of pyrites. There will thus be available a surplus of pyrites for the treatment of any further ores that may be opened up in the North Mount Lyell or other leases, or for the chemical works.

The blister copper produced amounted to 5,786 tons, as compared with 4,580 tons for the year ended Sept. 30, 1920. The contents were:

	Year Ended Sept. 30, 1921	Year Ended Sept. 30, 1920	Year Ended Sept. 30, 1919
Copper, tons	5,738	4,536	5,314
Silver, oz.	178,380	168,109	266,864
Gold, oz.	4,744	5,164	5,538

New Jersey Zinc Co.

A statement of the New Jersey Zinc Co., for the quarter ended Dec. 31, 1921, follows:

Income from operations and dividends from subsidiary companies, after deducting all expenses, taxes, maintenance, repairs and renewals, betterments, depreciation and contingencies		$705,373.71
Deduct:		
Interest on first mortgage bonds	$40,000.00	
Interest on stock subscription	10,676.64	50,676.64
Net income for the quarter		$654,697.07

SUMMARY

Net income for the first quarter		$178,161.11
Net income for the second quarter		583,927.53
Net income for the third quarter		763,052.65
Net income for the fourth quarter		654,697.07
		$2,179,838.36
Less dividends:		
2 per cent paid Nov. 10, 1921	$909,328.00	
2 per cent payable Feb. 10, 1922	909,328.00	1,818,656.00
Balance carried to surplus		$361,182.36
Dividends paid from accumulated surplus:		
2 per cent paid May 10, 1921		$840,000.00
2 per cent paid Aug. 10, 1921		909,328.00
		$1,749,328.00

Ore and Metal Movements for December, 1921

Imports and exports of the more important metals and ores during December of 1921, as reported to the Department of Commerce, and the figures for December, 1920, as finally revised, are as follows:

IMPORTS, DECEMBER, 1920 AND 1921

In Pounds, Unless Otherwise Stated

	December, 1920	December, 1921
Antimony ore, contents	112,937	......
Antimony matte, regulus, or metal	1,782,325	2,286,638
Copper		
Ore, contents	2,223,130	7,528,443
Concentrates, contents	3,740,940	4,520,355
Matte and regulus, contents	357,489	2,795,843
Imported from		
Spain		1,073,241
Canada	506,762	233,583
Mexico	2,344,200	1,107,655
Cuba	1,188,753	2,182,262
Chile	1,077,965	7,483,105
Peru	22,786	210,558
Colombia		2,581
Unrefined, black and blister	25,197,147	14,731,185
Refined, in bars and plates	7,794,612	1,655,414
Old, for remanufacture	259,007	784,790
Composition metal, copper chief value	1,369,153	7,721
Lead		
Ore, contents	1,265,230	830,967
Bullion, contents	7,550,590	....
Imported from		
Canada	760,121	435,061
Mexico	7,875,397	......
Chile	66,785	395,008
Pigs, bars and old	9,008,614	467,365
Manganese ore, long tons	64,748	14,900
Imported from		
Cuba, long tons	29	..
Brazil, long tons	46,650	14,900
British India, long tons	7,250	....
Tungsten ore, long tons	72	17
Pyrites, long tons	20,972	32,164
Imported from		
Spain, long tons	12,472	32,164
Canada, long tons	5,400	.....
Tin ore, long tons	1,594	561
Tin bars, blocks and pigs	5,893,627	8,879,859
Imported from		
United Kingdom	313,738	3,179,295
China	....	56,000
Straits Settlements	5,268,113	5,475,983
Australia	199,360	79,520
Zinc		
Ore, contents	936,712	80,000
Imported from		
Canada	75,111	80,000
Mexico	847,641	
Blocks or pigs and old		131,245

EXPORTS OF COPPER, LEAD AND ZINC

In Pounds.

	December, 1920	December, 1921
Copper		
Ore, contents	Nil	Nil
Concentrates, contents	Nil	Nil
Unrefined, black and blister	112,299	
Refined, in ingots and bars	36,995,210	58,524,588
Exported to		
Belgium	3,392,368	3,322,453
France	5,558,211	8,807,022
Germany	10,736,783	20,971,010
Italy	112,118	2,220,952
Netherlands	2,487,999	4,474,097
Spain	....	640,062
Sweden	1,611,156	1,118,348
United Kingdom	10,076,227	1,176,815
Canada	1,009,168	17,736
Japan		11,759,781
Other countries	2,011,180	4,016,312
Composition metal, copper chief value	15,944	1,037
Old and Scrap	97,082	100,400
Pipes and tubes	610,969	64,258
Plates and sheets	1,050,838	293,031
Wire, except insulated	2,845,344	405,097
Lead		
Pigs and bars		
Produced from domestic ore	266,467	1,985,816
Produced from foreign ore	2,523,157	4,442,678
Exported to:		
France	..	1,680,749
United Kingdom	1,568,459	1,668,715
Canada	32,960	14,388
Brazil	6,600	648,089
Japan	896,000	.....
Other countries	285,605	2,416,553
Zinc		
Dross	42,000	790,978
Spelter		
Produced from domestic ore	52,862	865,484
Produced from foreign ore	....	251
Exported to		
France		504,103
Canada		311
Mexico	2,200	2,102
Japan	742	112,045
United Kingdom	8,893	.....
In sheets and strips	784,388	322,645

Average Prices of Principal Metals for Twenty-Seven Years 1895-1921

	Copper Electrolytic Standard		Lead		Tin		Zinc			Antimony	Quicksilver	Aluminum	Silver	Platinum
Year	New York	London	New York	London	New York	London(a)	New York	St. Louis	London	New York	New York	New York	New York	New York
1895	10 76(b)		3 23		14 05	[illegible]	[illegible]			7 660	[illegible]	[illegible]	[illegible]	
1896	10 88(b)		2 98		13 29	[illegible]	[illegible]			6 650	[illegible]	[illegible]	[illegible]	
1897	11 29(b)		3 58	12 367	13 67	61 400	4 12			6 750	[illegible]	[illegible]	[illegible]	
1898	12 03(b)		3 78	12 983	15 70	[illegible]	4 57			8 690	40 70	[illegible]	[illegible]	
1899	16 67		4 47	14 933	25 12	122 429	5 75			9 430	[illegible]	32 72	[illegible]	[illegible]
1900	16 19		4 37	16 987	29 90	[illegible]	4 39			[illegible]	51 00	32 72	[illegible]	[illegible]
1901	16 11		4 33	12 521	26 74	118 633	4 07			8 250	47 00	33 00	[illegible]	[illegible]
1902	11 626	52 460	4 069	11 262	26 79	120 720	4 84			6 120	48 03	33 00	[illegible]	[illegible]
1903	13 235	57 970	4 237	11 579	28 09	127 320	5 40	[illegible]		6 000	41 32	33 00	[illegible]	[illegible]
1904	12 823	58 884	4 309	11 983	27 99	126 733	5 100	4 931		6 571	41 00	35 00	[illegible]	[illegible]
1905	15 590	69 465	4 707	13 719	31 358	143 083	5 882	5 730	25 433	10 250	38 50	35 00	[illegible]	[illegible]
1906	19 278	87 282	5 657	17 370	39 819	180 646	6 198	6 048	27 020	21 730	40 90	35 75	[illegible]	[illegible]
1907	20 004	87 007	5 325	19 034	38 166	172 638	5 962	5 812	23 771	14 840	41 50	45 00	[illegible]	[illegible]
1908	13 208	59 902	4 200	13 439	29 465	133 124	4 726	4 578	20 163	8 004	44 84	28 76	[illegible]	[illegible]
1909	12 982	58 732	4 273	13 042	29 725	134 774	5 503	5 352	22 185	7 466	46 50	22 00	[illegible]	24 87
1910	12 738	57 054	4 446	12 920	34 123	155 308	5 520	5 370	23 050	7 386	47 06	22 25	[illegible]	32 70
1911	12 376	55 973	4 420	13 970	42 281	192 353	5 758	5 608	25 281	7 540	46 54	20 07	[illegible]	[illegible]
1912	16 341	72 942	4 471	17 929	46 096	209 420	6 943	6 799	26 421	7 760	42 46	22 01	[illegible]	[illegible]
1913	15 269	68 335	4 370	18 743	44 252	201 679	5 648	5 504	22 746	7 520	39 54	23 64	[illegible]	44 88
1914	13 602	61 524(c)	3 862	19 076(c)	34 301	[illegible]	5 213	5 061	22 544(c)	8 763	48 31	18 63	[illegible]	[illegible]
1915	17 275	72 532	4 673	22 917	38 590	163 960	13 230	13 054	67 533	30 280	87 01	[illegible]	[illegible]	[illegible]
1916	27 202	116 059	6 858	31 359	43 480	182 096	12 804	12 634	72 071	25 370	125 49	60 71	[illegible]	[illegible]
1917	27.180	124 892	8.787	30 500	61 802	237 563	8 901	8 730	52 413	20 690	106 30	51 59	[illegible]	[illegible]
1918	24 628(d)	115 530	7 413	30 100	(e)	330 138	8 159	7 890	54 180	12 581	123 47	33 33	[illegible]	[illegible]
1919	18 691	90 796	5 759	28 590	63 328	257 601	7 338	6 988	42 879	8 190	92 15	(e)	[illegible]	[illegible]
1920	17 456	97 480	7.957	37 832	48 273	295 866	[illegible]	7 671	44 372	8 485	81 12	32 72	[illegible]	[illegible]
1921	12 502	69 356	4 545	22 752	28 576	165 265	[illegible]	4 655	25 845	4 957	45 46	21 11	62 654	[illegible]

(a) Prices of tin, London, from 1895 to 1914 from statistical report of Metallgesellschaft, Frankfurt-am-Main. (b) Prices 1895 to 1898 are for Lake copper. (c) Averages of nine months, no quotations being made during August, September, and October. (d) Average of eleven months, no quotations being made in December. (e) No average computed. (f) 99 per cent tin.

Quotations for copper, lead, tin, zinc, antimony, and aluminum, in New York or St. Louis, are in cents per pound. Quicksilver prices are per flask of 75 lb. Silver and platinum are quoted in dollars per ounce. All London quotations are given in pounds sterling per long ton.

Nitrate Industry Depressed by Large Stocks

Depression and demoralization marked the Chilean nitrate industry in 1921. The beginning of the year found large stocks unsold in Chile as well as in foreign ports, with the world at large abstaining from buying, the customary seasonal demand thus not having materilized. On June 30 stocks in Chile were 29,536,929 Spanish quintals (a Spanish quintal equals 101.43 lb.), according to a consular report from Santiago, of which about one-sixth was sold and awaiting shipment.

The production in the year ended June 30, 1921, was 47,263,030 quintals, as compared with 42,549,379 the year before. The number of oficinas in operation decreased from 101 on Jan. 1 to 41 on June 30. Prices as fixed by the Association of Nitrate Producers were nominally 17s. per Spanish quintal, f.o.b. nitrate port, including export tax, up until June 30, though the price tendency in the free market was steadily downward from Jan. 1, sales being small even at the low price of 9s. 6d. at which offers were made in June.

The most interesting feature of the year was the federation that European purchasers effected in February to protect themselves from disaster through the results of their speculation. This so-called pool, consisting of the principal marketers, succeeded finally on Oct. 11 in making an arrangement with the Producers' association whereby prices were to be reduced to a figure that it was thought would stimulate sales for consumption and which included a rebate from the association's prices to the members of the pool and certain American shippers. This rebate amounts to a subsidy of £1,500,000. In this way the loss to be met in disposing of existing stocks is to be divided between the producers and marketers.

Imports of sodium nitrate into the United States in the first eleven months of 1921 were 363,808 tons, as compared with 1,249,489 tons in the same period last year. The War Department's reserve on Jan. 1, 1921, was 300,000 long tons, of which 81,000 had been sold at the end of the year at prices ranging from $34.94 to $46.50 per ton.

The outlook for the industry in general is that it will be some time before present stocks are disposed of. The length of this period will largely depend on economic conditions in Central Europe, Chile's largest pre-war market.

The U. S. War Department's reserve of nitrate of soda on Jan. 1, 1921, was 300,000 tons. The only sale that has been made from that reserve is one of 81,000 tons. During the year little nitrate of soda was used for explosives, but a little was purchased in the open market it being cheaper to buy it than to transport it from the reserve supply.

Nickel Supplies Large and Demand Poor

For many years the price of nickel has been closely controlled, and for ten years before the Great War the metal probably brought on an average about 36 or 37c. per lb., with a range possibly of from 35 to 40c. During the war the price was raised somewhat to offset increased costs, but it is doubtful if much of the metal was sold for more than 45c. per lb. The International Nickel Co. has for some time produced more than half of the world's supply, and was thus enabled to maintain a closely regulated price.

The close of the war found most of the combatant governments with appreciable stocks of the metal, which were being used for current demands. Cessation of munition and armament manufacture, however, made these unnecessary, so government buying has been virtually a minus quantity in the last three years. The Mond Nickel Co. also had appreciable stocks on hand at the close of the war, and still has, having produced continuously since that time. The International Nickel Co. continued production for a time, as its stocks were low, but closed down last fall after amassing a considerable unsalable surplus. The new plant of the British America Nickel Corporation also produced for some months, and is now said to be holding about 4,000,000 lb. of the metal, awaiting a market.

For some time the market for nickel has been practically non-existent. The chief interest has maintained nominal prices of 41c., but it is extremely doubtful if any new business has been placed at this figure. From 30 to 32c. per lb. is about the best that can be obtained at present, with sales small and scarce even at this level. Competition in this country has been somewhat keener than usual, for the Mond Nickel Co. has appointed a New York selling agent; then, too, there is the British America accumulation, which may be unloaded at any time. Some American copper refineries have small amounts of nickel for sale, obtained as a byproduct, but the tonnage is insignificant. The U. S. Nickel Co. at New Brunswick, N. J., which formerly refined foreign ores and mattes, it is understood has been closed down for some months.

With the disarmament program practically sure of ratification, one of the main outlets of nickel will be closed, but it is likely that, except during the war, the commercial demand was the major one. Recovery of the nickel market will therefore depend on increased commercial activity and a widening of the uses for nickel and Monel metal. It is unlikely that the present surplus will be absorbed within two years, although this of course is entirely dependent upon conditions which it is difficult to predict.

MINING STOCKS

Week Ended February 4, 1922

Stock	Exch.	High	Low	Last	Last Div.	
COPPER						
Ahmeek	Boston	64	61½	62	Sept. '20, Q	$0.50
Alaska-Br. Col.	N. Y. Curb	[illegible]	[illegible]	[illegible]		
Allouez	Boston	30¾	29	29	Mar. '19	1.00
Anaconda	New York	49	47½	[illegible]	Nov. '20, Q	1.00
Arcadian Consol.	Boston	2½	2	2½		
Ariz. Com'l.	Boston	9	8½	8½	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*25	*22	*24		
Bingham Mines	Boston	13½	13	13½	Sept. '19, Q	0.25
Calumet & Arizona	Boston	60	58	59	Dec. '21, Q	0.50
Calumet & Hecla	Boston	275	272	275	Jan. '20, Q	5.00
Canada Copper	N. Y. Curb	*26	*25	*26		
Centennial	Boston	13¾	13¼	13½	Dec. '18, SA	1.00
Cerro de Pasco	New York	34¼	33½	33¾	Mar. '21, Q	0.50
Chile Copper	New York	17⅝	16¾	17¼		
Chino	New York	27	26¼	26¾	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*31	*28	*28½		
Consol. Arizona	N. Y. Curb			3	Dec. '18, Q	0.05
Cons. Copper Mines	N. Y. Curb	1¼	1	1⅛		
Copper Range	Boston	45½	43	44¼	Sept. '20, Q	0.50
Crystal Copper	Boston Curb	*60	*54	*57		
Davis-Daly	Boston	8¾	8	8¾	Mar. '20, Q	0.25
East Butte	Boston	11½	11¼	11¼	Dec. '19, A	0.50
First National	Boston Curb	*75	*65	*65	Feb. '19, SA	0.15
Franklin	Boston	†2¼	†1½	1¾		
Gadsden Copper	Boston Curb	*40	*30	*39		
Granby Consol.	New York	29¼	27	28¼	May '19, Q	1.25
Greene-Cananea	New York	27¾	27	27¾	Nov. '20, Q	0.50
Hancock	Boston	†3	†2¼	2¼		
Howe Sound	N. Y. Curb	2½	2¼	2½	Jan. '21, Q	0.05
Inspiration Consol.	New York	39¼	38¼	38	Oct. '20, Q	1.00
Iron Cap	Boston Curb	7¾	7½	7	Sept. '20, K	0.25
Isle Royale	Boston	25	24¼	25	Sept. '19, SA	0.50
Kennecott	New York	29	27½	28¾	Dec. '20, Q	0.50
Keweenaw	Boston	1	1	1		
Lake Copper	Boston	2½	2½	2½		
La Salle	Boston	1¾	1¾	1¾		
Magma Copper	N. Y. Curb	31	29	30¾	Jan. '19, Q	0.50
Majestic	Boston Curb	†*4	†*3	*3	....	
Mason Valley	Boston	†1¾	†1¼	1½		
Mass Consolidated	Boston	3	2¾	3	Nov. '17, Q	1.00
Miami Copper	New York	27½	26½	26½	Nov. '21, Q	0.50
Michigan	Boston	†2½	†2	2½		
Mohawk	Boston	58½	56¾	58	Nov. '20, Q	1.00
Mother Lode Coa.	N. Y. Curb	8⅛	7⅞	8		
Nevada Consol.	New York	14⅞	14½	14¾	Sept. '20, Q	0.25
New Cornelia	Boston	18½	18	18⅜	Aug. '20, K	0.25
North Butte	Boston	12¾	12¼	12¾	Oct. '18, Q	0.25
North Lake	Boston	†*40	†*20	*25		
Ohio Copper	N. Y. Curb	*10	*10	*10		
Old Dominion	Boston	†26½	†25½	26	Dec. '18, Q	1.00
Osceola	Boston	35¼	35	35	June '20, Q	0.50
Phelps Dodge	Open Mar.	†180	†170		Jan. '22, Q	1.00
Quincy	Boston	46	45	46	Mar. '20, Q	1.00
Ray Consolidated	New York	14¾	14⅛	14¼	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*6	*2	*3		
St. Mary's Min. Ld.	Boston	46½	45½	46½	Dec. '21, K	1.00
Seneca Copper	Boston	17¾	16¾	16¾		
Shannon	Boston	1⅛	1	1	Nov. '17, Q	0.25
Shattuck Arizona	New York	8¼	8	8	Jan. '20, Q	0.25
South Lake	Boston	*60	*60	*60		
Superior & Boston	Boston	1¼	1	1¼		
Tenn. C. & C. cfs	New York	11	9¾	11	May '18, I	1.00
Tuolumne	Boston	*65	*60	*62	May '13,	0.10
United Verde Ex.	Boston Curb	29¼	28¾	29⅛	Feb. '22, Q	0.25
Utah Consol.	Boston	2	1¾	2	Sept. '18,	0.25
Utah Copper	New York	63½	61¾	63½	Dec. '21, Q	0.50
Utah Metal & T	Boston	1¼	1	1¼	Dec. '17,	0.30
Victoria	Boston	2½	1½	2¼		
Winona	Boston	*45	*40	*45		
Wolverine	Boston	11	10½	10½		
NICKEL-COPPER						
Internat. Nickel	New York	12¾	12	12¾	Mar. '19,	0.50
Internat. Nickel, pfd	New York	71¾	69½	69½	Nov. '21, Q	1.50
LEAD						
National Lead	New York	92	87½	91	Dec. '21, Q	1.50
National Lead, pfd	New York	112½	112	112	Dec. '21, Q	1.75
St. Joseph Lead	New York	13½	13⅛	13½	Dec. '21, Q	0.25
QUICKSILVER						
New Idria	Boston	1	1	1		
ZINC						
Am. Z. L. & S.	New York	13⅞	12⅞	13½	May '20,	1.00
Am. Z. L. & S. pfd	New York	37	36	36½	Nov. '20, Q	1.50
Butte C. & Z.	New York	5⅞	5½	5½	June '18,	0.50
Butte & Superior	New York	28½	24½	27½	Sept. '20,	1.25
Callahan Zn-Ld	New York	5¾	5½	5½	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	134	133	134	Nov. '21, Q	2.00
Yellow Pine	Los Angeles			*50	Sept. '20, Q	0.03

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce; [illegible] Colorado Springs; The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.	
GOLD						
Alaska Gold	New York	⅜	⅜	⅜		
Alaska Juneau	New York	⅝	⅝	⅝		
Carson Hill	New York	14½	13⅞	14½		
Cresson Consol. G.	N. Y. Curb	3 1/16	2⅞	2 15/16	Jan. '22, Q	$0.10
Dome Extension	Toronto	*80	*77	*80		
Dome Mines	New York	23¼	21½	23¼	Jan. '22, Q	0.25
Florence Goldfield	N. Y. Curb	*20	*15	*20		
Golden Cycle	Colo. Springs	*80	*78	*80	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*4	*4	*4	Dec. '19,	0.05
Hollinger Consol.	Toronto	8.22	7.95	8.22	Jan. '22,	0.05
Homestake Mining	New York	57	57	57	Jan. '22, M	0.25
Kirkland Lake	Toronto	*32	*29	*31		
Lake Shore	Toronto	1.38	1.35	1.36	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	2.42	2.38	2.42	Jan. '22, K	0.05
Porcupine Crown	Toronto	*15	*14½	*15	July '17,	0.03
Porcupine V. N. T.	Toronto	*21	*20	*19¾		
Portland	Colo. Springs	*38	*38	*38	Oct. '20, Q	0.01
Schumacher	Toronto	*34½	*33½	*33½		
Silver Pick	N. Y. Curb			*6		
Teck Hughes	Toronto	*29½	*28⅞	*28⅞		
Tom Reed	Los Angeles			*90	Dec. '19,	0.02
United Eastern	N. Y. Curb	2 1/16	1 15/16	2 1/16	Jan. '22, Q	0.15
Vindicator Consol	Colo. Springs	*22	*22	*22	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*4	*4	*4		
Yukon Gold	N. Y. Curb	1¼	1⅛	1⅛	June '18,	0.02½
SILVER						
Batopilas Mining	New York	½	½	½	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*21	*19¾	*19¾	May '20, K	0.03
Coniagas	Totonto	1.40	1.25	1.40	May '21, Q	0.12½
Crown Reserve	Toronto	*14	*12	*12	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3⅝	3⅜	3½	Jan. '22, Q	0.12½
La Rose	Toronto	*35½	*33	*33	Apr. '18,	0.02
McKinley-Dar.-Sav.	Toronto	*20	*16	*16	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.05	1.05	1.05	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅜	6	6⅛	Jan. '22, Q	0.15
Ontario Silver	New York	4⅞	4⅞	4⅞	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb			*12	Jan. '12,	0.10
Temiskaming	Toronto	*34½	*32	*32	Jan. '20, K	0.04
Trethewey	Toronto	*7	*6½	*6½	Jan. '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*56	*42	*50		
Cash Boy	N. Y. Curb	*5	*4	*5		
Dolores Esperanza	N. Y. Curb	*99	*99	*99		
El Salvador	N. Y. Curb	*5	*4	*5		
Jim Butler	N. Y. Curb	*6	*6	*6	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb			*3	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*9	*7	*7	May. '10,	0.02½
Tonopah-Belmont	N. Y. Curb	1½	1⅜	1⅜	Jan. '22, Q	0.05
Tonopah-Divide	N. Y. Curb	*64	*60	*62		
Tonopah-Extension	N. Y. Curb	1 9/16	1⅜	1⅜	Jan. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1 9/16	1½	1 9/16	Oct. '21, SA	0.05
West End Consol.	N. Y. Curb	*85	*81	*81	Dec. '19, SA	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*7	*6	*6	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	1.02½	1.00	1.02½	Dec. '20,	0.15
Chief Consol	Boston Curb	3½	3½	3½	Aug. '21, Q	0.05
Consol. M. & S.	Montreal			19½	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†3.00	†1.00	...	July '20, Q	0.10
Daly-West	Boston	1⅞	1¾	1¾	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†2½	†2¼	2¼	Apr. '21, K	0.05
Electric Point	Spokane	*4⅞	*4½	*4⅞	May '20, SA	0.03
Federal M. & S.	New York	9	9	9	Jan. '09,	1.50
Federal M. & S., pfd	New York	39	38½	38½	Dec. '21, Q	1.00
Florence Silver	Spokane	*19	*18	*19	Apr. '19,	0.01½
Grand Central	Salt Lake	*40	*40	*40	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	4⅞	4⅝	4 13/16	Dec. '21, Q	0.17
Iron Blossom Con.	N. Y. Curb	*19	*18	*18	Dec. '21, Q	0.02½
Judge M. & S.	Salt Lake	3.00	3.00	3.00	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*5	*4	*4	June '21, I	0.02
Prince Consol	Salt Lake	*12½	*6¾	*7½	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*5	*4	*5	Feb. '19,	0.01
Rex Consol	N. Y. Curb	*7	*6	*7		
South Hecla	Salt Lake	†*60	*25		Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*10	*10	*10	Oct. '17,	0.05
Stewart Mines	N. Y. Curb			*3	Dec. '15,	0.05
Tamarack-Custer	Spokane	1.95	1.90	1.90	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.50	2.05	2.15	Dec. '21, Q	0.05
Utah Apex	Boston	3	2⅞	2⅞	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	*1	*1	*1	Nov. '17,	0.01
VANADIUM						
Vanadium Corp.	New York	35⅜	32	34⅞	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	48	48	48	Jan. '22, Q	1.50
Asbestos Corp., pfd.	Montreal	....	....	78	Jan. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	14½	13½	13½	Nov. '19, Q	1.00
Texas Gulf	New York	45	41⅛	44⅞	Dec. '21, Q	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	46½	44¾	46½	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	90⅛	88½	90⅛	Dec. '21, Q	1.75½
Am. Sm. pf. A.	New York			89	Jan. '22, Q	1.50
U. S. Sm. R. & M.	New York	35	33½	35	Jan. '21, Q	0.50
U.S. Sm. R. & M. pf.	New York	42⅞	42⅞	42⅞	Jan. '22, Q	0.87

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Volume 113 New York, February 18, 1922 *Number* 7

The Resumption of Copper Production

RESUMPTION OF OPERATIONS by some of the copper mining and smelting companies, and rumors of early activity at others, have come at a rather unfortunate time, for the last buying movement ended in December and the next has so far shown no signs of appearing. The result of expected increased production and an oversold market has been a price depression to a point almost a cent under the high figure of 13⅞c., delivered, which was reached in the last half of December. The London market has also weakened, owing to lack of local demand and pessimistic ideas of European copper requirements. Doubtless the weakness in both the London and New York markets has been to some extent interrelated.

Large amounts of copper were sold for both domestic and foreign deliveries during the last four months of 1921. This is gradually being used up, and buying for spring and summer requirements should begin in the next few weeks. This will quickly stiffen the price, both because a great amount of the metal is not available at current low prices, and for the reason that when consumers see that the low point has been passed they will be anxious to buy before any material advance has occurred. It is significant that all of the larger producers are firm in their disinclination to sell at the lower prices of the last few weeks. They will be able to obtain their price if they have sufficient staying powers, which it is altogether likely they have. It is equally significant that astute metal-trading interests are willing to sell for deliveries to the end of 1922 at or less than 14c., delivered. It is evidently the expectation, therefore, that prices throughout the year will not vary greatly from the 14c. level.

The worst thing that can happen to the copper market is too great a haste to resume producing operations, and to conduct them on too extensive a scale. It is natural that the various companies should wish to end the period of forced inactivity at the earliest possible time, both to promote the welfare of their former employees and also to have a better choice of men for their operating staffs. However, there is no surer way to depress prices and to duplicate the conditions which existed in 1920 and the early months of 1921 than to keep production two or three jumps ahead of the demand. Further delay in resuming may seem onerous, but it will result in more prosperity when the time comes.

The managements of the porphyry coppers, and they are generally large producers, disclaim any intention of resumption until conditions materially change. We think they are exceedingly well advised, and that they deserve the thanks of other producers for adopting this attitude. A price of 13 or 14c. was not an altogether unprofitably one for copper producers before the war, but it will be some time, we venture to say, before wages and the cost of supplies and transportation will reach the old levels.

The Arms Conference

THE ARMS CONFERENCE at Washington will, we feel sure, be recognized in history as one of the great forward steps which the world has taken. It has been successful past all our expectations and hope. The dramatic stroke at the beginning of the conference, of limiting the naval strength of the principal sea-powers, and thus for the first time in the world's history putting a stop to the race for naval superiority, at once placed the conference in a new category as regards diplomatic methods and swift accomplishment. The various discussions and differences since then have rather wearied a fickle, sensation-loving public, and the failure to agree upon submarine, aircraft, and land forces limitations has rather dampened the thunder of applause from the on-looking gallery.

The agreement upon international rules against using submarines to attack merchant vessels and against the use of poison gas sounds well, and is possibly well as far as it goes; but is not efficient war, such as the Germans prosecuted, of the kind that profits by broken rules? War is treachery and murder at best. Small use, then, for France to forsake poison gas, unless Germany does; and if Germany does, the indications are that she doesn't, but that in deep cellars and behind the walls of factories preparations go on as of old. The saner policy for France and the United States would be to trust in agreements, but keep their poison gas handy.

Nevertheless, the conference has been a great success; if it should be continued by others as fruitful, the halcyon days of the world may have begun. The crowning achievement was the complete settlement of the Chinese-Japanese-American question, by the return by Japan of Shantung to China, and the withdrawal of all foreign aggression and territorial aggrandisement from China. Add to this the Pacific four-power treaty, and we see peace in the Pacific assured beyond much doubt for at least ten years. More than that, a new standard of fair and even generous dealing between nations has been set.

Of great importance has been the faith and confidence of other nations, European and Asiatic, in the motives of the United States and a willingness to subscribe to her program, because it was the happiest way out. England's firm friendship and constant co-operation have made the thing possible.

Of deep significance are the words of Baron Kato:

> "In Japan we realized that a new spirit of moral consciousness had come over the world, but we could not bring ourselves truly to believe that it had struck so deeply into the souls of men until we came to Washington. We came and we have learned; and in turn we have, I think, given evidence such as no man can mistake that Japan is ready for the new order of thought—the spirit of international friendship and co-operation for the greater good of humanity—which the conference has brought about."

Much is left unsettled: but when we consider what has been done, we take heart and joyfully applaud.

Culture vs. Technique

IN A RECENT QUESTIONNAIRE circulated by the Mining and Metallurgical Society of America the following question is asked:

"In the planning of a course for the training of mining engineers, should the object be to turn out men trained along broad cultural lines, and with a thorough groundwork in the fundamentals of engineering, or is the object merely to turn out men trained in the technique of the profession and more along vocational lines?"

The question depends for its answer primarily upon the type of ability represented by the student. If he has ability, brain power, initiative, and imagination he should pass through the groove of "a thorough groundwork in the fundamentals of engineering." "Broad culture" is not the function of the engineering colleges, but of the colleges of arts, and the student who desires this training may acquire it there. If he has only a few strings to his bow, then he should narrow his objective by concentrating on one or at best a few subjects which should have technique as the foundation and a presentation along a vocational trend. The inherent ability of the student is the determining factor in the attaining of a specific objective. The objective should harmonize with the average student's abilities.

Another question covers the time to be given to instruction and is as follows:

"Most of the mining schools of the country offer a four-year course in mining engineering. Columbia and Stanford require six years, and Harvard has a five-year course. The Michigan College of Mines completes the course in three years, the number of weeks' work being, however, approximately the same as in the four-year courses of other schools.

"Question: What, in your opinion, should be the length of course?"

Before this question can be answered adequately we must know whether the mining schools are making efficient use of the time allotted to them. Is there sufficient concentration upon primary objectives? Are there not too many amusement and athletic diversions that militate against concentration? Are there not too many interruptions to continuous effort by short terms, interims, holidays, and excessive dissection of subjects?

Michigan outlines a course and allots three years to it, permitting the student who cannot keep up with the pace to take a longer time. In the four-year courses which cover approximately the same ground as Michigan does the pace must be too slow for some students. What about the pace in the five- and six-year courses? Recently a student came into our office and stated that he was quitting his course, a six-year one, because the sixth year offered so little that he could not see how he could keep himself busy. It is our candid opinion that with efficient use of the time and a well-planned curriculum, four years would be sufficient for students of average ability. By skillful arrangement of the curriculum, the student of less aptitude could extend his time to five years.

In addition, the objectives of the course play a part. If men are to be trained for service positions, two years efficiently used might be sufficient. Thorough training for an engineering career might require four or five years. This brings us back to the questions of what we mean by an engineer and what fundamentals of training are necessary to approach this definition. Thus it becomes highly important for mining schools accurately to define their objective and to plan for an efficient use of time.

International Taxes

WE AS A NATION are heavily taxed. Much of the tax goes to pay interest on war loans, and out of these war loans, billions went to our European allies as loans. On this we are getting no interest, so that the interest on the bonds bought by the American nation is not paid by the ultimate foreign borrower, but by the American taxpayer, who happens to be the bond buyer also. He digs up the taxes and pays himself the interest via the U. S. Treasury.

"But," says France, our largest creditor, "Germany owes us more than we owe you. Russia owes us as much. Yet the tendency of your philosophy is to call Russia a bankrupt and let Germany beg off the same way, but to hold us to our debt. Very well: we will pay our debt—if and when Germany pays us. Otherwise we shall owe you honorably forever." Says the editor of *Le Matin*, "France owes it, and she will never stop saying that she will pay"—a dry prospect, certainly.

It is all logical: the trouble is that the United States does not owe anybody else; otherwise her taxpayers might be as cheerful about mutual cancellations as are those of some of our European allies. England will cancel France's debt to her if we cancel the English debt: France will cancel part of the German debt if England will cancel her bill against France and we will do likewise. It is a simple arithmetical problem in cancellation. But for us, it would look bad on the books, even though it might mean our cancelling what we do not have and have a fat chance to get. So we shall wait to see what turns up at the Economic Conference in Genoa: after which it is plain that we shall receive a letter from across the water. But if it becomes clear to us that our taxpayers' prospect of the burden being slightly lifted depends ultimately partly upon the fulfillment by Germany of her reparation payment to France, and of Russia being set up in business under a guardian and made to pay her just debts, then maybe as a sentimental people we shall not be quite so sympathetic with the theories of those countries (like Germany and Russia) that they should pay nothing, and not so indignant about the American capitalist being eager to get back from those countries what he has loaned. *"L'état, c'est moi,"* said Louis XIV—"the state, it is I!" *Eh bien!* The capitalist, it is ourselves—the taxpayers—in the present instance.

Concerning Mining Books and Mining Journals

BOOKS AND JOURNALS take the place, if need be, of instructors, companions, and next friends. Many a mining man in a remote camp turns of a winter night to his shelf of favorite authors, his little library of technical volumes which discuss the problems of his own profession, his favorite literary and technical journals.

"Oh, that mine enemy would write a book!" was the pious prayer of an ill-wisher, knowing that the solemn and silent one may gain a great reputation for wisdom, but if he shows his hand, or, more properly speaking, his head, he at once exposes shortcomings which brand him as a poor weak one among mortals. And if the man that writes a book gambles and plays possibly a losing game with his prestige, how much more reckless an adventurer is he that writes and prints, every week, editorials, for fifty-two weeks of the year! The letters which we get from our interested readers, some pounding out the fact that we have displayed ourselves as poor, ignorant, dumb fish, others extolling us as almost worthy to be ranked among the foremost thinkers, show the danger of the fray and the audacity of the business. But when we have encountered a book of ours in the scanty pack of a tramper in the jungles of Nicaragua or treasured in the library of a lonely and thoughtful man in Mexico, or find that our little lessons are being taught to students in South America; or when our book has won us a hearty handshake from a prospector in Nevada, we have come to believe that the game is worth the candle and that we will take the danger of incidental missiles.

But each man covers in his mental scope only a small segment of the field of technical knowledge. The scope of the mining field has become so great that specialties unsurmountable arise. You may be expert on flotation; what do you know about blasting? You are a successful mine manager; what do you know about geology? Better possibly that you forget what you think you know if your thought runs in that direction. You understand about hoists and compressors and the like, even kilowatt-hours and power plants; do you understand the domestic and foreign situation of the market for the metal you mine? No, you do not know it all; the all-round mining man who protested his universal knowledge twenty years ago has shrunk into the background. He is likely not to know enough about anything to be able to compete with specialists; and jobs for him turn out to be increasingly scarce. But you can know as much about one branch as anybody—more than anybody should be your ambition; and when you want the details of the other branches of which you have only a general knowledge, you can look it up. You can ask those friends on your bookshelf, who have concentrated on the matter, till they are willing to gamble their reputation that what they say is correct.

You cannot do everything in your plant, even if you are general manager; many of your subordinates or your operating staff know more about some one detail of the business than you do. But by marshalling and controlling their knowledge and skill you extend the range of your own powers. Your books and journals are your technical staff. You have here your assistants, your specialists on mine management, cyaniding, flotation, concentration, power plants, electric installation, breaking and stoping, geology, market situation. They are ready when you want them—and this is the justification for editors and publishers, for without them the progressive evolution and improvement of the business of mining could not go forward.

The Printer's Devil

IN OUR Annual Progress Number of Jan. 21, the imp that lurks in type and printer's ink made Mr. Sidney J. Jennings say, referring to Canada and India:

> "It seems inevitable that a decrease in gold production in these two countries must take place, *in the cost of supplies and labor which took place during* may hold out surprises in the direction of new production."

This evidently unintelligible sentence was due to the error of an entirely foreign line being inserted in the paragraph, instead of the one in which a typographical error had been marked by the proofreader—all text pages of the *Journal* being set in linotype "slugs." What Mr. Jennings actually wrote was:

> "It seems inevitable that a decrease in gold production in these two countries must take place, *although Canada, with its large area still unexplored*, may hold out surprises in the direction of new production."

Certainly no line could have been omitted with more ingenuity to obscure the real intent of the analysis, with the accuracy of which all will agree.

Mr. W. R. Rogers, statistician of the Department of Mines at Toronto, in commenting on this subject, writes as follows:

"It is true that Canada's annual output of gold during the years 1917 to 1920 inclusive fell short of the output for the preceding quadrennium. This was due to war time conditions and the readjustment period which followed. There is every indication that gold production is on the upgrade for the next few years at least. The output from placer mining in the Yukon and British Columbia is on the decline, but this is more than offset by the increase from lode mines in other parts of Canada, notably the Province of Ontario. The production of Canada is important and is now equal to 30 per cent of that of the United States.

"Porcupine, Ontario's greatest gold camp, first became an important producer in 1912, and that year Ontario contributed only 14.1 per cent of Canada's total gold output. This percentage has steadily increased, until in 1920, 73.9 per cent, or $11,665,797 of Canada's gold production, came from Ontario. Ontario's gold output in 1921 is estimated at $13,870,000, without the exchange premium, which will average about 10 per cent. In 1922, production should show an increase of at least 25 per cent over 1921.

"Porcupine has produced annually since 1912 from 89 to 95 per cent of Ontario's gold. Although the stoping levels at the Hollinger, McIntyre, and Dome (the three big producers) have reached depths of 1,530, 1,500 and 1,300 ft., respectively, practically no ore has yet been milled from below the 1,200 level. The McIntyre shaft within a few weeks will reach a depth of 2,000 ft. The grade of the Dome ore now being mined at the lower levels has considerably raised mill heads. In 1921, Dome produced $2,290,000 from ore yielding $6.82 per ton. Hollinger, during the month of December, treated an average of 3,900 tons daily, and mill heads during the first nine months of 1921 averaged $8.55 per ton. The objective for this mine is 7,000 tons' daily capacity. Dome capacity is approximately 1,100 tons per day, and McIntyre is being increased from 550 to 800 tons daily.

"At Kirkland Lake, where some very high-grade ore is being milled, it is expected that six producers in 1922 will turn out about $3,000,000 in gold. In this camp practically all the ore is being developed above the 600 level, except at the Kirkland Lake mine, where the main development is between the 700 and 900 levels. The Lake Shore mill in December treated about 65 tons of high-grade ore daily, averaging $35.35 per ton, the best performance on record to date.

"There are several other promising gold-mining areas in Ontario in the development stage. The same applies to the Province of Manitoba. In fact, lode gold mining in Ontario is the brightest spot in the whole mineral industry of Canada."

Canada possesses an immense unexplored territory where the prospect of finding new mines is excellent. Our news columns recently reported a rush to a new gold strike in The Pas district. Whether or not this turns out to be of importance, it would indeed be strange if many new ore deposits of gold, copper, and other metals are not eventually opened in this northern area, as the country is slowly searched by prospectors. It is only comparatively recently that the construction of two new transcontinental railroads has opened up vast new territories to easier prospecting. And away from the railroads, particularly to the north and east of the Porcupine district, is an enormous district rich in possibilities. Quite recently a man wrote in to us and asked an indication of where he might prospect. We suggested Canada.

WHAT OTHERS THINK

Chloride Volatilization

Thomas Varley, of the U. S. Bureau of Mines,
Comments on H. R. Layng's Article
in the Nov. 12th Issue

THE DISCUSSION of chloride volatilization by Mr. Layng brings up many points of interest. The general summation of the article presented by him indicates that all his experiments, with the exception of the one made in the semi-commercial plant, were conducted in small muffle furnaces. Evidently the object of Mr. Layng's publication is to protect certain features set forth as possible bases for patent issues.

Criticism of Rotary Furnace

Mr. Layng first states that "in most chloridizing volatilization work, the ore and chloridizer are fed into a revolving furnace fired at the discharge end." This is somewhat misleading, for at the Salt Lake Station of the Bureau of Mines, where work has been carried on for the last four years on this process, the experiments and research tests conducted have been made in practically every kind of furnace and under varying conditions. The rotary kiln, adapted after the cement type of furnace, has been generally used for the larger tests, for the reason that the mechanical difficulties in large-scale operations by this kiln are few.

Mr. Layng emphasizes, and no doubt rightly, the rôle of rapid heating, though it is probably more accurate to say that recoveries are dependent upon the kind and amount of chloridizing atmosphere, the latter being obviously dependent in part upon the rate and the manner of heating. This is a rather self-evident statement, the truth of which has been frequently commented upon by other investigators. The fact that revolving kilns have been designed and operated for long periods of time with scoop feeds in which the ore and chloridizing reagents have been fed immediately into the heated end of the kiln, and passed through the furnace to the discharge end, is substantial evidence that the subject of rapid as against slow heating has been under practical test on a large scale. This is also true of the plant at Harbor City, Cal., designed by Morris P. Kirk and E. P. Barrett, in which they tilted the larger furnace with the intake of the feed at the hot or fire end of the furnace. G. H. Wigton, of the Chief Consolidated Mine, at Eureka, Utah, also has installed a similar kiln.

Supply and Dissipation of Chloridizing Agents

The varying rate of expulsion of the chloridizing agent in different kinds of ore has been noted by numerous experimenters, and devices have been made and used for feeding the chloridizing agent directly into the heated zone of the furnace, and independently of the ore. The actual rate at which the chlorine or its compounds is eliminated from the ore seems to depend not only on the chemical nature of the ore (acidic or basic) but also on the physical conditions of the ore particles themselves, as the rate of evaporation is a direct function of the surface exposed, except in relation to adsorbed films.

This is a natural conclusion and is set forth clearly in Serial No. 2,247, *Reports of Investigations*, Bureau of Mines, May, 1921, by Thomas Varley and C. C. Stevenson. This paper explains the dissipation of chlorides and the addition of calcium chloride in a specially designed injector at the heated portion of the kiln. In February, 1919, calcium chloride was added by this injector to the heated portion of the 50-ft. kiln at Goodsprings, Nev., and was also supplied in a similar manner in solution form.

Possibility of Errors in Muffle Testing

The usual experience with muffle tests on the chloride volatilization process indicates that it is extremely difficult to draw rigorous conclusions from results so obtained. This is particularly true when one is attempting to compare recoveries (i.e., amounts of various constituents volatilized) in related experiments. Even the matter of small inaccuracies in temperature determination is often sufficient cause for considerable discrepancy between otherwise comparable experiments. For example, it is perfectly possible that a temperature difference of 100 deg. between two tests might cause a difference in silver recovery, say at 850 and 950 deg., of no less than 50 per cent. As a safe estimate of the accuracy of technical temperature measurements at or near 1,000 deg. C. should allow for a variation of from 10 to 20 deg., two apparently duplicate tests might readily vary by $\frac{20}{100} \times 0.50 = 10$ per cent from this cause alone. In view of the possible discrepancy from undetermined causes, Mr. Layng's conclusions, based on runs *A* and *B*, second paragraph, page 766, and in all other instances where he places reliance on muffle tests, seem to be without sufficient warrant. Judging from our own experiences, it is probable that duplicate tests, made under conditions as nearly identical as they can be controlled in a muffle, might be subject to even greater variations than those observed.

Although muffle tests of the sort described are sometimes useful in a roughly qualitative way, the nature of the exact chemical reactions taking place during chloride volatilization is not determinable by these methods. Our knowledge of the complex reactions, a number of which probably occur simultaneously, is admittedly incomplete, and we therefore feel strongly that exact knowledge of what is taking place can be had only from scientific research rather than from small-scale technical experiments.

Physical and Chemical Composition of the Ore as Factors Affecting Volatilization

Microscopic examination of coarse calcined materials has shown the presence of mineral particles which had not been noticeably affected by the treatment received, and this evidence indicates that grains of mineralized quartz do not necessarily crack and expose the incased mineral to volatilizing conditions at the temperatures attained.

Ocherous oxidized ores are nearly always more porous and disintegrated than a straight siliceous oxidized ore, and the larger surfaces and nature of the first-named material would help to prevent vaporization loss of a chloridizing agent. Judging from the sulphur analyses, Mr. Layng was dealing only with oxidized ores—the type that have the greatest chance for success by volatilization, from the economic viewpoint, considering the difficulties found with other processes.

It will be noted that Mr. Layng, in common with other experimenters, has found considerable difficulty with silver. Beside the above-noted physical factors of manner of dissemination of the metallic portions, and the porosity of the ore, the actual constituents present in the gangue and the properties of the metal chloride itself must be examined. From work done in chloridizing processes (cf. O. Hofmann, "Hydrometallurgy of Silver") and in other processes where it was attempted to chloridize and volatilize the base metals, leaving behind metallic gold and silver (Schnabel, "Handbook of Metallurgy," "Chloridizing Roasting of Silver Ores for Amalgamation"; Rose, "Metallurgy of Gold," page 414, "Miller's Chlorine Process"), it was found that silver chloride formed largely after the other base-metal chlorides, and volatilized with greater difficulty. This, in connection with the above set forth statements on the varying physical natures of ores, and in consideration of the fact that silver is not only finely disseminated but also very low in percentage, would account for the difficulties found in volatilizing this metal without bringing in any unusual chemical compounds.

Some unpublished work on chloridizing of silver minerals, done at the Pacific Station of the Bureau of Mines, has shown that most of the silver minerals during oxidizing roasting are converted to metallic silver and likewise under certain conditions the chloride of silver tends to decompose and give metallic silver. We find metallic silver difficult and rather slow to chlorinate, and are now working on the hypothesis that the formation of metallic silver is one of the chief contributors to the above-mentioned trouble.

THE CAUSES OF SINTERING AND "BALLING"

The causes of sintering and "balling" in a kiln, with methods for their prevention; the importance of having the chloridizing agent present at the point of maximum temperature, together with the conditions preventing that presence and means to overcome the difficulty; firing at the feed end of the kiln, and the importance of a high temperature for rapid volatilization, were all noted in articles published before, particularly in one appearing in the Bureau of Mines Report, Serial No. 2,247 (Varley and Stevenson), May, 1921. Mr. Layng's work confirms many of these points. Perhaps he has over-emphasized the influence, in "balling," of a great excess of chloridizing agent, as compared to the influence exercised by the constituents of the ore. The melting point of salt, for instance, is given as 804 deg. C. Unless a great excess of salt has been used, the greatest "balling" is at the hottest zone (say 1,000 deg. C.), with the lead and other compounds in the charge exercising great influence. The use of lime, feeding the chloridizing agent in at the hot zone, and other methods of procedure, have been noted in the article above mentioned and in others. It may be noted that Mr. Layng's ore No. 5, with only a "trace" of lead, "showed the least tendency to cement," whereas ore No. 1, containing 6.37 per cent lead, and only 0.48 per cent lime, showed the greatest.

Mr. Layng confirms the fact, already noted, that calcium chloride is a better volatilization agent than sodium chloride, and also is better to prevent "balling." The distinction between this "balling" and a truly sintered product should be carefully noted provided "balling" is not excessive it will often give a calcine lower in metal content than the rest of the product, and it will tend to prevent "dusting." The sintering caused by forming, say, lead silicate, will be very harmful, and when large pieces of this sinter must be barred from the hottest zone, tailing losses are usually high. It is also true that most metals evaporate as such with much less speed than as chlorides.

Besides the varying degrees of fusibility given to an ore by its gangue constituents, these latter, even not including the well-known reactions of sulphur compounds, may be of importance from the chloridizing standpoint. For instance, writers have accredited much importance to manganese dioxide and cupric oxide. There is still much work to be done on determining the effect of the presence of various gangue constituents on chloridizing reactions.

MR. LAYNG'S FURNACE AN INGENIOUS DEVELOPMENT

Mr. Layng's furnace contains many ingenious ideas, and it is to be regretted that more data showing the results from its operation have not been submitted. The method of assisting the dust to settle and of obtaining a high hydrochloric-acid concentration to assist volatilization should be particularly noted.

The furnace resembles closely the Stetefeldt furnace which was used in the chloridizing roasting of silver ores for many years. Among the articles on this furnace might be quoted one from the *Transactions* of the A.I.M.E., Vol. 25, p. 137, by W. S. Morse, on operation at Aspen, Col. The ore was dried in four double-shelf dryers before being charged into one Stetefeldt chloridizing furnace, all firing being done with producer gas. About 30,000 tons of ore was treated in fourteen months; assuming steady operation, this would indicate about seventy tons' capacity per day. In dropping down the shaft, the sulphur was ignited (possibly the chloridizing action was started), and after the ore was drawn from the hopper at the bottom of the shaft (time in hopper not stated; probably, from other furnace operation, three hours) it was, in the particular case quoted, 43.5 per cent chloridized. Then it was left in a heap on the floor 102 hours longer, at the end of which time a further 26.4 per cent of the silver was chloridized. Of the total ore, 53.3 per cent went down the shaft, and the rest was caught in the return flue and dust chambers, from which it was removed and piled in a heap on the cooling floor. It is not stated how often the flues were cleaned. The ore from the flues and dust chambers was about 20 per cent better chloridized than the ore from the bottom of the shaft. The Aspen plant was, of course, seeking to avoid volatilization loss, as chloridizing and leaching was being practiced. The total loss (mechanical "dusting" and volatilization) is given as about 9.2 per cent. The ore from the dust chambers ran 18 oz. in silver and the ore from the shaft of the furnace 27 oz., so it appears that little volatilized silver chloride was stopped in the dust chambers, and that, therefore, the total amount of silver volatilized was (speaking from the volatilization process standpoint) low. To recapitulate, the "dusting" was high, the rate of roasting was slow, and the amount lost by volatilization was small.

Mr. Layng will undoubtedly run his furnace at higher temperatures than those used in the Stetefeldt, but some of the difficulties noted would probably be inherent in this type of furnace. It is difficult to conjecture what temperatures were used in the Stetefeldt furnace, as the subject of temperature measurement in those days had received only limited attention and was not well developed.

In new-type furnace operation, it is usually difficult to control, by variation of the fuel, more than one variable. Considering the ore feed fixed, that variable which it is most desired to regulate is the condition of the products—the concentrate and the reject (including slag). It is usually found advisable, to get a good fuel economy, to utilize whatever variable excess heat may come off for some other purpose, as pre-heating the ore or heating steam boilers. However, if Mr. Layng has succeeded in thoroughly volatilizing his valuable metals and at the same time has an exit gas temperature of 300 deg. F., he has shown that he has a most efficient furnace.

The use of a Stetefeldt type furnace had been considered by Bureau of Mines metallurgists, but it had been thought necessary to use the heat of the exit gases through a fairly long covered flue to pre-heat the ore—i.e., using the flue like a muffle for the gas, and rabbling the ore forward; and to evaporate there the excess of liquid chloridizing agent (in any leaching process the chloridizer would be returned as a solution). It was planned to add only enough liquid chloridizing agent to settle the dust.

It was feared that ore charged cold and wet would not have time to be heated to volatilization temperature. Even with these precautions, it was thought that the heat utilization would be poor and the dust loss (and therefore the circulating load) high. If Mr. Layng, in surmounting these difficulties, as he claims he does, has still succeeded in keeping a good extraction, he has originated a remarkable furnace. His estimated costs, as given for a 100-ton plant, are also unusually low. The development of this furnace will be watched with greatest interest.

That Mr. Layng could recover his volatilized product in solution towers would show that he had a different product than Mr. Croasdale, who did not have such success. He possibly had normal chlorides, due to the action of the water vapor, and was thus enabled to absorb them in towers as did Ottokar Hofmann (see Greenawalt's "Hydrometallurgy of Copper," page 238).

Salt Lake City, Utah. THOMAS VARLEY,
Superintendent, Salt Lake City Station,
U. S. Bureau of Mines.

The Calculation of Mill Tonnages

Fred M. Heidelberg, in his article "The Santa Barbara 500-Ton Mill for Concentrating Lead Carbonate Ores," in *Engineering and Mining Journal*, Dec. 31, 1921, calls special attention to the method used to obtain tonnages in the fine-grinding department. These tonnages can also be obtained by (1) simple inspection, (2) a short calculation.

(1)—The total original feed of plus 2 mm. to the rod mill is 425 tons (40 per cent of feed to the trommels, 200 tons, and 75 per cent of feed to the screens, 225 tons). At any instant the rod mill is crushing to minus 2 mm. at the rate of 425 tons. In the mill discharge this represents 50 per cent of the total. Therefore, the load in the mill—original feed plus return—is $\frac{425}{0.50}$, or 850 tons. Add to this the middling return from the tables, twenty-five tons, and the total is 875 tons.

(2)—Let $x =$ the tons returned to the mill from the screens. Then $(200 + x) =$ tons mill load, and $[300 + (200 + x)] =$ tons feed to screens.

As the mill discharge carries 50 per cent plus 2 mm., and the original screen feed 75 per cent plus 2 mm, $0.50 (200 + x) + 0.75 (300) = x$, solving which, $x = 650$ tons.

The total load on the mill then, is $x + 200$ or 850 tons. Add twenty-five tons middling return from the tables, and the total is 875 tons.

The circulating load in the mill, due to the return of part of the original feed, is therefore, $650 - (0.75 \times 300), = 425$ tons.

The ratio of circulating load to original feed is $\frac{425}{425}$, or 1 to 1. This ratio would probably be increased, due to minus 2-mm. material returning from the trommels and screens. GEORGE O. DESHLER.

Butte, Mont.

Direct Advertising for Copper

In common with all owners of copper stock, I am interested in improving the position of this metal with the consumer, for the remedy in the present lamentable position of copper seems to me to lie in improving the demand more than in any other direction. I notice that this seems to be the opinion, also, of Mr. A. G. McGregor in the able article contributed to your issue of Jan. 21. The defects in the retail distribution of the metal have been pointed out in various editorial articles. The remedy lies in finding new markets by direct methods.

My own experience in advertising leads me to value most highly the direct, personal appeal, and the experience of other interests in introducing the then new metal, aluminum, points the way. Most of your readers know that this was done by organizing a band of college students under good leadership to visit the housewives of America during the college vacation time and present for their inspection one or more articles made of the new metal. Among these was a lighter tea kettle. The long-suffering drudge who for years had lugged the heavy cast-iron monstrosity from stove to sink and back saw the point at once, and numerous and profitable orders were the immediate result.

This experiment might readily be duplicated in the campaign to popularize the increased use of copper. Aluminum is today the best advertised metal in America, largely because of this campaign, which went direct from the producer to the ultimate consumer. You see comparatively little advertising of the virtues of aluminum, but in every department store you will find a full supply and a vigorous demand.

Without any such demand wash-boiler bottoms are made of copper and many wash boilers are made entirely of copper. The number of small articles used by the housewife and made of copper is now quite limited because of defective marketing, but the number that might be used as the result of well-directed advertising is very large. EDWARD HART.

Easton, Pa.

VIEW OF OLD QUARTZITE HILL IN PIOCHE, SITE OF THE RAYMOND & ELY, MEADOW VALLEY, YUBA AND OTHER GREAT MINES OF THE EARLY DAYS

Ore Deposits of the Pioche District, Nevada

Failure of Past Development Due to Lack of Correlation of Several Types of Ore Formations—The Possibilities of Following Them From One to Another—Deeper Development, Properly Carried Out, Will Indicate Future Prospects of the Area

BY JOHN CARTER ANDERSON

Written for Engineering and Mining Journal

DURING THE SUMMER OF 1921 I spent a number of weeks in examination of mines and prospects in the mining districts surrounding Pioche, Lincoln County, Nev., in the course of which, through the uniform kindness of the residents and operators of the district, I had opportunity to visit nearly every property of interest. Over forty mines and prospects were visited, and many of them studied in detail.

This paper is submitted, therefore, in the hope that it may be of service to the operators of the district, whose many courtesies made it possible, and of interest to others who are concerned with the study of ore deposits.

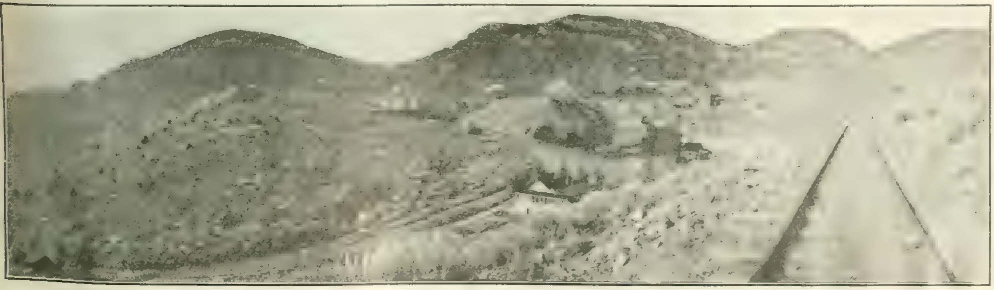
The early discoveries were in the fissure in the quartzite hill south of Pioche, and from 1869 to 1875 there was a production in excess of $16,000,000, principally from the Raymond and Ely and Meadow Valley mines, with some production from the Alps and others. The Raymond and Ely fissure was opened to 1,200 ft. with a winze 300 ft. deeper on the Yuba dike contact, first cut in a crosscut south on the 1,200 level. Decreasing silver values in the fissures, a flow of water on the 1,200 level, and the finding of zinc on the dike contact shut down the mines.

About 1890 another period of activity resulted in the mining of some rich contact orebodies along the Yuba dike in the main camp. In 1907 and 1908 a stock boom of considerable proportions started some operations by a number of companies, of which the Prince Consolidated is the only one that has been carried through to any success.

During all the intervening years leasers were active, and from time to time good orebodies were taken out on a number of properties such as the Mendha and Hamburg, in the Highland district. Several attempts were made to reopen the early mines by company operations, but their production of late years has been mainly by leasers.

Of recent years the work of chief importance has been the development of the big bedded deposits of the Prince Consolidated, Virginia Louise, and Combined Metals properties. The Prince Consolidated and Virginia Louise have been largely productive of low-grade oxidized silver-lead-manganese-iron fluxing ores, and the Combined Metals has developed a large tonnage of silver-lead-zinc sulphide ores.

The Bristol district, a few miles north of Pioche, which is here considered as a part of the broader Pioche district, has had corresponding periods of activity and



ANOTHER VIEW OF THE OLD MINES AT PIOCHE. NORTH 30 DEG. WEST BOUNDARY FAULT PASSES THROUGH THE LOW SADDLE IN THE REAR OF THE BIG DUMP [illegible], with a large production at various times by company operations and leasers. Among the many properties which have been largely productive are the Jackrabbit, Hillside, Mayday, and Gypsy. The activities of the Bristol Silver Mines Co., now shipping about 400 tons of silver-lead-copper ore weekly from the Mayday and Gypsy fissures, are the most important in the entire district at present and have a material bearing on the future of many of the properties.

In the main the area exhibits a wide extent of Paleozoic sediments intruded by Post-Carboniferous acid and semi-basic dikes, cut by several series of mineralized fissures, and later broken into numberless fault blocks by three or more series of post-mineral faults. From the presence of gold and silver veins in a series of andesitic flows in the Fay and Deerlodge districts to the east, it is believed that part if not all of the district was covered by flow rocks at the time of intrusion and mineralization. Over the greater part of the area these flows and a great thickness of sedimentary rocks have been removed by erosion; and after the country had been blocked out by faulting and erosion to a condition somewhat resembling its present topography, recent flows and tuffs covered the country. These too have been almost wholly removed from the greater part of the district, but remnants of them can be found in the Silverhorn and Fairview areas.

SEDIMENTARIES SHOULD BE FURTHER STUDIED

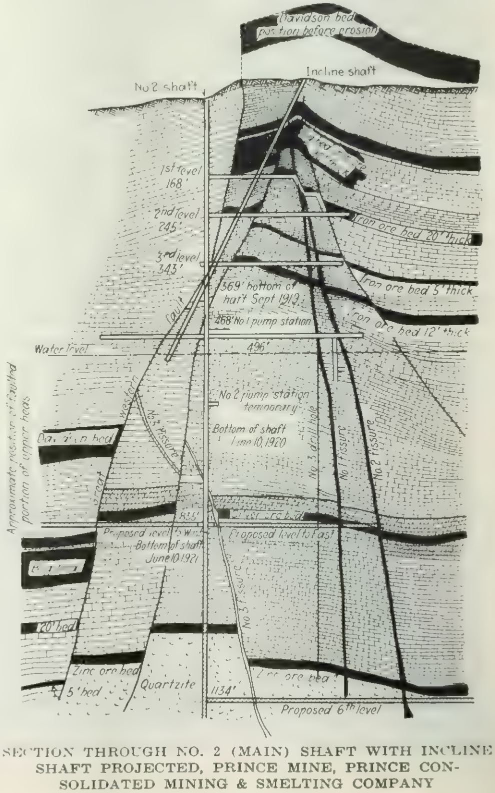
The sedimentary rocks of the region have been studied by Walcott, Spurr, and others, and their age and correlation with other sections determined, but much advantage would result from detailed study of the formations and the isolation of distinctive beds in the limestones above the Mid-Cambrian shales, and it is to be hoped that study of the district by the U. S. Geological Survey can be hastened. There are ore deposits in many of the fault blocks in which nothing but limestone is exposed, where it might be of great economic importance to know in what horizon of the beds the work is located and the probable depth to other beds which have elsewhere been particularly susceptible to mineralization. Few of the limestone beds above the shale horizon are sufficiently distinctive to be easily separated, and this can be done only by the detailed study which the U. S. Geological Survey alone can give them.

The oldest formation exposed in the region is the basal Cambrian quartzite. Deep development of the old mines at Pioche has shown this to be more than 1,500 ft. thick, and it is probable that it is of much greater thickness. In the Patterson Mountains to the north, 10,000 ft. or more of quartzite of similar age is found, and, though it is possible that it may thin out in the direction of Pioche, everything points to a great thickness of quartzite below the bottom of the deepest workings. This quartzite and its thickness is of economic importance from the fact that the most productive fissures of the district, those of the Raymond and Ely, Meadow Valley and Alps mines, have been found wholly within the quartzite. These veins are remarkable for their persistence in length and depth, and though there was a diminishing in silver values and an increase in lead and zinc in depth, it is believed that they will some day be mined for these metals at much greater depth than the present bottom of 1,500 ft.

The quartzite has fissured cleanly from top to bottom, whereas the same fissures continuing upward into the limestones and shales have been blanketed, split and soon died out. My observations point to a reasonable conclusion—that, conversely, many of the tight small fissures found in the overlying formations may open out into similar strong fissures when development reaches down to the quartzite. It is believed that future development will make productive mines in the quartzite from fissures of small importance in the formations where they are now opened.

TWO MAIN SHALE BEDS DEVELOPED

Lying conformably above the quartzite is a series of alternating shales and limestones in which the shale beds predominate for several hundred feet. These shales are exposed in numerous fault blocks in the Pioche Mountains and in the Highland Range, and have been extensively developed in the Prince Consolidated and Virginia Louise mines in the flat to the south of Pioche. Here the two main shale beds have been given the local names of the Gladstone shale and the Louise shale. They have sufficiently distinctive characteristics to be identified elsewhere. The Louise shale is highly fossiliferous and has been determined by Mr. Walcott as Mid-Cambrian. The Gladstone bed is that which overlies the quartzite. It reaches a greatest thickness of about 400 ft. It is everywhere highly micaceous and can be distinguished by the shining plates of white mica. The Louise shale lies above the Prince ore bed and under the Davidson ore bed, and has a greatest thickness of about 110 ft. It is a clean brownish shale,



SECTION THROUGH NO. 2 (MAIN) SHAFT WITH INCLINE SHAFT PROJECTED, PRINCE MINE, PRINCE CONSOLIDATED MINING & SMELTING COMPANY

THE OLD SUSAN DUSTER. A PARTLY DEVELOPED ORE-BODY OF THE COMBINED METALS TYPE.

with abundant fossils and without trace of mica or grit. Above the Louise shale are other thin beds of shale in the limestones to a total height of perhaps 1,500 ft. above the quartzite.

About 3,000 ft. of massive and heavy-bedded limestones of Upper-Cambrian age have been found in the Highland Range and are in part represented in various fault blocks in the Highland, Stampede Gap, and Bristol areas. In many of the fault blocks there is as yet no means of determining what horizon of these Upper-Cambrian limestones is represented. For the most part they are light to dark gray, hard and usually quite siliceous, with relatively few pure limestone beds.

Northward from the Bristol mine the limestones are overlain by quartzite beds which have been determined as of Silurian age, and still to the north Devonian and Carboniferous fossils are found in the limestones. In the Silverhorn district are found one or more heavy beds of shale. The total thickness of these formations above the Upper-Cambrian limestones con be determined only relatively, as the intervening country is much broken up and no continuous exposures are found, but it certainly represents several thousand feet at least, or a total of perhaps 8,000 ft. or more of sediments above the Cambrian quartzite.

Four types of intrusive rocks have been found in the Pioche and Highland districts, and related types occur in the surrounding region. Two of these were accompanied by paralleling series of fissures and a related mineralization, and a third may be related to a still later period or stage of mineralization. As previously stated, two series of flow rocks are found in outlying parts of the district, but as there is little or no connection between them and the majority of the ore deposits they will not be further discussed. The consensus of opinion has formerly favored one of these intrusives, the Yuba dike, as the direct source of all of the ore of the Pioche district, but the present study has shown conclusively that it has been by no means the sole agency of mineralization and possibly is of minor importance as compared with the occurrences of later diorite intrusions.

West of Stampede Gap, and about ten miles west of Pioche, is a massive intrusion of granite in the limestones, and extending to the eastward from this is a dike of granite porphyry or rhyolite porphyry, which can be followed to the eastern end of the mineralized zone. It is locally called the Yuba dike, because the first big contact ore deposit found along it was on the Yuba claim just east of Pioche. The Yuba dike has been separated into segments by a series of heavy faults, striking north-south or north 30 deg. west.

YUBA DIKE EARLIEST IGNEOUS INTRUSION

In its eastward course it shows increasingly the effects of quicker cooling, and might properly be called a rhyolite porphyry where seen in the quartzite at Pioche, but there can be no question as to its identity at any place. It has a strike of from east-west to north 75 deg. west and a dip of from 70 to 80 deg. to the south, and varies in width from 40 to 75 ft. It is believed to be the earliest expression of igneous intrusion in the district.

The diorite porphyry dikes of the district have been seldom recognized, and little or no importance has been attached to them, owing to the common belief in the super-importance of the Yuba dike. I first recognized them in the Comet district on the west side of the Highland Range, about ten miles southwest of Pioche. Three dark-green dikes of diorite porphyry were there found with a strike of north 70 deg. east and a steep dip to the south. Paralleling them was a series of north 70 deg. east mineralized fissures in the limestones and shales. The relations between the dikes and the fissures were such as to suggest a direct connection between the intrusives and the mineralization. Later, similar dikes with the same strike were found at the Point mine, the Ely Valley, and the Pioche Mines Co., in the main Pioche district. Likewise, a most persistent set of mineralized fissures, having a strike of from north 50 deg. to north 70 deg. east and usually between north 65 deg. and north 70 deg. east, has been found at intervals from end to end of the district. This association of the north 70 deg. east dikes and fissures with mineralization is so striking that one is forced to the conclusion that an important period of mineralization followed the intrusion of the diorite porphyry. Several examples of this series of fissures will be discussed in detail later. The diorite porphyry dikes, like the Yuba dike, seem not to have everywhere reached to the present surface.

A rhyolite dike, about 6 ft. wide, somewhat similar to the Yuba dike, but slightly less acid and without the distinctive quartz phenocrysts of that rock, was seen on one of the claims of the Pioche King Mining Co., northwest from the Prince Consolidated.

Exposed in the Hamburg tunnel is a dike of rhyolite porphyry about 6 ft. wide, filling a north-south fault. This dike is post-mineral and of no importance in con-

[illegible] with the ore deposits, except as it may fault them. Its north-south strike is of interest as an indication that the north-south period of faulting is related to the last outpouring of flow rocks.

Three series of mineralized fissures were observed in the district, the east-west to north 75 deg. west fissures, the north 60 to 70 deg. east fissures; and the north 20 to 30 deg. west fissures.

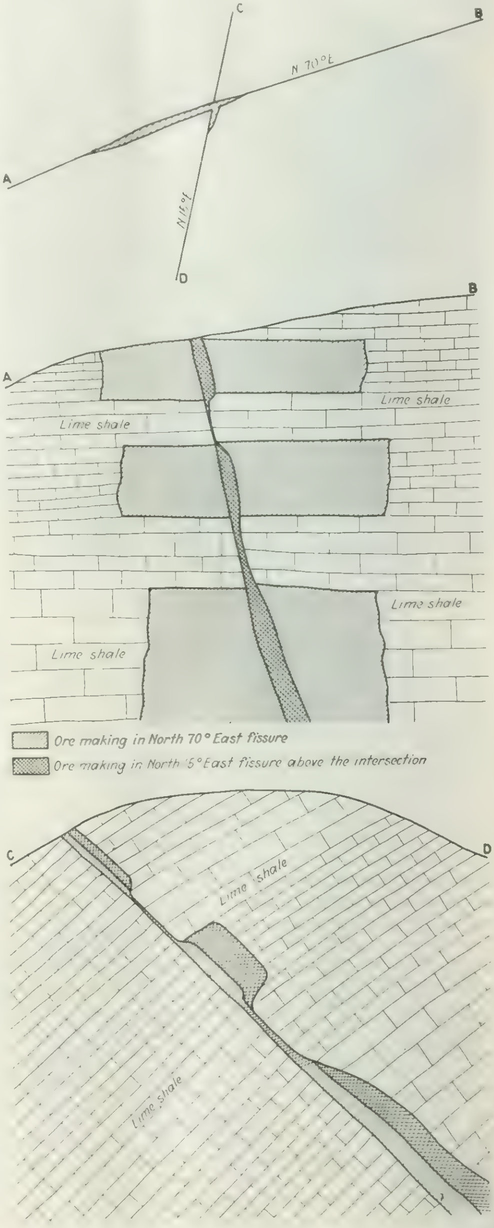
The first set seems to accompany the Yuba dike, with a general strike of from east-west to north 75 deg. west and steep dip toward the dike. Those north of the dike, as in the Montgomery-Doll group, dip to the south, and those on the south, like the Mendha, Hamburg, Highland Central and Highland Queen, dip to the north. This is probably the earliest set of fissures in the district, and the ore deposits of this series may be genetically related to the Yuba dike.

The second set of fissures have a strike of from north 60 deg. to north 70 deg. east, with an occasional fissure which turns as much as north 50 deg. east. The greater number dip to the south, though here and there one is found with a steep dip to the north. They parallel the strike of the diorite porphyry dikes, and in parts of the district the relation of the mineralization in the fissures to the dikes is clearly apparent, and it is probable that there is everywhere some connection between them. Fissures of this type are the Mayday and Tempest fissures, in the Bristol district; the Florence, west of Stampede Gap; the mineralized fissures which crosses the big garnet-iron outcrop on the Manhattan, in Stampede Gap; undeveloped fissures on the Edwards and Great Western groups, in Stampede Gap; the Wheeler fissure, in the Highland district, which is about north 50 deg. east; the Alps fissure, in the quartzite east of Pioche; and, last but not least, the Raymond and Ely-Meadow Valley fissure, from which the chief production of the Pioche district was taken.

The third set of fissures, those with the north 20 deg. to north 30 deg. west strike, is the most difficult of all to interpret or weigh the importance of the accompanying mineralization, because of the fact that there is a big series of parallel faults of this strike which are definitely post-mineral. The one place where there can be no question as to the accompanying mineralization is in the high-grade fissures in the Prince Consolidated, which have a strike of from north 20 deg. to 30 deg. west and dip to the northeast. Like the first two series of fissures, they show small displacement of the beds. The No. 1 fissure has yielded quite a tonnage of good lead-silver ores. They have been thought to be the channels through which the big beds of the Prince Consolidated and Virginia Louise were replaced and mineralized, but though they in places cut some of these beds they do not conform with the beds, and in my opinion they do not represent the main channels of circulation, if they have any connection whatever with the mineralization of those beds. Most of the faults of this strike (north 20 to 30 deg. west) which were seen in the district were post-mineral faults cutting both of the earlier sets of mineralized fissures.

If the mines of the district are ever opened to depths of 3,000 ft. or more, as I believe they will be, it will be found that there are three sets of intersecting mineralized fissures, each faulting those earlier than itself, as do the fissure systems at Butte. However, there can be no question, though the opposite opinion has been widely held in the district, that the north 30 deg. to north 50 deg. west faults which bound the quartzite in the main Pioche district are later than the ore deposits which have been so far developed and in no way mark the limits of possibilities for ore.

There are several series of post-mineral faults, a correct understanding of which is essential for the finding of faulted portions of ore deposits. Two of these,


C
B
N 70°E
A
N 15°E
D
B
A
Lime shale
Lime shale
Lime shale
Lime shale
Ore making in North 70° East fissure
Ore making in North 15° East fissure above the intersection
C
D
Lime shale
Lime shale

PLAN AND CROSS SECTIONS ILLUSTRATING INFLUENCE OF FISSURE INTERSECTIONS AND DIFFERENT LIME STRATA ON THE LOCALIZATION OF ORE DEPOSITS IN THE BRISTOL DISTRICT the north 30 deg. west faults and the north-south faults, are of big displacement. They have had much to do with the blocking out of the district in its present form, and with the throwing of faulted sections of ore deposits from one property to another. The others, as the south 70 deg. east faults, the north 32 deg. to north 45 deg. east faults and the north 15 deg. east faults, are of lesser displacement and usually affect only the search for faulted orebodies within a single property.

The north-south faults were observed particularly with respect to their faulting of the Yuba dike, where the extent of their throw is often measured in hundreds of feet. As before stated, they have, in every observation made, lifted the block east of the fault with a drag to the south, so that in searching for the dike or for veins cut by the north-south faults, one must look to the south when going east and to the north when going west. These faults cut the Yuba dike and the diorite dikes, and so are later than those periods of intrusion. No evidence whatever of any mineralization was seen along this series of faults.

The north 30 deg. to north 50 deg. west faults are economically of great importance, as they have faulted many of the important orebodies of the district. They have generally been considered as pre-mineral, rather than post-mineral, but in so far at least as concerns the main fissure veins of the district, such as the Raymond and Ely-Meadow Valley and Alps fissures, and the Yuba dike and its contact deposits, they are post-mineral. Likewise, as concerns the big bedded deposits of the Prince Consolidated and Virginia Louise, and the smaller precious-metal beds of the Half Moon type, they are post-mineral. They are usually faults of large displacement, reaching into hundreds of feet, though the bigger faults of the system may have lesser sympathetic faults, such as are seen with the Davidson fault in the Prince Consolidated.

In different parts of the district other post-mineral faults are found. Of these are such faults as the Endline fault between the Prince Consolidated and Virginia Louise, the north 32 deg. east faults in the Combined Metals, and the north 37 deg. to north 45 deg. east faults in the Half Moon. It is probably that with these lesser faults, as with the bigger faults, there is a constant direction of displacement, which, once worked out for a given series of faults, can be successfully applied in development. These faults vary from a displacement of a few feet to perhaps a maximum of 150 ft.

The classes of ore deposits found in the Pioche district are as varied as the history of the camp, and its ups and downs are but a record of the working out of one type of deposit and the period of quietude until someone developed the possibilities of another class.

The failure of past development has been its inability to learn the interdependence of the several types of ore deposits and the possibilities for following from one to the other in one property. The recent attempt at deeper development on the Prince Consolidated is the most hopeful indication of a real future for the Pioche district, and it will fail unless it is carried to a conclusive test, as it should be.

The ore deposits of the district may be divided into the following main classes: Fissure veins in quartzite; contact veins along intrusive dikes; bedded deposits, and fissure veins and fissure intersections in upper limestones.

LOOKING BACK AT THE OLD CAMP OF PIOCHE

The original discoveries of the camp were the Raymond and Ely-Meadow Valley veins of this type. They are remarkably persistent fissure veins in quartzite which have been mined for more than 2,000 ft. along the strike, up to 1,200 ft. in depth, and have widths of from 2 ft. to 9 ft. They yielded large amounts of high-grade silver and silver-lead ores, producing over $16,000,000 from these two mines alone in the years from 1869 to 1875. Most of these workings were inaccessible at the time of my visit, but evidences are everywhere seen of the extent of the old workings.

The ores as a rule became lower grade and baser in depth, and probably the high values above were in part at least due to secondary enrichment. It is to be expected that these ores will give place to baser ores in depth, as did the contact ores on the Yuba dike, but it is believed that the veins will persist and ultimately be mined to much greater depths than the present deepest workings.

What is believed to be the extension of some of these veins has been found in the overlying shales southwest of the boundary fault between the quartzite and the shale. Here they have pinched up to almost nothing, like the characteristic fissure veins seen elsewhere in the district in these horizons. A parallel case is seen in the Comet district on the west side of the Highland Range. The Comet vein, which is in the basal Cambrian quartzite, is a strong fissure 3 ft. to 9 ft. wide, but near-by fissures in the limestones and shales are almost impossible to follow except where they swell in crossing certain limestone or lime-shale beds.

OTHER FISSURES OFFER POSSIBILITIES WITH DEPTH

There should be a good possibility for other fissures in the district, which may be of small importance in the upper horizons, to open out into strong fissures when followed down into the quartzite. Fissures of this type are the north 20 deg. to north 30 deg. west silver-lead fissures of the Prince Consolidated and fissures of the east-west and north 70 deg. east series in the Highland district. The strength of the fissures in the quartzite and their weakness in the overlying formations are due to the physical reaction of the different formations to the fissuring. The quartzite broke cleanly from top to bottom because of the uniform nature of the rock, whereas the more yielding and constantly varying nature of the alternating limestone and shale beds above, blanketed and dissipated the force of the fissuring.

Just as the first work of the district was the exploitation of these quartzite fissures which were exposed by erosion, the final stages of development will lead down to the quartzite fissures which underlie the many lesser fissures found in the higher formations.

CONTACT VEINS ALONG INTRUSIVE DIKES

The next period of extensive operations in the district followed the development of the contact orebodies along the Yuba dike in the main Pioche district. The earliest discovery was in a crosscut from the 1,200 level of the Raymond and Ely. A winze was sunk 300 ft. on the so-called black ledge, a contact vein of zinc blende between the dike and the quartzite. There being no market in those days for zinc, this orebody was never worked, but it is reported that later big bodies of silver-lead ore were stoped nearly to surface on the Yuba and Mazeppa claims.

The Yuba dike can be traced for about ten miles to the west, and in many places mineralization shows along the contact. It is in successively higher beds of the Cambrian limestones as it progresses westward, and it is possible that, as with the fissures, the contact mineralization will pinch to nothing in certain limestones and bed out to form good bodies of ore in the more soluble members. Prospecting has been active recently on the western part of the dike in Stampede Gap, and it is to be hoped that it will be followed up by deeper development, as there should be big possibilities for deep ores along this contact.

Practically no work has ever been done on the diorite porphyry contacts, though some mineralization is reported from different localities. However, from the close apparent relationship between these dikes and some of the north 70 deg. east fissures, it is possible that contact ore deposits may be developed along them.

BEDDED DEPOSITS DIVIDED INTO THREE CLASSES

Several types of bedded deposits are to be noted in the district, which differ perhaps more in accordance with the horizons at which they have formed than in manner of origin. It is indeed possible that all three types may be found bedding out from one fissure as development proceeds, for the most strongly marked characteristic of the mineralization of the region is the habit it has of bedding out from an otherwise often barren fissure, where the fissure cuts certain favorable contacts or soluble limestone beds. The bedded deposits may be divided into three classes: The thin, gold-silver-lead beds at limestone-shale contacts; the silver-lead beds in limestone; and the big manganese-iron-silver-lead beds.

Beds of the thin gold-silver-lead type are found on the Abe Lincoln, Half Moon, Pioche Mines Co. and other properties in the Pioche Mountains two or three miles northwest of Pioche. They are siliceous replacements along a limestone-shale contact, that at the Half Moon being typical of the class. Here the bed is from 6 in. to 15 in. thick, with an average of less than 12 in. It lies between limestone above and shale below, and in different minor fault blocks dips at flat angles to the east and north. Values are reported to have been around $20 to $25 to the ton, about equally divided between gold and silver, with a little lead. A small mill operated unsuccessfully for a while, its chief result being to demonstrate the economic impossibility of successfully mining thin, flat beds of this character. This type of ore bed offers little attraction except to the chlorider who occasionally takes out a few carloads.

A type of bedded deposit from which large returns have been won is that of the bedded deposits in limestone which are directly related to fissure veins. Chief among these are the Mendha, Hamburg, Highland Mary, and Highland Queen mines, in the Highland district, about seven miles west of Pioche. Production from the Mendha and Hamburg properties is reported as in excess of a million dollars. Profits certainly were not in a fair ratio to the output, because of the chloriding methods of operation, but the possibilities of this type of deposit under proper methods of development and operation are excellent. The fissures from which these beds were formed are of the east-west series. In certain horizons in the limestones they may open out to workable size and value, but in others they may be difficult to even trace. Oftentimes they may be not so much beds as swells in the veins, a condition due to the more soluble limestone they are following.

CONDITIONS WARRANT FURTHER DEVELOPMENT

Development has usually been confined to the one commercial bed first opened by the prospector, and no serious attempt at real development has ever been made. In some instances such an attempt, if carried through to a finish, should have good chances for developing valuable ore deposits at other horizons. The beds of this type are usually found in the Upper-Cambrian limestones at an undetermined but considerable distance above the quartzite. Chief values are in silver and lead, with some gold, and the ore is usually of direct shipping grade, though some more siliceous beds running about $20 in gold, silver, and lead have been partly developed.

Prospecting has discovered many other smaller beds of silver-lead ores of this type along fissures of the east-west and north 70 deg. east series, and some of them have yielded small shipments of high-grade ore. Their chief importance is as possible leaders to bigger beds at depth.

One other bed of a related type is of interest because of the wide publicity recently given to the camp of Silverhorn, about twenty-three miles north of Pioche. The deposits here are in a much higher horizon than those to the south. They lie between a limestone-shale contact, apparently in genetic connection with an acid dike. A siliceous bed of considerable thickness near the dike was formed by replacement at this contact, which dips northerly at from 20 to 30 deg. Erosion has stripped the overlying shale from the hanging wall of the quartz and cut away the softer dike at the foot, so as to leave an outcrop of quartz with a deceptive appearance of great size. The quartz thins out rapidly in the direction of the dip, and any attempt to follow the quartz to depth will be a failure. It represents a bedding out at a high horizon of the final siliceous solutions with a little mineralization, and so may indicate a channel of circulation which at some depth may have bedded out again to form valuable deposits of ore, but whether or not such other bedding may occur within economic limits of sinking is problematic. Added to the apparent size of the outcrop was the bait of superficial rich chlorides and a little argentite, but it is doubtful if the body of the quartz or any considerable part of it will carry payable values.

At the Prince Consolidated and Virginia Louise mines, about two miles south of Pioche, several big replacement ore beds have been developed and partly mined. The average of the ores is about 3 oz. silver, 3 per cent lead, and 3 to 6 per cent zinc, with an excess of manganese and iron over silica of from 15 to 30 per cent. As the beds are oxidized they are a valuable fluxing ore, and the Prince has shipped about 800,000 tons to the Salt Lake smelters, earning good dividends from the shipments. The Virginia Louse has shipped a lesser but considerable tonnage, and a recent report by Walter Harvey Weed estimates that there is from 500,000 to more than 1,300,000 tons of positive and probable ore in the mine. There are good prospects for finding more ore in both mines. The ore was formed by a complete replacement of limestone beds, intercalated with the shales which overlie the Cambrian quartzite.

From my own observations it appears that as yet no satisfactory explanation of the source of the mineralization has been found, nor will the full possibilities of the deposit be known till this is determined. The deposit is cut off on the west by a north 30 deg. west fault which is roughly parallel with the apparent long axis of the deposit, and part of one big bed at least is cut off on the east by a north-south fault. These faults are certainly post-mineral, and there is reason to expect to find big sections of the ore beds beyond them, but the direction and extent of lateral movement along them must first be determined before they can be found other than by accident. The only indication seen of a possible source of mineralization of these beds was in the fact that they seem to die out to the north in the Prince and to thicken toward the south in the Virginia Louise. This may serve to indicate the approach to the main channel of circulation from which the replacement spread.

Some have believed that the ore beds are not the result of the oxidation in place of beds of primary sulphides, but are a redeposition of migratory oxides. I can see no reason to believe that they were formed in other than the same manner as the big sulphide bed of the Combined Metals, Inc.

The Combined Metals, Inc., on the west end of the Panaca claim, but in the shale beyond the fault which cut off the rich Raymond and Ely vein in the quartzite, has a replacement deposit in a bed of limestone in the Gladstone shale, which is of much importance. Here has been developed a body of 150,000 tons of lead-zinc-iron sulphides carrying 8 oz. silver, 8 per cent lead and 18 per cent zinc, in a bed that is 40 ft. thick at center, 5 ft. thick at the edges, with an average thickness of 27 ft.; 40 ft. to 167 ft. wide, with an average width of 92 ft.; and over 400 ft. long, with a possibility of finding faulted extensions to the west.

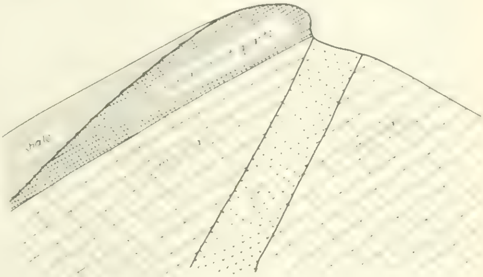
The cross-section on p. 280 of the Prince Consolidated, furnished by the company, gives a general idea of the lay of the beds and the north 30 deg. west fissures and faults. Though the correctness of assumptions based on drilling results remains to be proved, this sketch gives an excellent idea of the upper beds.

The possibilities of the type of ore deposit under discussion have best been demonstrated by the Hillside, Mayday, Gypsy, and other mines in the Bristol district. This group of mines has been worked at various times by a number of companies and individuals, and some of them are said to have made large and profitable productions, the total being reported as several million dollars. As often as worked they have been reported as bottomed, due to the pinching of the veins in certain limestone beds; but deeper work has found and yet will find other splendid orebodies.

Among the main fissures are the Mayday, Hillside and Tempest of the north 70 deg. east series of fissures, and the Gypsy of the north 15 deg. east series. The Mayday and Tempest are parallel and several hundred feet apart on surface; the Hillside may be an extension of one of these, but the connection is obscured by faulting. The Gypsy has been mined to a depth of about 1,700 ft. on the dip of the Mayday fissure, or 900 ft. vertically. The surface outcrop is not big and is marked by irregular streaks of iron and copper oxides.

The ore to the 800 level has been a mixture of iron, copper and lead oxides, with good silver values. Between the 800 level and the bottom some galena and blende is found.

The Hillside mine exhibits characteristics similar to those above noted, and a big body of rich sand carbonates and silver-lead-copper oxides has been mined out to the 900 level. This is at a higher horizon in the Upper-Cambrian limestones than the Mayday, and it should have the same possibilities for opening out at other lower horizons. Similarly, other smaller orebodies that have been mined at intersections of other north-south fissures with the Mayday and Tempest fissures should have possibilities at lower horizons.



REPLACEMENT DEPOSIT IN LIME SHALE CONTACT AT SILVERSHORN

I believe that there is a big future for the district. There are a great number of mineralized fissures of each class, many unprospected dike contacts, and several important sections of faulted ore deposits that it should be possible to find. If the district is thoroughly studied as a whole, a sound basis of correlation of the deposits worked out, and the lessons of this study applied intelligently to the individual property in a comprehensive plan of development, other important orebodies will be found. As in the past, the work will lag, and the district be dull at times till some courageous pioneer proves that in depth one may pass from one type of deposit to another within the same property. Then will come a rush of development that will make mines from many of the great number of mineralized outcrops in the district.

The possibilities for extension in depth are great, and though the investigator is not yet in a position to predict such a future, there is sufficient copper in evidence in parts of the district to show the presence of that metal in the mineralizing solutions, and it may be that here, as in some other districts, below the zinc copper will be found.

Roasting Zinc Ores for Electrolytic Reduction

Formation of Zinc Ferrate Not Always Entirely Accountable for Poor Extraction—Extremely Fine Grinding Deleterious—Quick Roasting With Thin Beds Generally Advisable—Draft Regulation Important

By THOMAS FRENCH

Written for Engineering and Mining Journal

IN A PAPER which I wrote in 1917,* reference was made to the difficulty of obtaining a high extraction of zinc after roasting ores for the reduction of zinc by the electrolytic process. At that time the extraction of zinc at one large plant varied from 40 to 60 per cent, whereas at another, 70 per cent was above the average. In the paper mentioned, it was stated that extractions of 90 per cent of zinc had been obtained from low-grade ferruginous ores, though 95 to 97 per cent could be obtained from concentrates containing 45 per cent of zinc.

During the Great War the chief concern of the producers of zinc was to obtain a large output of zinc, regardless of the percentage of extraction, although even at that time the low figures occasioned a certain amount of alarm. It was estimated that if the price of zinc fell to 7c. per lb., or even to 9c., under some mining and operating conditions, the profit would be insufficient to warrant operation of the plants. Since then, a great amount of valuable experimental and working data has been accumulated, and much improvement in roasting has been accomplished, but still the results are lower than was predicted.

MODIFICATION OF ROASTING METHODS ESSENTIAL

The object of this article is to suggest various means by which the methods of roasting may be so modified as to give increased extractions. Some of the suggested alterations are quite at variance with the present recognized practice, but as a pioneer in the electrolytic reduction of zinc ores, I actually obtained the results described.

If, through overheating, ferrate of zinc has once formed, no ordinary modification of the roasting process can be made to cure it. Some ores, in which the zinc probably exists in combination with iron as ferrate of zinc, cannot be made to give a high extraction of zinc, no matter how carefully the roasting operation may be conducted, and some ores may easily be seen to have undergone thermal metamorphism.

In the past, ferrate of zinc has often been blamed for poor extractions of zinc when in fact it was only partly responsible. It requires a considerable degree of overheating, and time, completely to combine all the iron with the zinc at the temperature used in roasting, and even then there is a definite limit to the amount of zinc that may be combined with the iron. Where a markedly low extraction of zinc occurs, the reason may more often be found in incipient fusion or sintering of the ore through the use of too high a temperature in the earlier stages of roasting, or in the failure to convert the sulphide wholly into oxide or sulphate. Once sintering has occurred—and this is likely to happen in furnaces with rotating stirrers—it is difficult to drive off the sulphur without using an excessive temperature.

Many investigators have insisted on the necessity of grinding the ores extremely fine, and data have been given prominence that might be considered conclusive proof of its benefits. It has been recommended that a large proportion should go through 200 mesh. There are, however, certain objections to fine grinding. Not only is much dust produced in the roasting furnace and carried into the flues, but when falling from floor to floor the fine state of division of the particles of sulphides causes them to flash, producing sintering and a temperature that is often far in excess of that necessary to form ferrate of zinc. For these reasons I have always endeavored to grind the ore so that as little as possible is either finer or coarser than 30 mesh. High extractions of zinc have been obtained from ferruginous ores that have been roughly crushed to pass an 8-mesh screen. This is, however, the other extreme, for although the ore is completely roasted, it is found that the zinc does not dissolve sufficiently rapidly, and that by further grinding after roasting an extraction of an additional 1 per cent or possibly 2 per cent can be obtained.

Some finely ground ores and concentrates have when wet a tendency to cake and form small lumps. Some of these in roasting pass through the furnace from hearth to hearth as small balls, which never break, and as they are only superficially roasted the center contains unaltered sulphide. In some instances a considerable loss in extraction occurs in this way. A mechanical contrivance should be placed on the drying hearth of the furnace to break up these lumps; otherwise they should be separated by sifting from the roasted ore.

SHORT ROAST ADVANTAGEOUS

In reviewing the data that have been published it is very noticeable that the ore is kept in the roasting furnace for a much longer time than is necessary or good for it. If temperature and time are involved in the formation of ferrate of zinc, the shorter the time the ore is exposed to possible periods of excessive temperature the less likelihood is there of the formation of ferrate of zinc. Following the practice which obtains in roasting ores for the retort process, it appears to be customary to keep the ore in the furnace for a long period, in some cases as much as twenty-four hours. This implies that for the same output the bed of ore on the hearths must be extremely thick.

In mechanical roasting furnaces the output is determined by the speed of the rabble arms and the number and disposition of the rabble blades. The amount of feed must be regulated to suit these, and by adjusting them to one another the ore may be kept in the furnace for any desired length of time, provided the depth of ore is within reasonable limits. The depth of ore on the hearth must be so regulated that the maximum of sulphide is converted into oxide or sulphate before it leaves the last hearth, with the minimum amount of

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*"The [illegible] of Electrolytic Zinc," *Trans.* American Electrochemical [illegible], Vol. [illegible], 1917.

auxiliary heat. It is here that the greatest judgment is required in order to obtain the best results. The difficulty is all the greater because any variation in the ores demands a different adjustment. The matter is further complicated by the fact that the rabble blades cannot be readily altered. Fortunately, only a little trouble is involved in varying the speed of the rabble arms.

OPTICAL PYROMETER NECESSARY TO EFFICIENT REGULATION

Oxidation is active on the freshly exposed surface of the ore on the middle hearths. Within a few seconds, however, the intense heat generated by the rapid oxidation on the surface dies down, and oxidation on and under the surface then proceeds much more slowly. Although pyrometer couples sunk in the roasting ore, as is often the practice, are useful in giving a general average of the temperature of the hearth, they do not give the actual temperature at which the ore is being roasted on the surface, and it is on the surface that the greater part of the roasting is done. A slight increase in the auxiliary heat for a short time may result in a sufficiently excessive superficial temperature to form ferrate of zinc or to cause sintering to take place, which the sunk couple would not register, as it would give only an average of the temperatures of the exterior and interior of the mass. An optical pyrometer is necessary to give the correct temperature at which oxidation is taking place on the surface.

To obtain the best results in roasting, the ore should be turned over as soon as the surface heat has died down. For this purpose the speed or number of the rabble arms should be considerably increased, and the number and pitch of the rabble blades must be correspondingly altered to prevent the ore from traveling over the hearths too rapidly.

DETAILS OF PREFERRED PRACTICE

The speed at which roasting takes place varies with different ores, but with most ores a seven-hearth Wedge furnace with an internal diameter of 22 ft., for instance, may be made to deliver the completely roasted ore with a considerable proportion of sulphate, sufficient to prevent either a loss or accumulation of acid in the dissolving department, at the rate of about one ton per hour. The ore should not remain in the furnace for more than four and one-half hours, and three and one-half hours is often sufficient. At this rate, the depth of ore on the hearths must be less than that usually employed when the ore remains in the furnace from six to twenty-four hours. The thinner the bed of ore and the more it is stirred, the sooner will it be roasted. In a laboratory muffle furnace, for instance, a thin layer of ore may be completely roasted in an hour or less. It is evident that with a thick layer of ore, and the slow stirring necessary to retain the ore in the furnace for an extended period, many of the particles of the ore may chance never to be near enough to the surface to be completely roasted, and a lowered extraction will result.

The draft of the furnace should be limited to the utmost. A definite amount of oxygen is of course necessary, but the excess employed should be as little as possible. This statement, again, is at variance with that of other investigators, but I have obtained the best results by that means. In furnaces of the McDougall or Wedge types, the damper at the outlet of the furnace should be closed sufficiently to cause the doors on the top floor to smoke to the slightest degree. Retarding of the draft has more than one effect. Among other things it prevents an excessive amount of dust from being carried into the flues when finely ground ore is roasted. As the ore falls in a cloud of dust from floor to floor, it is probable that the concentration of oxygen in the vicinity of the stream of particles is so reduced that it prevents the extremely high temperatures caused by the flashing of the ore and the formation of ferrate of zinc. It has also the effect of preventing the too rapid oxidation of the ore on the upper floors, which may produce a temperature high enough to sinter the ore.

COAL-FIRED FURNACE INEFFICIENT

When coal-fired furnaces connected with roasting furnaces are used as sources of auxiliary heat, a considerable amount of draft is required to cause the fire to burn rapidly enough to provide sufficient heat for the complete oxidation of the ore. This type is not to be recommended, as the heating is not only too local in its action, but it is also an inefficient and costly method. Producer gas can be much more conveniently applied at the points where it is most required, but it also is too cumbrous and costly when compared with oil firing. The oil necessary to roast a ton of ore with limited draft does not usually exceed five gallons and is at times only half of that amount. When this is compared with the amount of coal used in some of the larger works, where it varies from 300 to 600 lb., and the concurrent labor is considered, the advantages of oil firing are apparent.

DOUBLE ROASTING SOMETIMES NECESSARY

Occasionally, incompletely or under-roasted ore is produced, generally when a breakdown has occurred in the roasting furnace. It becomes a difficult matter to dispose of this ore economically. I have found that the best method to adopt is to mix the under-roasted ore with a suitable small coal, and run it through the furnace a second time. If the ore has merely cooled off too much to finish the roasting on the lower hearths with the auxiliary heat that is available, it is only necessary to scatter a sufficient amount of small coal onto these hearths. It soon becomes intimately mixed with the ore and provides sufficient heat to complete the roasting. If the partially roasted ore has been spoiled through sintering, it must be reground before it is mixed with the coal.

When ores rich in sulphide are mixed with coal and roasted, little volatilization of zinc is noticeable. There is, of course, no advantage in roasting a rich sulphide ore mixed with coal, as there is sufficient heat in the upper hearths to burn off the sulphur without the aid of auxiliary heat; but when a carbonate or silicate ore mixed with a proportion of sulphide is to be dealt with, the only courses open are separation by concentration, dissolving out the carbonate or silicate and roasting the sulphide residue afterward, or mixing with sufficient ground coal to provide the heat which in a richer sulphide ore is supplied by its oxidation. Were it not that oil is so easily applied in roasting, there can be little doubt that the mixing of coal with the ores when they reach the lower hearths would be largely used in the future, as the extraction of zinc from ores treated in this way is all that can be desired. When, however, low-grade ores are being treated, an excessive amount of oil or other fuel would be necessary, and it is here that a mixture with coal would be invaluable. The coal used for this purpose should be a free-burning one, of a non-caking character, and one containing as little ash as possible.

My observations have indicated that the percentage of zinc that can be extracted from an ore roasted with ground coal, compared with the same ore roasted with auxiliary heat, is less only by the amount of ash in the coal used; if this is deducted the percentage of extraction is about equal in both methods. It is, however, an extremely difficult matter to determine this with any degree of accuracy, for the weight of two successive batches of roasted ore from a given quantity of ore is seldom the same, on account of unequal oxidation and loss of dust, even when every effort has been made to have all the conditions of roasting exactly similar.

When complex ores containing a moderate percentage of lead are treated with ground coal, there does not appear to be any more danger of the lead separating in the metallic state, when reasonable care is used, than there is from the reaction of sulphide of lead with oxide or sulphate. If the lead is reduced it is in a fine state of division, and it does not show much tendency to run together. When the reduced particles of lead reach the surface they are apparently quickly reoxidized.

Furnaces of the McDougall or Wedge types are usually up-drafted, and hitherto they have not been notably successful when down-drafted, on account of the difficulty of keeping the upper doors free from sulphur fumes. This difficulty may be overcome by connecting the upper hearths with the flue, and bypassing a small part of the gaseous products of combustion by means of dampers, to prevent the escape of fumes into the roaster building. The small quantity of auxiliary heat that is required for the purpose of igniting the ore is supplied to the top hearth by means of oil, producer gas, or an ordinary coal-fired furnace placed on a special platform at that level. If the doors are made to fit well, there is not much difficulty in siphoning the gases downward. This type of furnace has the great advantage of carrying the hot products of combustion of the ore over the partly roasted ore on the lower hearths, where the sulphur content is too low to maintain combustion, instead of upward over the ore on the upper hearths where combustion is already active.

Zinc Volatilization Being Studied

At the Intermountain Station of the U. S. Bureau of Mines, Salt Lake City, Utah, in the investigation of the chemistry of the volatilization process, the determination of the vapor pressure of zinc chloride over the range of temperature 300 to 700 deg. C., which is one of the essential factors of the above equilibria, has been completed. Values obtained by the static type of apparatus recently designed have given results consistent with boiling-point determinations found in the literature. A satisfactory method for preparation of c.p. anhydrous zinc chloride, free from zinc oxide or hydrochloric acid, has also been worked out. The experiments on gas velocity with zinc oxide plus salt plus silica show that the percentage of zinc volatilized is independent of the gas velocity, but that the volatilization of salt increases with it, although the air is partly dried by passing through calcium chloride. In the mixture of lead and zinc oxides, the percentage of zinc volatilized increases with the percentage of lead volatilized, much of the zinc going off as water-soluble zinc chloride.

Dichromates Valuable in Differential Flotation

Results of the co-operation work of the U. S. Bureau of Mines with the State of Colorado will be published soon by the Colorado Bureau of Mines. The work was devoted mainly to the low-grade complex sulphide ores in the state, and the field report covered all properties working such ores. The ore dressing was confined largely to the application of differential flotation, as influenced by chemical agents, to the complex iron-zinc-lead ores containing precious metals. The results showed that potassium dichromate (or sodium dichromate) in slightly acid solution is an efficient agent in separating zinc sulphide from iron and lead sulphides; it has since been applied with success to the complex sulphide ores and sludges of the Vinegar Hill district, in Wisconsin. In addition, some cyaniding work was done on oxidized ores from the Creede district; and the Caron-Clevenger process for the treatment of refractory silver ores containing pyrolusite was successfully applied to ore mined near Del Norte, Col.

Magnesite Deposits Examined in Pennsylvania

About the middle of the last century most of the Epsom salts used in the United States was made in Baltimore from magnesite mined in Pennsylvania. The use of Epsom salts has continued, but the mining of magnesite on a commercial scale in Pennsylvania ceased prior to 1860. The demand for magnesite on the Atlantic seaboard resulted last summer in an investigation of the possibility of working the Pennsylvania deposits profitably, and that the U. S. Geological Survey might be informed concerning the recent developments, the deposits were examined by R. W. Stone.

The deposits examined are near the oxbow of Octoraro Creek, on the Pennsylvania-Maryland state line. Some work has recently been done on a deposit just east of Goat Hill, in the southwestern part of Chester County, about two miles north of Rising Sun, Md. The magnesite occurs in the state-line serpentine, and all the old pits recently reopened are within a few rods north of the state boundary.

The work done, which consisted of re-excavating the pits, quarries, open cuts, and a shaft that had become filled with dirt, showed that the magnesite occurs in a fine network or stockwork of small veins, most of them less than an inch thick. There are apparently two principal systems of veins, which cross at right angles; the veins of the north-south system stand nearly vertical, but those of the east-west system dip southward at a high angle. Two veins were uncovered, one about 14 in. wide and the other, which was found a few rods farther east, in an open cut, about 12 in. wide. A thorough exploration, including the reopening and drainage of a shaft with underground drifts, failed to disclose any larger veins, but it is reported that a body of magnesite about 30 in. wide was found in the shaft at the crossing of two principal veins.

The development work completed last fall shows that the quantity of magnesite available close to the surface is small and that many tons of waste would have to be handled to produce a single ton of ore, and production on a commercial scale was therefore not attempted. The magnesite is of the white amorphous variety like that produced in California and Greece. It has the typical curved porcelaneous fracture and is apparently of high grade.

PORT KEMBLA, NEW SOUTH WALES, AUSTRALIA

Australian Mining Conditions

Low Metal Prices and High Costs Restrict Activities Western Australia Leading Gold Producing State—Gold Premium Alone Makes Possible Operation of Many Mines Government-Owned Mines Not Highly Successful Activity in Petroleum Prospecting

By Peter G. Tait
Editor, Chemical Engineering and Mining Review

Written for *Engineering and Mining Journal*

THE YEAR 1921 was undoubtedly the worst ever experienced in the history of Australian mining. Low metal prices and high production costs made it impossible for the companies to make ends meet, and under the arbitrary methods of adjusting wages and labor conditions it was, unfortunately, necessary for the economic pinch to be felt before the labor unions would budge an inch. They failed to realize, because they did not want to, that war-time and peace-time conditions are altogether different; that the nation has to get back to normal as other nations are doing; that owners, small and large alike, are not prepared to deplete their wasting assets without some return.

However, the truth now appears to have penetrated the dullest intellects, and a gradual revival may be expected. The chairman of the North Broken Hill, at the last meeting of shareholders, stated that working costs, compared with the first half of 1914, had increased by 155 per cent, whereas the price of lead was slightly above the pre-war figure. After considerable opposition, the Wallaroo & Moonta and the Mount Lyell copper mines were able to convince the courts by production of their cost sheets and independent examination of the accounts, that a readjustment of the wage rate was absolutely necessary. The first-mentioned company actually closed down for several months and the latter threatened to do likewise.

At the end of October, the famous Mount Morgan mine, which has been shut down since May, obtained the sanction of the Queensland Court to reduce wages by 20 per cent, making the new minimum wage 10/10 per day. The government will subsidize operations to the extent of £1,000 per week, by way of rebate on railway freights, and the greater part of this amount will be distributed pro rata, raising the minimum wage to 11/9 per day. Even at these reduced wages the companies do not expect to make a profit, their aim being philanthropic rather than selfish. At the same time, they will probably lose less than if the mines and works were idle, because of the overhead charges which have to be met in any event.

Looking back, one cannot help thinking of the huge sums lost by the employees and by the community through the short-sighted policy of the unions which caused the Broken Hill strike, beginning in May, 1919, and lasting for eighteen months. It was during this period that silver reached such phenomenal prices. It is not alone the unions that have to be blamed for huge losses sustained by the industry. In 1920-1921, the muddling of the government in connection with the control of the metal industry was responsible for a loss of £500,000. Copper which might have been sold for £110 per ton was ultimately thrown on the market when the price was down to about £70. Through the two circumstances noted the mines of Australia lost perhaps £2.000,000, an amount which would have gone a long way in seeing them through the depression of 1921.

The same state of affairs reflected by Australian conditions has been world-wide. Mining in the past has been one of our staple industries; the industry, in fact, which laid the foundations of the country's commercial importance, and has added millions to the wealth of the empire. It can truly be said that great expansion is possible. The gold yield may not reach the high figures of a few years ago when the Bendigo, Charters Towers, and Kalgoorlie mines were at their zenith, but there are other valuable mineral assets which must be developed to meet the needs of industry by the aid of science.

It is impossible to do more at the date of writing than to give an estimate of the gold yield for 1921. The production will be approximately 714,500 fine ounces, as shown in Table I.

TABLE I. AUSTRALIAN GOLD PRODUCTION, 1920-1921

	Actual Gold Yield 1920	Estimate for 1921
New South Wales	48,907	50,000
Queensland	115,230	50,000
South Australia	1,697	500
Tasmania	6,246	5,000
Victoria	168,979	98,000
Western Australia	617,842	510,000
Northern Territory and Papua	3,642	1,000
Totals	962,543	714,500

GOLD PREMIUM KEEPS MINES GOING

Had it not been for the formation of the Gold Producers' Association, with the approval of the commonwealth authorities, to export "new" gold only, there would have been few if any gold mines working in 1921 in Australia. As it is, there is hardly a mine making a reasonable profit over and above the amount received as a premium; and it will therefore be seen that the future of the industry depends on two alternative factors—the reduction of costs represented by labor and supplies to something like pre-war values, and the maintenance of the present premium on gold. Permission to export was originally granted for six months only, but extensions have been granted from time to time.

During the half year ended June 30, 1921, the average London price for fine gold was £5 10s. 8d. per oz. The association sold during September (including local sales) 99,648 oz. of standard gold at an estimated net price of £5 2s. 3d. per oz., which is equal to £5 11s. 6d. per oz. fine. Table II shows the amount of the distribution of premium made in respect of the half year ended June 30, and the total sum distributed since the formation of the association in April, 1919.

TABLE II. TOTAL OF AUSTRALIAN GOLD PREMIUMS

State	Half Year Ended June 30, 1921 Amount			Total to Date Amount		
Western Australia	£274,856	12	1	£1,874,363	15	1
Victoria	63,387	15	4	420,877	11	8
Queensland	73,585	12	11	382,918	3	3
New South Wales	26,826	3	1	126,056	8	3
Tasmania	2,812	4	7	17,119	10	4
Papua	1,469	2	5	7,320	7	3
South Australia	1,619	0	2	6,058	18	4
Northern Territory				19	12	7
Totals	£444,656	10	7	£2,834,734	6	9

As illustrating the altered conditions of gold mining in Australia, the following statement made by the chairman of directors of the South Kalgurli Consolidated, one of the Golden Mile group in Western Australia, is typical. He said:

> "Looking back to pre-war days, I direct attention to the vast change that has come over mining activities. Then expenses ranged all told in the neighborhood of 20s. a ton; now they are over 32s., an increase of 60 per cent. During the present year these costs must go up still further in consequence of the award of the Arbitration Court, which came into force on Jan. 1 last. This award meant an increase in the cost of working the South Kalgurli Consolidated, so far as the directors could make out, of roughly £1,500 a month. This change, which even took the workmen themselves by surprise, spelt ruination to most, if not all, the Kalgoorlie mines, and its continuance threatened to lead to the abandonment of the field."

In the face of such a statement it requires pluck to undertake the development of new mines, and it is really surprising to see the number of new companies being registered.

The award referred to increased the minimum wage in Western Australia from 12/6 to 16/— for surface men and 16/6 for underground men, skilled labor being advanced in proportion. For Sunday work and overtime, double pay is allowed, as well as fourteen days' holiday on full pay each year.

NECESSITY OF IMPROVING METHODS

The whole blame for the present state of affairs at Kalgoorlie cannot be laid at the door of the employees. With few exceptions little new equipment and few improved methods have been introduced during the past decade, and if any attention has been given to this aspect by the managements no details have been made public. One direction in which there would appear to be considerable room for economy is in the erection of a modern central power station. The nearest coal field is at Collie, about 500 miles away. Consequently wood is the only fuel for power generation. The position today is that nearer supplies of the local timber (eucalyptus) have been cut out for a radius of about eighty miles. Two companies, the W. A. Goldfields Firewood Co., and the Boulder Firewood Co., operate many miles of 3 ft. 6 in. tramways, and both are extending their lines. This, with the natural increase in wages of the employees of the timber companies, has been reflected in the cost of fuel to the companies. When it is realized that thousands of horsepower units of gas producers burning wood in long lengths are at work in Australia and that these plants are guaranteed to consume a maximum of 2½ lb. of fuel per hp.-hr. as against anything from 8 to 24 lb. when used in a boiler furnace, it is surprising that the use of gas engines has not been seriously considered.

The tributing, or leasing, system is a popular method, adopted by some companies, of working their mines without running the risk of losing money. Groups of men are given certain sections to work, the company taking a royalty on the gold produced and also making a profit on the treatment of the ore in its mill. Several of the large companies have let their properties to tribute altogether, and some excellent results have been obtained from ground considered by the companies not worth working on their own account; others, again, have not been so fortunate. One Golden Mile lease in particular has by the considerable number of rich returns obtained by tributers been rather a surprise, causing one to wonder at the inadequacy of early-day sampling—the tributes being mostly in the upper reaches of the mines.

Table III shows the ore treated and gold production of the principal Kalgoorlie mines for the first nine months of 1921.

TABLE III. JANUARY TO SEPTEMBER, 1921, AUSTRALIAN TONNAGE OF ORE AND GOLD PRODUCTION

Kalgoorlie Mines	Tons	Fine Ounces
Associated	43,862	13,460
Associated Northern	3,570	4,591
Golden Horseshoe	85,919	40,578
Great Boulder Prop.	77,368	50,123
Great Boulder Perseverence (a)	36,183	35,542
Ivanhoe	112,098	44,573
Kalgurli (b)	17,884	8,668
South Kalgurli Consolidated	57,820	23,505
Lake View and Star	39,190	11,310

(a) Tributers. (b) Seven months.

Statistics available show that the output of the Tasmanian mines for the twelve months ended June 30, 1921, was valued at £1,071,903, a decrease of £530,139 compared with the preceding year. The principal decreases were: Tin, £203,149; copper, £56,872; silver, £38,886; scheelite, £29,702; and wolfram, £20,440.

At the time of writing, with the exception of Mount Lyell, practically all the West Coast mines, including the Mount Bischhoff, North Farrell, Magnet, the Renison Bell tin group and the Zeehan silver producers, are at a standstill awaiting a turn in the market. [Later: In November representatives of Continental smelters resumed buying Tasmanian silver lead ores.]

The Queensland government in the last year or two has embarked on several state-owned mining ventures, but it cannot be said that any great success has yet been attained. The lead and copper smelting works taken over from the ill-fated Chillagoe company showed a loss during the twelve months ended June 30, of £49,450. The total indebtedness of the smelters to the government on June 30 was £292,212.

Another of the state treatment works is the Irvinebank tin smelter. The loss for the year totaled £18,307, and this, with the total of £10,643 for the previous year, gives a total loss of £28,950 since the works were taken over in October, 1919. The plant has been closed down owing to the low price of tin.

During 1920, Chillagoe treated 27,457 tons of copper ores and 20,859 tons of silver-lead ores. The copper produced is being stacked pending the recovery of the market. The tin smelters at Irvinebank produced 250 tons of tin in 1920. The experience with these works and also at the state batteries, of which a number are operating on various fields, shows that the promises of the small producer to keep the plant going if erected are rarely fulfilled, making it necessary, as has always been the condition with privately controlled treatment works, for the owners to have a mine or mines of their own.

GOVERNMENT PRODUCING ARSENIC

The production of arsenic is another field into which the government entered early in 1918. At this time arsenic was in large demand and the market price was high. Large quantities are used in Queensland for combating the prickly-pear pest, and it is being supplied for this purpose at £23 per ton, although, as the auditor general recently pointed out, the cost of production is approximately £50. In consideration of the fact that the net loss for the year was £4,797, and the aggregate loss £46,802, it would appear that the government would have been better advised, and would have adhered more to the functions of a government, had it subsidized private producers.

The state is also becoming heavily involved in its coal mines at Bowen, Baralaba, and Styx River, but undoubtedly some steps were necessary to prove the resources of the state in this field. The whole of Australia in the past has been too dependent on the coal fields of New South Wales.

Little is being done so far with the iron and steel works to be erected at Bowen; the total expenditure aggregates only £16,286. It is understood that a part of the recent loan raised in New York will be devoted to the establishment of the iron works, but there are so many demands for money, as can be realized in part by the foregoing, that it is unlikely that any considerable amount from that loan will be forthcoming.

Western Australia has an extensive state battery system which is in the nature of a subsidy to encourage mine development. The output of gold from these batteries from the time of inception to July 31, 1921, is as follows:

Tons of ore milled, 1,303,138; production by amalgamation, £4,457,994; by sand treatment, £654,708; by slime treatment, £218,414, and by treatment of residues, £9,353. Total gold produced was valued at £5,340,471. At the tin-dressing plants the tonnage of tin ore treated amounted to 80,067, the production being black tin valued at £92.420 and residue treatment, £572.

The Cloncurry copper field, embracing the Mount Elliott, Hampden-Cloncurry, Mount Cuthbert, and Mount Oxide companies, besides many smaller camps, is stagnant, with no prospect of a resumption until the market price of copper improves.

MOUNT ELLIOTT DISTRICT RICH IN COPPER

Mount Elliott made an effort to interest American capitalists, and experts were sent out to investigate, but evidently the negotiations failed. Although some of the mines are approaching exhaustion, the area is undoubtedly one of the richest copper fields of the world. The suggestion has been made and is worthy of more mature consideration that the three large companies should amalgamate and erect treatment works in a central situation, and this may yet be done.

Queensland's mineral production (other than gold, coal, or precious stones) for the first half of 1921 shows a total value of only £176,290, as compared with £1,102,037 for the same period in 1920. Copper accounted for about two-thirds of this decrease.

The large plant erected at Risdon, near Hobart, by the Electrolytic Zinc Co. reached the producing stage during the last quarter the 1921, but its contribution for the year will not be large. The company has concluded an arrangement with the British Board of Trade for the treatment of 750,000 tons of Broken Hill zinc concentrates, and in addition has contracts giving it a percentage of the current output of the Broken Hill mines. It was recently reported that the British zinc smelters are undertaking treatment of concentrates from the same source, so accumulated stocks should gradually be depleted.

DEVELOPMENT IN PAPUA PROMISING

In the commonwealth territory of Papua, the New Guinea Copper Co., in which Hampden-Cloncurry investors are largely interested, appears to have a promising mine, the ore reserves standing at 235,000 tons, containing 10,750 tons of copper and 2,900 oz. of gold. The original proposal to erect a smelter at the mine has been dropped, and the ore will now be shipped to Australia. The railway and shipping facilities at the port are completed. The factor which makes it possible to work the Papuan mine, though others on the mainland are lying idle, is undoubtedly the supply of cheap native labor.

The Hampton Plains gold field, in Western Australia, which came to the front in 1920, has failed to maintain its position, and now more interest is being centered on the Ives and Monger groups beyond. A battery at Mount Monger is treating prospectors' parcels, and this is of considerable help to the field, doing away with the necessity of sending to Kalgoorlie.

Wallaroo and Moonta, in South Australia, after being shut down for several months, resumed work in August, 1921, wages being reduced to 10/6 for the lowest paid grade of labor. The rates are to be revised when the selling price of copper reaches a figure of £78 per ton.

At Bendigo the Amalgamated Gold Fields Co. is operating mines in the central portion of the field on the Garden Gully, Sheepshead, and Derby lines. Of the mines being worked by this company, the Carlisle and Unity are working spurs at the 1,235 level, with profitable yields from a large tonnage; at the Constellation two feet of payable spurs at the 622 level are being mined; at the Hercules, prospects are improving. The quarterly yield (September) was 3,552 tons fcr 1,070 oz. Development work is in progress at the Virginia mine, below the 1,440 level, where payable gold was formerly obtained. At the Monument Hill, Great Northern, Londonderry, and Ironbark mines fair yields are being obtained. Bendigo A. I. Company's New Moon line crushed 3,565 tons yielding 1,113 oz. and is being further developed. Lansell's Little 180, Lansell's North Red, White & Blue, and Lansell's Needle are developing, the crushings for January to June, 1921, from the latter being 6,202 tons, yielding 1,764 oz. The New Red, White & Blue mine crushed 4,759 tons, yielding 4,028 oz. for the first half of 1921.

At Ararat, the Langi Logan group of deep alluvial mines are opening up a wide lead. The New Langi Logan mine yielded 1,798 oz. of gold from 1,550 fathoms of wash during the first half of 1921, making a total yield of 14,054 oz. from 11,003 fathoms from this mine. The Langi Logan South mine for the same period of 1921 yielded 1,624 oz. of gold from 1,725 fathoms.

At Daylesford, the Ajax and Ajax North are the chief mines working. From January to June, 1921, the Ajax mine yielded 660 oz. from 2,060 tons and the Ajax North mine 1,685 oz. from 6,102 tons.

At Heathcote the Costerfield Gold & Antimony Co. is considering the erection of smelters to deal with antimony concentrates in the state. In the Gippsland district, the A. I. mine, Gaffney's Creek, is developing at No. 7 and 8 levels, the shaft now being 1,330 ft. deep. The yield for the first half year of 1921 was 3,694 tons, for 2,851 oz., making a total of 76,220 tons, yielding 62,136 oz. of gold.

PETROLEUM AND MISCELLANEOUS MINERALS

Oil is the magic road to wealth if the statements of the promoters of dozens of companies are to be believed, and the country is being overwhelmed with oil experts of all shades. Most of these alleged oil finds are "duds," and in several states the geological survey officials have found it necessary to speak plainly and even to insist that overenthusiastic promoters should not make knowingly misleading statements. At the same time it is believed sufficient evidence does now exist to allow it to be said that the indications in the northwest of Western Australia and probably through the northern part of Australia to Queensland, where natural gas exists in large quanities at Roma, are sufficiently favorable to warrant prospecting on sound lines.

Among other minerals there has been considerable activity. The iron and steel industry has given some encouragement to the mining of manganese, fluorspar, and other metals and minerals. Industrial activity has stimulated the demand for cement, baryta, gypsum, asbestos, ocher pigments and clays. The rare-metal mines are practically all closed, being unable to produce at present prices. The Tasmanian osmiridium deposits keep a number of men at work, but at recent low rates, few are earning more than wages. For the first half of the year, 905 oz. was produced, valued at £26,539. What appears to be a valuable deposit of cobalt is being developed on the Cloncurry field by W. H. Corbould, of Mount Elliott. Several parcels were dispatched to England for treatment, and the results were sufficiently favorable to warrant the erection of a treatment plant.

Gems, principally sapphires and opal, are produced in Australia, the former in New South Wales and Queensland and the latter on the old-established White Cliffs field, in New South Wales, and on the comparatively new Stuart Range field, in South Australia. Mica also occurs in payable quantities in the McDonnell Ranges, South Australia, near the center of the continent. Water and transportation difficulties have to be overcome. A promising deposit has also been opened up in the Cloncurry district, Queensland, and several parcels sent out have found a ready market in New South Wales and Victoria.

German Potash Again a Market Factor

The disturbance in the fertilizer industry due to the slump in prices of farm products, resulting in delayed payment for fertilizer stocks already purchased, created a below-normal market for potash during 1921 amounting to an almost total failure. Domestic potash producers shut down their plants early in 1921 and have not since operated.

American fertilizer manufacturers have recently concluded a contract with German potash producers for 75 per cent of their estimated needs in 1922 and for the remaining 25 per cent have closed contracts with the French potash producers. Despite the fact that two of the domestic producers offered the fertilizer interests their hold-over potash at the German price, they were unable to sell.

Apparently, American potash interests are out of the market for the season and face extinction unless protection is given them in the near future. The tariff bill, now before the Senate, provides for a temporary tariff starting at 50c. per unit for the first two years and diminishing to nothing at the end of five years. The larger American producers appear to be willing to continue and even to put additional money into betterment if the protection asked for is granted.

Though the future of the domestic producers is uncertain, they are in a strategic position to control fertilizer markets adjacent to their producing units by entering into the manufacture of commercial fertilizers. Apparently no movement to accomplish this object as yet has been initiated.

Imports of potash for 1921 were much lower than those of 1920, amounting to approximately an equivalent of 25,000 tons of K_2O for the first ten months of the year. Imports for 1922 will be as great as, if not greater than those of 1920, during which an equivalent of 225,000 tons of K_2O was imported.

Testing Electrolytic Production of Antimony

At the Northwest Experiment Station of the U. S. Bureau of Mines, at Seattle, Wash., the electrolytic extraction of antimony from low-grade antimony ores and from gold ores containing antimony has been studied. Calcium polysulphide proved the cheapest and best alkaline-sulphide leaching agent for antimony ores, whereas sodium sulphide proved to be the best for gold ores containing antimony. Some Western and Alaskan ores are of these types and have proved refractory to usual methods of treatment.

Mining Engineers of Note

Frank Klepetko

AMONG the group of engineers who have been and are actively associated with copper mining and metallurgy none stands out more prominently than Frank Klepetko. Entering his work at a time when copper metallurgy received the impetus that has been followed by a continuous period of development, he soon acquired an important place as an authority in copper smelting and refining. He was born in what is now Czechoslovakia in 1856. His parents came to the United States in 1867, and settled in Cleveland, Ohio, where he attended the public schools, being graduated from high school in 1875. He obtained his degree of Engineer of Mines at the School of Mines, Columbia University, in 1880. In common with many men prominent in the copper industry today, Mr. Klepetko began his service in the Lake Superior "Copper Country." From 1880 to 1882 he was employed by the Conglomerate Mining Co., of Michigan. He then entered the employ of A. S. Bigelow, of Boston, Mass., and his associates, in their various mining and smelting enterprises in Michigan, the principal of which were the Tamarack, Osceola, and Kearsarge mining companies, the Hancock & Calumet R.R., and the Dollar Bay Smelting Works. But the call of the West, which has weaned many away from the first fields of their endeavor, was strong, and in 1891 he was transferred by Mr. Bigelow to Montana, to complete the construction of the Great Falls smelter for the Boston & Montana C. C. & S. Mining Co., and, when this was finished, he remained there to superintend the operation of the plant. Many difficulties had to be overcome and many problems solved to bring the plant to its present high degree of economy and efficiency. Among these may be mentioned the following: The improvement of wet-concentration methods for ores, effecting higher savings; development of a satisfactory and economical calcining furnace; the gasifying of high-ash coal; the application of gas to reverberatory smelting of copper ore calcines; the development and application of the blast furnace to the semi-pyritic smelting of raw copper ores, including their mechanical charging; the development of the direct converter process for copper mattes—i.e., the bringing of molten copper mattes directly from the furnace to the converter, without intermediate solidifying and remelting; the improvement of the parallel system of electrolytic copper refining, and the development and improvement of mechanical appliances in all departments. These improvements placed this plant so far ahead of similar plants that it became a model property, and its improvements were copied by copper metallurgists generally. In 1896 Mr. Klepetko was appointed general manager of the Boston & Montana and the Butte & Boston mining companies, which later were absorbed by the Anaconda Copper Mining Co. In addition to these duties, he was appointed, in 1900, manager of the Anaconda reduction works. In 1902 he resigned his active Montana positions to take up consulting work in New York, and he has been so employed ever since. Under his supervision and management, the great copper smelting works at Great Falls, Mont., the Utah Consolidated smelter at Salt Lake City, the Michigan Smelting Co.'s smelter at Houghton, Mich., the Cerro de Pasco smelter in Peru, and the Anaconda smelter of the Anaconda Copper Mining Co. have been constructed. When Mr. Klepetko left the Anaconda smelter, it was considered one of the best, both from a metallurgical and an economic standpoint.

FRANK KLEPETKO

While in Peru for the Cerro de Pasco Mining Co., Mr. Klepetko became convinced that there were splendid opportunities for profitable mining in that country, and he acquired large mining interests there.

Mr. Klepetko has always been a man of great energy and believes in being personally on the job. For over a year he has been in Peru supervising the work being done at plants in that country in which he is interested. He is a member of the Columbia University Club, the Engineers' Club, the American Institute of Mining and Metallurgical Engineers, the Institution of Mining and Metallurgy, the North of England Institute of Mining and Mechanical Engineers, and the Montana Society of Engineers.

HANDY KNOWLEDGE

Neighborly Chats With the Foreman

Loyalty to the Company

BY DUNCAN MACGREGOR

Written for Engineering and Mining Journal

Sore again, Jim! I heard you cussing the mine, the "super," and the universe the other day, and I decided that I would tell you a few things after your safety valves had seated themselves. When a locomotive boiler is blown out, they take it to a convenient place and the steam raises a hurra with the sticks and stones and dust until all the poison is out of the boiler. It would create havoc and no end of work if it were blown off in the round house, and so would your cussing if the "super" and the directors and stockholders had been about. You used more wisdom than I thought you had when you broke loose the other day. It's a good plan to blow off where it won't hoist you out of your job.

To get down to business. Have you ever thought how it is that your job goes on and on and the pay check comes in as regularly as the calendar? First, it is by grace of the mine; second, it's due to the fact that a certain group of men found the money to put into the plant, equipment and the development to make a go of the mine. They picked the directors and the directors picked the "super." The "super" has to keep all the wheels going and has troubles of his own, and naturally he wants you to take care of your own. The stockholders expect expenses to be met by proceeds and also want a little velvet now and then. A pretty large part of the proceeds of the mine goes to you, your men, the "super" and others, who get their three squares and a home out of their work.

Work is a good thing, and most of us don't appreciate it until we have stalked a job for a month or more without finding a thing to shoot at. Good honest returns are needed on the part of everyone to make things go. Loyalty is at the bottom of every success, and earns its reward in the pay and in the satisfaction of seeing the company grow.

You have a very definite part to play. In a measure you are in a position of trust. It is up to you to get a proper accounting for labor time, for that represents money outgo, and unless reasonable performance is secured, the ship will go on the rocks. Prevention of waste in supplies, powder, tools, and power is another way in which you can show your loyalty. The accumulated saving within a year by a little extra watchfulness on your part may put a dividend upon the board and encourage more capital to go into mining enterprises.

You are one of the props of the "super," and in proportion as you do your share and hold up your end you will clinch your own job and give the stockholders a run for their money. Facing the other way, it's up to you to make work a pleasure for your men. Loyalty to them consists in having and showing faith in them. You are getting restless, I see, and I'm not going to sermonize on this, but just let me suggest that you go down into the mine like a boy rushing out upon the first snowfall of the season, and the men will catch your spirit and reflect it, and your troubles will disappear.

McLellan Rock Drill Bit

BY H. A. KEE

Written for Engineering and Mining Journal

Experiments at the Kerr Lake property, at Cobalt, Ont., have proved of value in procuring more efficient rock-drilling footage, particularly during the last year, by materially altering the design of the company's standard four-point cross-bit. These changes are essentially the result of a machine-drilling contest held at Cobalt on July 2, 1921.

Two teams entered from the Kerr Lake with thirteen other entries. In the course of experimenting and practicing for the competition, it became apparent that changes were necessary in the bit, to procure maximum drilling speed in the contest. W. P. McLellan, master mechanic, and others of the mine staff and employees assisted in working out the design of the bit used, which is referred to here as the McLellan Kerr Lake bit. The Kerr Lake teams experienced little difficulty in drilling the two deepest holes in the given fifteen minutes, using a No. 88 Rand Leyner water drill, although the machine used was not the best drilling No. 88 Rand Leyner water drill in the contest. It will therefore be apparent that the exceptional results were due not only to the efficiency of the miners and good work of the machine but also to the diameter, gage and temper of the bit, which drilled a perfectly free hole in exceptionally hard-surface Cobalt conglomerate without the slightest difficulty, although the first three steels had only $\frac{1}{16}$-in. gage variation in 24 in. run.

We found during recent years, by studying conditions closely and experimenting considerably with various types of water machines in the hard lower contact of the Keewatin and diabase formations, that the customary practice of using drill bits $\frac{1}{8}$-in. gage variation per foot of run is entirely unnecessary, and with the McLellan Kerr Lake bit on $1\frac{1}{8}$-in. hexagon hollow steel the diameters of bits have been gradually decreased from $2\frac{1}{8}$ in. to $1\frac{1}{2}$ in. on 1-in. hexagon hollow 2-ft. starters, used to collar 7-ft. holes. The company is now successfully using $\frac{3}{64}$-in. variation per foot of run on steel from 2 to 8 ft. long, in underground operations. If it were possible to gage more closely with the drill sharpener, the steel could be successfully used with even less variation in Cobalt conglomerate and in the Keewatin and diabase formations.

By boring a smaller hole greater efficiency is obtained from the $1\frac{1}{4}$ and $1\frac{1}{8}$-in. explosives, as larger holes allow the explosive to buckle when placed in the hole, and the result is at least one air gap to each stick of explosives used, which condition, with the best possible tamping facilities, does not give the desired results. It is probable, too, that $1\frac{1}{8}$-in. powder well tamped in proper-sized holes drilled in average ground will produce results as good as can be obtained with $1\frac{1}{4}$-in. explosives, and this would prove a further saving.

We therefore appreciate the benefits of using a bit of smaller diameter and of improved design when drilling efficiency is increased from 20 to 40 per cent, with about the same advantage in the results obtained with explosives, and a material advantage is indicated, not only in the breakage of steel but also in repairs to machines. Such advantages are due to the use of drill bits which cut freely with the minimum amount of vibration and steel-to-rock resistance, thus eliminating unnecessary binding and reaming conditions.

We always appreciated the necessity of properly designed and tempered reaming angles for reciprocating piston drill boring, but in operating with Leyner and other water-stoper types we believe that best results can be procured with the minimum amount of resistance and reaming. This may be accomplished by using the tempered, cutting edges of the bit and gage corners only to cut or chip out the hole, instead of undertaking to guide the steel with the reaming edges of the wings designed with a slight degree of taper.

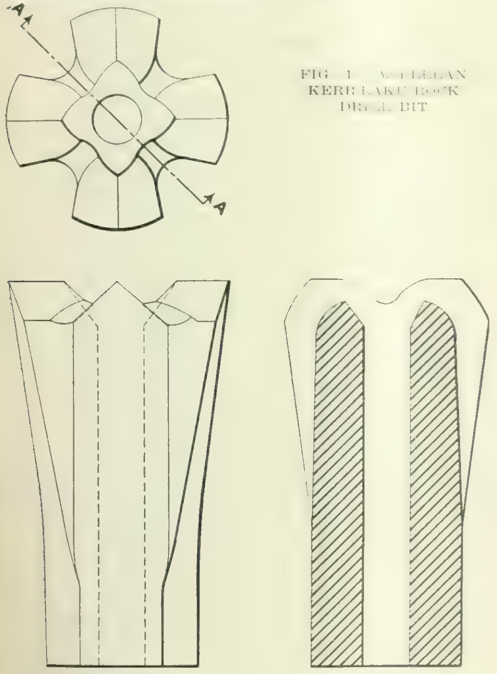


FIG. 1. McLELLAN KERR LAKE ROCK DRILL BIT

With the McLellan Kerr Lake bit, which may be used as a detachable bit, a core is left in the bottom of the hole and large pieces of this core break off as the four individual chipping chisels cut out the channel around the core. Then these coarse ($\frac{1}{8}$ to $\frac{3}{8}$ in. in size) particles of core are, in operation, blown out of the hole by the usual water and air pressure. The lower portion of this center core positively guides the drill bit by inner bearing or contact of bit and core, leaving the essential outer corners of the bit free for maximum boring, with a minimum amount of wear. All of this is indicated in Fig. 2.

It may be said that slightly tapered or nearly parallel wings are necessary to keep the steel from cutting out of line, as is undertaken with the standard double-taper bit, but we believe that extreme variation in gage and large diameter bits is more often the reason for running or binding holes, and, in average hard ground, with a minimum variation in gage and small bit diameter, these difficulties may be eliminated.

The McLellan four-point cross-bits are made with heavy wings about $\frac{5}{8}$ to [illegible] in. thick, the pitch or taper of which is 7.5 deg., and finished with an 8 in. circle rounded fillet, which design allows ample diagonal corner clearance as compared with diameter of cutting edges of bits which are made with 92 to 100 deg. angle, depending on the character of ground to be drilled.

As indicated by Fig. 3, it will be noted that the McLellan punch, when used separately from the sharpening dollie, is a double-tapered tool, which, without sticking in or splitting the steel, makes the walls of the hole in the bit the proper shape to assure higher cutting efficiency.

As previously stated, this center core acts as a positive guide for the drill bits, making it possible to drill perfectly free-running holes 12 to 13 ft. in the hardest Cobalt conglomerate with water machine and hollow steel, and this has been done with a gage variation of from $\frac{1}{64}$ to $\frac{3}{64}$ in. per ft., due to the fact that this combination of core guidance and positive rock-chipping bit cuts a perfectly smooth and straight hole in the direction in which it is pointed.

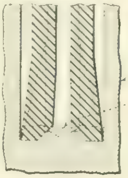


Fig 2

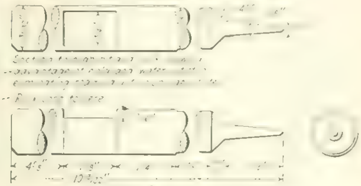


Fig. 3

FIG. 2. SECTION THROUGH BIT AND ROCK SHOWING ADVANTAGE OF ENLARGED WATER OUTLET IN ELIMINATING REAMING ACTION ON SIDES OF STEEL

FIG. 3. McLELLAN PUNCH

We have found, too, that vertical down holes at least 8 ft. deep can be drilled without difficulty with this design of bit by using the same diameter of bit on each steel, but we have not as yet undertaken to drill holes at various angles.

Mine Models of Glass

By A. J. McDERMID

Written for *Engineering and Mining Journal*

In making mine models of glass the glass can be prepared for tracing in the following manner: First, wash with Bon Ami; then dull the surface by drawing across it a pencil eraser in the places where the lines are to be. Ordinary drawing ink can then be applied successfully by means of a lettering pen, a ruling pen, or a camel's hair brush. This plan obviates the necessity of using oil paints, which require a day or two for drying.

Straightening Track Spikes

By ROY H. POSTON

Written for *Engineering and Mining Journal*

Underground track spikes may often be used several times if straight enough to be redriven in a new tie. To straighten bent spikes a device may be used consisting of piece of discarded cast iron of suitable dimensions with a hole slightly larger in diameter than the width of the spike. The bent spike is forced through the hole.

THE PETROLEUM INDUSTRY

Petroleum Investigations of U. S. Bureau of Mines

Field work in the Bristow, Okla., oil district is being continued by F. X. Schwarzenbek and J. O. Cable, petroleum engineers of the Bureau of Mines. Considerable difficulty was experienced in obtaining locations and elevations of wells in the Slick field, owing to the rough and woody country in which the field is situated. The southern part of the Slick field is troubled with water and basic sediment in the oil, it costing one company as much as 17c. per bbl. to remove the basic sediment. The various causes of the formation of the emulsion are not definitely known. It is sometimes caused in pumping wells by leaky valves and gas when water accompanies the oil. Gas agitation of the wells may cause water and oil to emulsify. The work of constructing the peg model of the field will probably be started immediately.

Information is being collected for a report to the Secretary of the Interior on the value of natural gas in the Osage Nation in Oklahoma. This report is to be used in redetermining the price basis for the computation of royalty on gas produced, eleven gas leases having been made by the Department of the Interior covering the Indian lands of the Osage Nation. The present basis for determination of royalty is 18c. per 1,000 cu.ft. at the well. Each lease has a clause providing for redetermination of price basis at specified times. On March 16, 1918, the price of gas was established at 18c. per 1,000 cu.ft. for four of these leases, and the price will hold until March 16, 1923. The present price of 18c. for gas for the other seven leases has not yet been redetermined. The new price will hold from Sept. 16, 1921, to Sept. 16, 1923.

D. B. Dow, chemical engineer of the Bureau of Mines, has completed the field work outlined in his study of hazards in the shipping of natural-gas gasoline. The proposed regulations submitted by the Bureau of Explosives allow no gasoline to be shipped in standard cars unless the vapor tension of the product is below eight pounds. The present regulation allows gasoline of ten pounds' vapor tension to be shipped in standard cars. Several tests were made to determine the loss which might be expected, due to weathering gasoline of ten pounds' vapor tension. These tests indicate that the loss will be about 11 per cent.

Work is being continued at the Bartlesville station on the effect of back pressure on oil production. The production of well No. 7 of the Osage Development in Oklahoma has been measured daily under various back pressures. Samples of the fluid produced were taken hourly for several days, and the water and basic sediment content determined. A back pressure of about 25 lb. affected the oil production when the tests were first started, but several months later a back pressure of only 20 lb. affected the same well. Final conclusions as to the effect of back pressures on wells on this property have not been drawn.

The special investigation of water problems in Oklahoma oil wells has as its objects to increase the production of oil on properties that are now producing large amounts of water; to instruct operators in the use of cement as a means of shutting off water; and to determine the source of water and devise means for shutting it off by applying modern engineering methods. The work will be undertaken in the Deaner, Cushing and other fields. R. R. Templeton, petroleum engineer, and R. M. Carr, assistant petroleum engineer, have been assigned to the investigation.

Oil Royalty Taxes of Indians To Receive Adequate Protection

Washington Correspondence

The House of Representatives Committee on Indian Affairs has reported a bill which would authorize the Interior Department to employ competent tax experts to prepare the income tax returns of the Five Civilized Tribes of Indians in connection with their oil royalties. The compensation to be paid these tax advisers would not exceed 5 per cent of the depletion or other allowance secured by them for the Indians. It is said the present returns, which are prepared by the superintendent of the tribes, do not adequately protect the Indians against the payment of excessive income taxes, and, further, that the superintendent has no knowledge of the basis on which the Revenue Bureau fixes depletion.

The superintendent has been computing the taxes on the basis of the actual decrease in production for each current year, taking the per cent of the decrease as the depletion, which, however, has not been allowed by the Government, and additional assessments have been made. The Interior Department has suggested that it use the oil operators' tax returns as a basis for preparing the returns for the Indians owning royalties. The Revenue Bureau declined, on the ground that the returns must be held confidential and also because the operators' returns would not be a proper basis for royalty owners, as the depletion unit of the operator is not determined by the same computation as the depletion unit of the royalty owner. The Indian royalty owner is entitled to revaluation for discovery, but only under exceptional circumstances is the operator entitled to such revaluation for discovery.

Orange Field, Texas, Shows Deeper Sands

Special Correspondence

Attention is again centered on the Orange field (Terry field), in Orange County, Tex. Recently the Humble Oil & Refining Co. completed its No. 5 Chesson well, flowing 5,000 bbl. through a choker from 3,920 ft., or about 300 ft. deeper than the other big wells in the field. Later the sand in the oil cut the connections, and the well ran wild for a time, flowing at the rate of 12,000 bbl. daily. This trouble happened a second time, and the well lately has been flowing at the rate of 25,000 bbl. daily. Fifty new wells are being drilled, and several producing wells will be deepened to the new sand.

Technical Papers

Underground Loaders — A general review of the various types of underground loading devices is given in *Reports of Investigations*, U. S. Bureau of Mines, by C. Lorimer Colburn, "Underground Loading Devices in Metal Mines" (obtainable on request from the Bureau at Washington). The report covers the operation, capacity, construction, and performance of the different types of underground mechanical loading machines and their applications in the various metal-mining districts. A study of the subject is being continued by the Bureau of Mines. The material included in the report covers those machines which are now in accepted use.

Oil—"Oil Possibilities of the Holbrook Area in Northeast Arizona" has recently been published by Dorsey Hager, geologist and petroleum engineer. This report covers the findings and deductions of the area extending from the town of Holbrook, Ariz., as a center, to the Zuni Uplift, in New Mexico, 100 miles east; to the Grand Canyon, 125 miles northwest; to the Apache Uplift, 70 miles south; and to the San Juan (Utah) area, 150 miles north. The area of immediate interest for oil possibilities lies within a radius of 40 miles of Holbrook.

Petroleum in Colombia — "Geology and Oil Resources of Colombia; the Coastal Plain," is the title of a seventeen-page article in *Economic Geology* for November. (Lancaster, Pa.; price, 65c.). The writer, Elfred Beck, spent six months in Colombia in the summer of 1919 exploring a large tract of land near the Caribbean coast. The paper includes a detailed account of the geology in the vicinity of the San Andres concession, a reconnaissance report of the remaining area explored, and comparisons with the geology of Colombia as a whole.

Cedar Mountain, Nev.—Bulletin 725-H of the U. S. Geological Survey, Washington, D. C., twenty-one pages, obtainable on request, is entitled the "Ore Deposits of Cedar Mountain, Mineral County, Nevada." Cedar Mountain, in the western part of the state, contains the Simon silver-lead district, which is the chief center of interest, and the Omco gold district. The bulletin is confined to a description of the geology of the region.

The Joplin-Miami District—The mining edition of the *Joplin Globe* (published at Joplin, Mo.) is a sixty-six page supplement containing much information of value to any one interested in the zinc-lead mining industry of the Tri-State district. Zinc for roofing purposes; better selling methods for ore producers, and local milling methods are among the subjects discussed. A mining directory and two maps are useful features.

Bureau of Mines—The eleventh annual report of the Director of the U. S. Bureau of Mines, for the year ended June 30, 1921, is now available on request to the Bureau at Washington, D. C. It is a pamphlet of 133 pages describing the work carried on during the year.

Canadian Mining in 1920 — "Summary Report, 1920, Part D" of the Canadian Department of Mines, Ottawa, Ont., obtainable on request, includes discussion of the "Nipigon-Schreiber District, Ontario"; the "Geneva Map-Area, of the Sudbury District, Ontario"; the "Paleozoic Stratigraphy of Pagwachuan, Lower Kenogami, and Lower Albany Rivers, Ontario"; the "Oil Possibilities of Manitoulin Island, Ontario"; the "Brockville-Mallorytown Map-Area, Ontario"; and an extended paper on the "Fluorspar Deposits of Madoc District, Ontario,"

Cyanide Precipitate Melting — Tests made on the melting furnaces of the Cia. de Real del Monte y Pachuca, to determine the approximate dusting and volatilization losses during the melting of the precipitate, and the volatilization loss during air refining of the resulting doré bullion, are given in a five-page paper in *Mining and Metallurgy* for January. (29 West 39 St., New York; price, $1.)

Oil in Oklahoma—Bulletin 726-F of the U. S. Geological Survey, Washington, D. C., twenty-five pages, obtainable on request, is entitled "Geologic Structure and Oil and Gas Prospects of a Part of Jefferson County, Oklahoma." Recommendations are made as to the most likely places for drilling.

Mining in South Dakota — The "Thiry-first Report of the State Inspector of Mines for South Dakota," for the year ended June 30, 1921, obtainable on request to the State Inspector of Mines, Lead, S. D., is a twenty-three page pamphlet discussing briefly developments among the mining companies for the year, together with a list of accidents and a directory of the mines of the state.

Miners' Almanac—The U. S. Bureau of Mines, Washington, D. C., has issued the 1922 edition of the "Miners' Safety and Health Almanac," obtainable on request to the Bureau. The book contains fifty-three pages of good advice mingled with the customary almanac tabular matter.

Mining in California—A report by the State Mineralogist on "Mining in California in 1920" has recently been issued by the California State Mining Bureau, San Francisco, Cal. It gives condensed summaries of activities in the various mining districts of the state.

Technical Education — Bulletin 152 of the Mining and Metallurgical Society of America (115 Broadway, New York City) contains a twenty-five page discussion of the report of the Committee on Technical Education.

Mineral Resources Recent publications in the "Mineral Resources" series, issued by the U. S. Bureau of Mines, Washington, D. C., obtainable on request, include: "Gold, Silver, Copper, Lead, and Zinc in Montana in 1920," twenty-four pages; "Concrete Stone and Concrete Blocks in 1920," six pages; "Talc and Soapstone in 1920," thirteen pages; "Gold, Silver, Copper, Lead and Zinc in Arizona in 1920," twenty-six pages; "Gold, Silver, Copper, Lead, and Zinc in Utah in 1920," twenty-three pages; "Barytes and Barium Products in 1920," eleven pages; "Gold, Silver, Copper, Lead, and Zinc in Nevada in 1920," twenty-nine pages; "Gems and Precious Stones in 1920," four pages; "Zinc in 1920," seventeen pages; "Manganese and Manganiferous Ores in 1920," thirteen pages; and "Gold, Silver, Copper, Lead, and Zinc in Idaho and Washington in 1920," thirty-one pages.

Organizing Recreation — "Important as it is to organize and direct the hours spent in industrial employment, it is equally important to provide for wholesome and revivifying amusement in the worker's leisure time." How the Ingersoll-Rand Co. has done this is described in a twelve-page liberally illustrated article in *Compressed Air Magazine* for December, 1921. (11 Broadway, New York; price, 35c.)

Magnetic Concentration—The Minnesota School of Mines Experiment Station, Minneapolis, Minn., has issued a comprehensive 138-page pamphlet, Bulletin No. 9, entitled "Magnetic Concentration of Iron Ore." The subject is attractively presented, and discusses the matter from the theoretical, experimental, and commercial standpoints.

Milling Zinc Ore—"Milling Methods in the Tri-State Zinc District" is the title of a fourteen-page bulletin issued by the U. S. Bureau of Mines, Washington, D. C., in the *Reports of Investigations* series, No. 2,314. It may be obtained on application. Most of the paper is devoted to a discussion of laboratory jigging work on locked grains of blende and flint. Some comments are made on the general milling practice of the district.

Mining at Howe Sound, B. C.—The mining practice at the Britannia mine, Howe Sound, B. C., is described in an eleven-page paper in the January issue of the *Bulletin* of the Canadian Institute of Mining and Metallurgy, Drummond Building, Montreal, P. Q. The veins or lodes standing at an angle of approximately 72 deg., with a width of 10 to 70 ft., and having fairly strong walls, lend themselves most economically to the overhand shrinkage stoping system.

Magnesite — *Economic Geology* for December, 1921 (Lancaster, Pa.; price, 65c.), contains a seventeen-page paper by H. C. Boydell on the magnesite deposits of Eubœa, Greece. The article is devoted entirely to the descriptive and economic geology of the deposits.

ECHOES FROM THE FRATERNITY

R. M. Linton Elected Chairman of New York Section A.I.M.E.

Classification of Mining Methods Considered—Dr. H. M. Payne Talks on Conditions in Mexico at Monthly Meeting

Mexico is just as safe today as the United States, and there is less of a crime wave there than here, according to Dr. Henry Mace Payne, who recently made an economic survey of the country. Dr. Payne briefly reviewed the situation existing across the border, in an address, illustrated by lantern slides, at the monthly meeting of the A.I.M.E. at Machinery Club on Feb. 8. As he sees it, conditions south of the Rio Grande are much better than they have been since Diaz, and he expressed his belief that Obregon was a second Diaz.

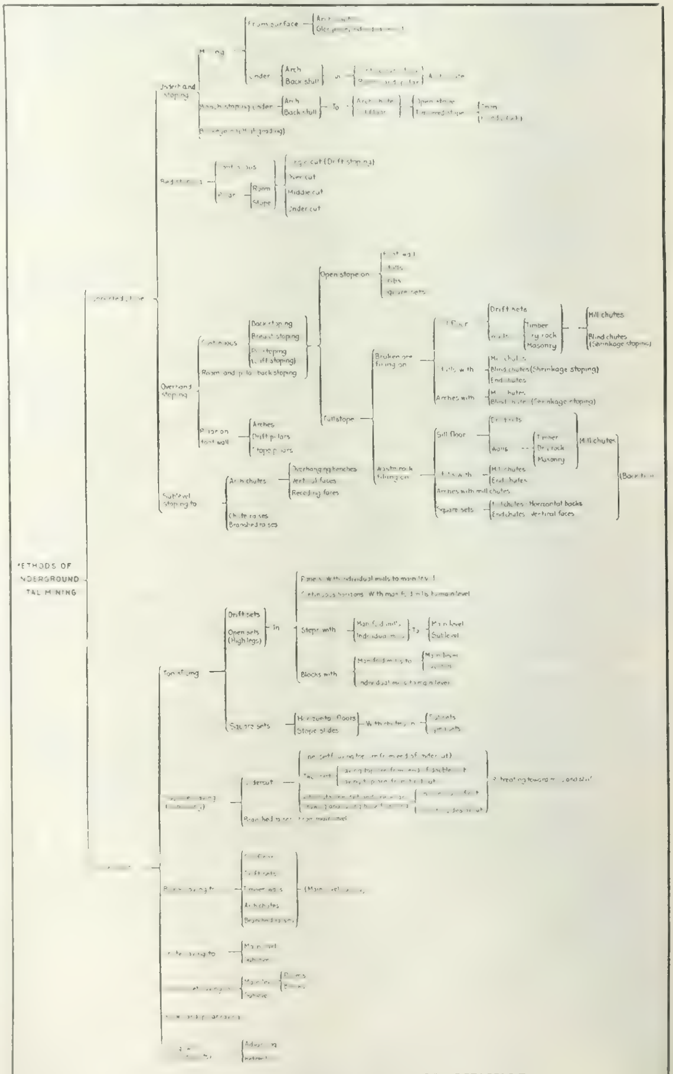
Hard money circulating instead of worthless paper has been an important factor in bringing about the change, according to Dr. Payne. Railroad service in Mexico is improving much more rapidly than most had anticipated. New construction is in progress, and there is much activity in many places, particularly in the states of Jalisco and Nayarit. Bandits are operating in some parts, but that is also true here in New York, Dr. Payne pointed out. The speaker emphasized the difficulty of getting authentic information there, as it would be in any country where 90 per cent of the people were illiterate.

As to why recognition of the Obregon government has been withheld, Dr. Payne hazarded the guess that it was because the interest on the external debt had not been paid. The petroleum situation, he said was only a small factor in the present state of affairs. "Obregon will be recognized," he said, "when the game of diplomacy has been played down to the last card in the deck."

"Classification of Mining Methods" was the topic for discussion on the evening's program. The discussion, however, was rather limited, bearing principally on the diagram drawn up by Prof. F. W. Sperr, of the Michigan College of Mines, which had previously been circulated among the members. Brief comment was made upon this, with here and there a word of criticism, by the speakers, which included Robert M. Linton, Allen H. Rogers and B. Britton Gottsberger. Prof. Robert M. Raymond, of Columbia University, had prepared a chart, giving his own classification, which was thrown on the screen. There was no discussion of Prof. Raymond's classification, as the chairman of the meeting wished the members to have the opportunity to hear Dr. Payne. The charts showing both classifications are here reproduced, that of Prof. Raymond being shown on the opposite page.

Robert M. Linton was elected chairman of the New York Section for 1922 in the balloting which took place during the evening; Prof. Robert M. Raymond and Donald M. Liddell, vice-presidents; E. L. Gruver, treasurer, and Bradley Stoughton and B. Britton Gottsberger, committeemen.

William Young Westervelt, who acted as chairman, announced that a committee on licensing of engineers had been appointed, with Donald M. Liddell as chairman. The other members were D. E. A. Charlton, B. Britton Gottsberger, P. W. Henry and Allen H. Rogers. This committee was appointed in accordance with a resolution introduced at the preceding monthly meeting of the New York Section, on which occasion licensing was discussed.



METHODS OF UNDERGROUND MINING
A Classification by F. W. Sperr

METHODS OF UNDERGROUND MINING

A Classification by R. M. Raymond

	METHOD	MODIFICATIONS	ROADWAYS AND SUPPORT	SUPPORT OF STOPE	HANDLING OF ORE
Supported Stope	**Bed Stoping**				
	Continuous	Breast Stoping	[illegible]	Pillar	On Sill Floor
	Rooms	Breast and Back Stope Heading and Bench		Cribs Roof Caving	Through Chutes [illegible] Beneath
	Underhand				
	Benches	Bench Stoping From Level Beneath Level	Level Pillars	Pillars or Arch Stulls	On Sill Floor Through Arch Chutes
	Glory Hole	Glory Hole	[illegible]	Open	
	Overhand				
	Open Stopes	Back Stoping Step Stoping	Level Pillars Drift Sets	Pillars Stulls	To Sill Floor Slide Chutes
	Sub-Level Stopes				
	Advance	Back Stoping	Level Pillars	Pillar	To Sill Floor
	Retreat	Step Stoping	Stulls	Cribs Stulls Stulls and Partial Filling	To Sub-Levels and Sill Floor Through Raise Chutes to F. W. [illegible]
	Shrinkage	Arched Longitudinally Arched long and F. W. to H. W.	Level Pillars Drift Sets Roadways in F. W.	Level Pillars and Broken Ore	Chutes in Pillar Chutes from [illegible]
	Rill Stoping		Drift Sets Level Pillars	Waste Filling	Mill Blind Mills
	Cut and Fill				
	Continuous	Horizontal Backs	Level Pillars	Waste Filling	Chutes or Mills
	Sections	Incline Backs	Drift Sets	Cribs on Filling	Rock Chutes to F. W. Drifts
	Slicing		Roadways in F. W.		
	Square Set				
	Full Width Vein	Long Step Faces	Drift Sets	Square Set Timbers	Through Chutes in Square Sets
	Sections	Short Step or Inclined Vertical Faces	Square Sets Pillars	Square Set and Filling	Through Chutes and Wing or Slope Chutes
Caved Stope	**Top Slicing**				
	Continuous	Blocks with Central Mill	Drifts and Crosscuts Connecting all Chutes	Props and Caps or Modified Square Sets Temporary	Chutes to Main Level Mills to Sub-Levels
	Stepped	Blocks with Manifold Mills Mitchell System			
	Sub-Level Caving	Drift and Pillar Two Set Drifts Three Set Drifts	As Above	Light Drift Sets Temporary	Line of Mills to Main Level
	Block Caving	Single Blocks Between Levels Sub-levels and Thin Blocks	Roadways Beneath Roadways on H. W. Side		On Sill Floor Through Branched Raises To Haulage Level
	Shrinkage Stope and Pillar Caving	Above Main Drifts Above Sub-Levels	Drifts and Crosscuts Connecting Chutes	Broken Ore and Pillars Temporarily	Through Chutes to Main Levels Through Chutes to Sub-Levels

New Mining Law Must Be Made Acceptable to All Classes

Proposed Measure Discussed at Meeting of Mining and Metallurgical Society of America

The revised mining law now before Congress is not perfect, but its sponsors are anxious to make it so. Thus may be summed up the discussion on this topic at the monthly meeting of the New York Section of the Mining and Metallurgical Society of America at the Harvard Club, on Tuesday evening, Feb. 14. Representative S. S. Arentz, who introduced the bill into the House last July, was present as the guest of the evening; several members of the Mining and Metallurgical Society committee who formulated the new code explained their purposes, and others offered various suggestions.

F. F. Sharpless opened the program with a history of the legislation, showing that it was not a mushroom project, but had been many years in the making and was the result of wide dissatisfaction with the existing law. He stated that sentiment in the West was to the effect that the proposed revision would not benefit the prospector and was, therefore, not to be commended. To illustrate, he quoted a characteristic, bristling article published by Sidney Norman in the *Northwest Mining Truth*, asking that the Western prospector be let alone, and not worried and hounded as he had been; in short, that the existing law be allowed to stand. Mr. Sharpless reminded his hearers, however, that the prospector was not the only one to be considered; that the engineer and financier, after all, played a major part in the mining industry.

Representative Arentz then addressed the gathering. He creates the impression in manner that he is more of a mining man than a politician, and was most favorably received. He emphasized the needs of the prospector, who, after all, as he pointed out, is a pretty important member of the mining industry. Admitting the proposed bill was not perfect, he urged everyone to offer *constructive* criticism, and to point out how it could be improved rather than give it a blanket condemnation. The bill is now in committee, and hearings on it are expected to begin about the middle of March, so Mr. Arentz urged that a full discussion before that time was highly desirable. In its final form, he said, the bill should be so constructed as to meet the approval of all classes.

H. F. Bain then explained some of the features of the proposed law, and showed that most of the opposition was probably due to lack of understanding. He dwelt on the wisdom of allowing an alternative to the present requirements regarding assessment work, which are usually a waste of money and do not develop the property as would the same amount spent on road construction or devising a method of treatment. The proposed code must be so altered as to be acceptable, he said; otherwise, the existing law would later be revised by a group of lawyers along with the public land law.

Further explanatory and critical remarks were offered by Messrs. Gottsberger, Spurr, Rogers, Douglas, Ingalls, Peale, and Channing. The consensus of opinion seemed to be that the provision in the proposed law making the boundaries of claims cardinal lines was the most open to reasonable objection.

The climax of the meeting as far as interest was concerned came at the close, as it should in any well-ordered entertainment. Mr. Arentz had said that certain parts of the bill were ambiguous and cited as an illustration that section which allowed a locator to hold a property for a term of years without discovery. Was it ten years or twelve? Mr. Ingalls maintained that there was no ambiguity, and that it was only necessary to read the law to understand it. Mr. Bain then rose to say that he had read it—nay, studied it carefully—and still did not understand this point. The chairman, Mr. Weld, who had been looking over the bill the while, then sought to straighten things out by explaining just what this section actually did mean. "Am I not right, Mr. Ingalls?" "No" laconically replied Mr. Ingalls, amid much laughter from the revivified listeners. Mr. Ingalls then carefully explained this part of the bill.

Columbia Section, A.I.M.E., Views Mine Model

The February meeting of Columbia Section, A.I.M.E., was held at Spokane, Wash., on Feb. 3. Chairman Rush J. White presided. Following the routine business the chairman introduced F. W. Callaway, engineer for the Bunker Hill and Hecla mines, who exhibited a model of and explained the underground workings of the Star mine and its relation to the adjacent properties. W. G. Woolf exhibited a series of crude ore samples and intermediate and final products of the Star mine, and explained the process of lead and zinc metallurgy by which the results were obtained.

Slate Producers Organize

Form Association to Increase Efficiency and Effect Standardization

Action was taken to form a national organization at a meeting of slate producers held at the Engineers' Club, New York, on Feb. 8, under the auspices of the National Federation of Construction Industries. About fifty delegates, representing all the slate-producing sections in Eastern states, except Virginia, were present. It was decided by unanimous vote to organize, and a committee of seven was appointed to suggest a name, prepare a constitution and by-laws, and issue a call for a meeting to complete organization.

In opening the meeting as chairman, Oliver Bowles, mineral technologist, of the U. S. Bureau of Mines, spoke of the prevalence of unscientific methods of quarrying slate and the need of substituting machinery for manual labor. Wastage, he stated, was enormous, in some quarries over 90 per cent, and no considerable development of byproducts has been undertaken. Slate production, and particularly the production of roofing slate, had rapidly decreased, and substitute materials had gained precedence, largely because no concerted effort was being made by the industry to maintain and strengthen the market for slate. A similar note of encouragement to organize was sounded by G. F. Laughlin, of the U. S. Geological Survey, who deplored the decreasing use of a material naturally so superior for many purposes.

Standardization was urged by Victor D. Abel, of the Structural Service Bureau, Philadelphia, Pa. At present sanitary slate products have to be manufactured to order, which prevents the producer from manufacturing for stock. Studies recently made, he said, showed that most sanitary and chemical slate products could be standardized to a great degree without the slightest disadvantage in use. D. Knickerbocker Boyd, architect and structural standardist, also urged standardization as a means of increasing the slate market.

Committee on Rock-Drill Steel To Meet

The directors of the U. S. Bureau of Mines and of the Bureau of Standards have called a meeting of the advisory board that is to co-operate with these bureaus in the investigation of the breakage and heat treatment of rock-drill steels and other steels and alloys subjected to similar impact stresses. The meeting is to be at 10 o'clock a.m. on Feb. 20 at the Engineering Societies Building, in New York.

MEN YOU SHOULD KNOW ABOUT

Vernon S. Rood, of the Utah Apex mine, has gone East on business.

F. C. Merritt, consulting engineer for the Loring interests, visited Reno and the Comstock early in February.

Alexander Wise, superintendent of the Comstock Middlemines Co., left Virginia City for San Francisco on Feb. 1.

John A. Burgess, consulting engineer and geologist of San Francisco, has been in Mina and Candelaria on official business.

Walter A. Rukeyser has returned from a trip to the new gold district in the Elbow Lake region of northern Manitoba.

Herbert G. Moulton has become associated with Coverdale & Colpitts, consulting engineers, 66 Broadway, New York City.

Frederic R. Weekes sailed on Feb. 11 for Venezuela, where he will be engaged on professional work for the next two months.

A. J. Young, president of the Bailey Silver Mines, Cobalt, has been elected president of the Atlas Gold Mines, in the Shining Tree district.

Allen Murray Yonge has recently accepted temporary appointment as efficiency engineer of all of the state institutions of California.

F. W. Bradley has been in Spokane recently in connection with the Day-Hecla lawsuit, but will, it is expected, return to San Francisco soon.

A. A. Richie has been appointed mine foreman of the Simon Silver Lead Mines Co., to succeed **Tom McNamara**, who is seriously ill in San Francisco.

John M. Fox resigned, the first of the year, as superintendent of the California Rand Silver Co., and is now in Johannesburg on professional business.

N. O. Lawton recently became associated with **Duncan MacVichie** in the practice of consulting and mining engineers, with an office in Salt Lake City.

G. T. Jackson, formerly manager of the Alaska Gastineau, has been appointed manager of the Shasta Zinc & Copper Co. at Winthrop, Shasta County, Cal.

H. Foster Bain addressed the Engineers Club of Philadelphia and affiliated societies on Feb. 14 on the subject, "The Field for Mining Engineers in China."

G. M. Fowler, of Salt Lake, geologist for the International Smelting Co., made a business trip through Reno, Tonopah, and southern Nevada during the first week in February.

Bradley Stoughton, formerly secretary of the American Institute of Mining and Metallurgical Engineers, was elected president of the Yale Engineering Association at the annual meeting on Feb. 2.

Donald B. Gillies, of Cleveland, vice-president of the McKinney Steel Co., the president of the Michigan College of Mines Alumni Association, recently visited Houghton and Calumet to meet the alumni.

Kenneth Williams has been appointed metallurgist at the Copper Queen smelter of the Phelps Dodge Corporation. He was formerly general foreman of reverberatory furnaces and roasters at that plant.

Oscar Spitzer, representing the International Minerals & Metals Corporation, recently visited the Wisconsin Zinc district with a view to obtaining a future calcined-blende ore supply for his company's smeltery at Springfield, Ill.

W. B. Tucker has been transferred from the Los Angeles field division of the California State Mining Bureau to the Redding branch. C. McK. Laisure, who was in charge of the Redding branch, has been made district engineer of the Bureau, with headquarters in San Francisco.

Mining and metallurgical engineers visiting New York City last week included: **E. W. Moore**, El Cajon, Cal.; **William Griffith**, Scranton, Pa.; **E. O. Daue**, Philadelphia.; **E. Mosonyi**, Bis, Mexico; **W. Spencer Hutchinson**, Boston; **A. J. Klamt**, Los Angeles; **A. L. Colby**, Bethlehem, Pa.; **W. W. Taylor**, Signal Mountain, Tenn.; **W. A. Wilson**, Salt Lake City, and **Christian Urang**, Salt Lake City.

OBITUARY

J. A. Lannon, manager of the Lucky Twenty mining company, Ouray, Col., died recently.

Arthur Ferland died at Haileybury, Ont., on Feb. 9, at the age of sixty-six years. Mr. Ferland was one of a syndicate who purchased the property which is now the Nipissing mine and was a director of the Chambers-Ferland company.

Eugene R. Day, managing director of the Hercules mine, and one of the most prominent mining men of the northwest, died of heart disease in Spokane on Feb. 11. Mr. Day was born in Truckee, Cal., in 1874 and went to the Coeur d'Alenes in 1886. He was one of the original owners of the Hercules mine and was also a director and stockholder in the Tamarack and Custer Consolidated Mining Co., the Northport Smelting & Refining Co., and the Pittsburgh Smelting Co.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

Hollinger Consolidated's suit against the Northern Canada Power Co. has been dismissed.

Four gold mines on the Rand, South Africa, where a strike has been in progress, are reported to have resumed. The outlook is considered a little brighter.

The Apache Powder Co., in which several of the large copper companies of Arizona are interested, is about to start its new plant in Cochise County, Ariz.

The Coronation Syndicate is attempting to interest the public in a new development scheme in the Transvaal. Details are given on p. 303 by our London correspondent.

Apache Powder Co.'s Plant Ready To Start

Important Mining Companies of Arizona Interested in New Enterprise

Finshing touches are being put on the plant of the Apache Powder Co. in Cochise County, Ariz, and experienced powder men are arriving daily from all parts of the country to take charge of the different departments. It is expected that the company will begin turning out powder about March 1.

The plant has a capacity of 1,000,000 lb. of powder a month, which can be increased within a short time to 1,500,000 lb. a month should the demand arise. It occupies more than 600 acres and is within seven miles of Benson and four miles from St. David.

The site of the plant is ideal as regards natural protection to the buildings and surrounding property from explosions. The plant is divided into danger and safety zones. Offices, shops, power houses, stores, and dwellings are within a zone protected from danger of explosions by high hills and ridges. This constitutes the "safety zone." The "danger zone," where the explosive ingredients are handled and powder is actually made, is in deep gullies and ravines. Each building within the danger zone is so located and protected that if an explosion should occur no damage would result to other buildings.

The different units are connected by a narrow-gage industrial track. The main plant is connected by standard-gage with both the El Paso & Southwestern and Southern Pacific railroads.

Water is furnished to the plant by a 16-in. artesian well of a capacity of several hundred gallons per minute. Employment will be furnished to about 150 skilled workmen when it is run to full capacity.

W. W. Edwards, an experienced powder manufacturer, is in charge as manager and he will be assisted by D. E. Fogg. Both will be under the general supervision of C. E. Mills, managing director.

Powder made will be that used in general mining operations, such as high explosives, dynamite, gelatine dynamite, and all kinds of permissible explosives. Raw material entering into the manufacture, based on the annual production of 12,000,000 lb. of powder, will approximate 15,000 tons. Much of this raw material is produced in Arizona.

The Apache Powder Co. is controlled by the share-holding mining companies and the enterprise is an effort to meet, in part, the economic situation confronting the mining industry. The site of the plant at Benson has been well chosen with regard to transportation facilities and the comparatively short hauls to the more important copper mines at Globe, Miami, Ajo, Bisbee, Clifton, Morenci, and Jerome, which are to be supplied with the company's product.

It is not the intention of the company to make the manufacture of powder a money making enterprise. It will sell its product at a very small margin of profit, and while the shareholders in the company will be the greatest gainers by its operation, it is expected that the mining industry of the state as a whole will be benefited.

Radioactive Ore in Congo

By Special Cable From Reuters to Engineering and Mining Journal

London, Feb. 13—Dispatches received from Brussels state that deposits of radioactive ore have been discovered in the subsoil of Katanga, in the Belgian Congo. The plateaus in that country are reported to contain radium ore, which is said to be found at shallow depth. A plant is being erected, and it is anticipated that the annual production will be of importance.

Hollinger Power Suit Dismissed

The suit of the Hollinger Consolidated Gold Mines, Ltd., against the Northern Canada Power Co. for alleged damages out of failure to supply power has been dismissed.

Receiver for El Salvador Mines

The El Salvador Silver Mines Co., with property in El Salvador, has been placed in the hands of a receiver.

New Colorado Wage Scale Gives Miners $4 Per Day

Notice Recently Filed With State Industrial Commission—Cripple Creek Expected

The new wage scale for Colorado metal mines, effective March 1, and applying in all of the principal camps excepting Cripple Creek, where the scale is 25 cents less, is as follows:

Mine Workers:

Miners	$4.00
Machine runners	4.00
Machine helpers	4.00
Trammers	3.50
Muckers	3.50
Cagers	4.00
Timbermen	4.00
Timbermen helpers	3.50
Pumpmen	3.50
Electricians	$4.50 - 5.00
Motormen	4.00 - 4.50
Nippers	4.00
Other underground labor	3.50
Topmen	3.50
Engineers	$4.00 - 4.50
Firemen	3.50
Machinists	4.50
Blacksmiths	4.50
Blacksmith helpers	4.00
Carpenters	5.50
Shift bosses	$5.50 - 6.00

Mill Workers:

Mill shift bosses	$4.50
Millmen	4.00
Roustabouts	3.50
Machinists	4.50
Electricians	4.50
Carpenters	4.50
Repairmen	4.75
Ore sorters	4.00
Tram men	4.00
Teamsters	3.50
Timekeepers	3.50

Indorse Proposal as to Lead Smelting

A resolution indorsing Senator Poindexter's effort to bring about a reciprocal agreement between Canada and the United States, providing that lead bullion derived from ores shipped across the international line, either way, may be returned free of duty to the country of origin, was passed at a recent joint meeting of the Northwest Mining Association and of the mining bureau of the

Spokane Chamber of Commerce. It states that such an agreement would not interfere with the lead schedules provided in the Fordney Tariff Bill and would provide alternative smelting outlets for ore from districts adjacent to the International boundary in Washington and British Columbia.

A. S. & R. Wages Still Above Pre-War Scale

An analysis of the wages paid in 1921 at the United States plants of the American Smelting & Refining Co. shows that readjustments produced further slight decreases in the rates of pay in December compared to November rates, but that the wages paid were, in December, still 65 to 66 per cent above pre-war rates, according to a bulletin issued by the company.

The analysis states, further, that in 1914, repair, supply and construction labor was paid an average of $2.42 for an eight hour day, whereas in November, 1920, the rate was $5.39, an increase of 123 per cent. The rate for direct operating labor in 1914 was $2.02 per eight-hour day, but in October, 1920, it had risen to $4.55, an increase of 125 per cent.

In December, 1921, through various readjustments, the rates for repair, supply and construction labor had been reduced to $4 for an eight-hour day. This was a decrease of one-half of 1 per cent compared to November rates, but 25.9 per cent below the highest rate, $5.39, paid in November, 1920.

Similarly, the rate of $3.37 in December, 1921, for direct operating labor was 1.1 per cent below the November rate, and 25.9 per cent lower than the record rate of $4.55 for this class of labor in October, 1920.

Nevada Freight Rates Lowered

Freight rates from Reno, Nev., and points on the Pacific Coast to Tonopah, Goldfield and other southern Nevada points were recently reduced from 25 to 40 per cent, effective as from Jan. 30. It is expected that this reduction will prove a stimulus to the mining industry in Nevada.

Four Rand Mines Reopen

Work was resumed on Feb. 13 in the Village Deep, the Durban Roodepoort Deep, and partially at the East Rand City Deep and the Crown Mines, according to a press dispatch recently received. Otherwise the strike situation on the Rand is unchanged.

NEWS FROM WASHINGTON

By **PAUL WOOTON**
Special Correspondent

Chestatee War Minerals Case May Be Reopened

Many Requests Made as to Status of Applicants Under Amended Act—Majority Seeking Rehearings

As fixed by the Secretary of the Interior, Feb. 15 was the last day on which notice of a desire to have a rehearing on claims could be filed with the War Minerals Relief Commissioner. A veritable avalanche of such requests and general inquiries as to the status of war minerals relief under the amended act has all but overwhelmed the office of Commissioner Robison. These requests have not been classified in their entirety, but it is evident that requests for rehearings and adjudications have come from the great majority of claimants, whether or not there have been awards. By broadening the "request or demand" phase of the original bill to include a published request, many claimants whose cases had been closed are now able to establish an earlier date on which they were stimulated by the Government to produce, or to prepare to produce, minerals covered by the act.

Among the cases likely to be reopened is that of the Chestatee company. Former Senator Hoke Smith, of Georgia, is pressing that claim before the War Minerals Relief Commission.

Gold Standard To Be Discussed at Genoa

Referring to the forthcoming Genoa financial conference, the Federal Reserve Board predicts that the gold standard will be an outstanding topic of consideration, and urges the gold standard as a means of rehabilitating credit and currency systems. "Discussion at Genoa is likely to relate in no small measure to the restoration of the gold standard," it says. "There is a gratifying unanimity of opinion among leading economists, financiers, and statesmen to the effect that any permanent rehabilitation of credit and currency systems will necessitate a return to a gold basis of some sort. But to reinstate the gold standard, many complex problems will have to be solved, connected with reparations payments, domestic and foreign indebtedness, and the effect of national policies upon the amount and direction of current expenditures."

Government's Silver Purchases Almost 93,000,000 Oz.

Purchases of silver by the Bureau of the Mint during the week ended Feb. 11 amounted to 1,684,000 fine ounces. This brings the total purchases under the Pittman Act to 92,958,888 fine ounces.

Indian Land Bill Reported

The House Committee on Indian Affairs has reported a bill providing for the leasing for mining purposes of certain lands on the Fort Peck, Mont., Indian Reservation.

Fibroferrite Found in Australia

Australia is said to be preparing for commercial use a newly discovered metalliferous substance known as fibroferrite. It is said to be valuable as a solvent. Its composition is: Ferrous sulphate, 50 per cent; oil of vitriol, 15 per cent; ferric sulphite, 10 per cent; alums and sulphur, 20 per cent; inert material, 5 per cent.

Appropriation Estimates Cut for Bureau and Survey

Need for Department of Mines Emphasized by Chairman Rhodes in Discussing Bill Before House

More liberal appropriations for the U. S. Bureau of Mines was urged by Representative Rhodes in the course of debate in the House on the Interior Department appropriation bill. He reviewed some of the achievements of the Bureau to indicate that it is working efficiently with the funds allowed it, but he declared that an industry which produces $6,000,000,000 of new wealth (and even that figure does not include bituminous coal) is entitled to something more than a bureau "tucked away in a secondary Cabinet office and about which little is said and less is known."

The question was raised as to what is being done with the royalties being collected under the Oil Land Leasing Act. Mr. Rhodes pointed out that these royalties do not accrue to the bureaus serving the mining industries. He called attention to the fact that 50 per cent of the royalties collected are turned into the reclamation fund; 40 per cent goes to the state and 10 per cent to the Federal Treasury. More fully to demonstrate the need for a Department of Mines, Mr. Rhodes introduced as a part of his remarks his recent article in the *Engineering and Mining Journal* on "What Can Legislation do for the Mining Industry?"

The discussion of the bill had the effect of emphasizing many of the achievements of the Bureau of Mines.

Though some reduction was made in the funds asked for the Bureau of Mines, more serious cuts were made in those for the Geological Survey. Representative Cramton, of Michigan, who was in charge of the bill, stated that these reductions do not indicate "any lack of confidence in the Survey or any lack of appreciation of its work. They were made because we feel that some of its work can wait. The Geological Survey is a great service, and it has been administered remarkably well by Dr. George Otis Smith."

Referring at another point in his remarks to executives in the Interior Department, among whom he mentioned Dr. Smith and H. Foster Bain, the Director of the Bureau of Mines, he said "the committee was impressed highly by their zeal, intelligence, and the efficient conduct of their bureaus."

Appropriations totaling $1,580,900 for the Bureau of Mines and $1,325,940 for the Geological Survey are carried in the appropriation bill referred to. The amounts asked for the Bureau are $106,600 more than for the current year but $79,565 less than the estimates. Those for the Survey are $288,400 less than the current year and $395,120 less than the estimates. The detailed estimates are:

Bureau of Mines: Salaries and general expenses, $76,900, no change; investigating mine accidents, $378,000, a decrease of $31,065 from current funds and $36,065 from estimates; operating mine rescue cars, $211,000, an increase of $51,000 over current funds and an increase of $33,000 over estimates; purchase and equipment of mine rescue cars, $75,000, no appropriation having been made last year for this purpose, but the estimate called for $6,000 more; testing fuel, $136,000, a decrease of $6,510 from the current year; mineral mining investigations, $125,000, a decrease of $5,000 from estimates; petroleum and natural-gas investigations, $135,000, no change; mining experiment station expenses, $170,000, a decrease of $30,000 from the current year and $5,000 from estimates; care of buildings at Pittsburgh, $55,000, an increase of $5,000; mining station and mine inspection in Alaska, $35,000, an increase of $27,675 over the current year; publications, $1,000, a decrease of $500 from current funds and estimates also; enforcement of oil leasing act, $155,000, an increase of $23,000 over the current year but a decrease of $7,000 from estimates; purchase of land adjoining experiment station at Pittsburgh, $28,000, a new item.

Geological Survey: Salaries, $20,760, a decrease of $1,400 from current fund and estimates; scientific assistants, $29,900, no change; topographic surveys, $275,000, a decrease of $55,000 from the current year and also $15,000 from estimates; geologic surveys, $300,000, a decrease of $52,000 from the current year and also estimates; chemical and physical researches, $40,000, no change; illustrations, $18,280, a decrease of $6,720 from estimate; report of mineral resources, $125,000, no change; investigation of mineral resources of Alaska, $75,000, no change; gaging streams, $180,000, no change; periodicals, $2,000, no change; geologic maps, $110,000, a decrease of $30,000 from the current year and also estimates; and classification of lands, $150,000, a decrease of $150,000 from the current year and also estimates.

The committee provides for consolidating the offices of register and receiver of land offices at twenty-five district land offices and abolition of the office of Surveyor General of South Dakota.

NEWS BY MINING DISTRICTS

London Letter

Coronation Syndicate Attempting Reconstruction Scheme—Rand Strike Depresses Market

By W. A. Doman

London, Jan. 31 — There must be many mining engineers in the United States who remember the great Coronation Reef fiasco, and the trouble that arose out of it among the partners of one of the leading Rand mining houses. For years the Coronation Syndicate has been dormant, but recently attempts have been made to interest the public once more. It is a new public now, and five-shilling shares are small fry when one thinks of the £3,000 which the original syndicate's shares reached. A reconstruction scheme is being brought forward, and the capitalization is to be as follows: 520,000 five-shilling shares fully paid to existing shareholders, £130,000; 1,000,000 fully paid for a property, £250,000; 400,000 to be issued for cash, £100,000; total, 1,920,000 shares, £480,000.

Authority is to be obtained to increase the capital to £750,000, so as to permit of placing 400,000 further shares under option to the old shareholders, 400,000 further shares to the underwriters, and 280,000 share in reserve. The property is reported to contain the Randfontein Reefs, which are described as "very valuable," though unproved. Two shafts are to be sunk, and it is estimated that £100,000 will be sufficient for the purpose.

A mining official has expressed the opinion that with working two reefs (Leader and West Reef) over a stoping width of 48 in. there will be 38,920,000 tons of reef on the mynpacht and discovery claims alone. This reminds me of the remarkable calculation of tonnage made years ago in connection with West Rand Consolidated. It has not materialized, and the company is not a success. The tonnage may be there—any tonnage you like on the Rand; it is the gold content that is lacking. The western wing of the great goldfield has undergone examination by many a mining engineer and geologist, Professor Molengraaf among the number.

Perhaps in connection with the above-related conditions may be quoted the Randfontein Central results for the December quarter of last year. Ore crushed was 358,000 tons, the value recovered per ton was 29s. 2d. and the working costs 27s. 8d., leaving a profit of only 1s. 6d. a ton, or £30,830 in all, and this exiguous amount has to meet certain overhead charges. Of 6,395 ft. of development sampled, 61 per cent was payable, the average value being 23.5 dwt. over 17 in. This percentage of payability was the lowest of the year, and compared with 85.1 in the final quarter of 1920.

The strike on the Rand still drags on, and it seems for the moment to have put the whole mining market out of action. Many companies are in need of additional capital; the possibility of failure, however, prevents any appeal to the public.

Johannesburg Letter

Mining Industry in Difficulties in Rhodesia—Afrikander Gold Mine May Be Reopened

By John Watson

Johannesburg, Jan. 10—Word has been received of the closing down of the entire Rhodesian chrome-mining industry; also of nearly all the asbestos mines, and certain gold mines find difficulty in making both ends meet it is said. There is a prevalent feeling that wages will soon have to come down. The cost of living now is said to be only 23 per cent above pre-war rates. Mine managers and directors are said to have reached the conclusion that efforts must be made to reduce wages to a more moderate rate.

It is pleasing to see that there is a prospect of the Afrikander gold mine, near Klerksdorp, being worked once more. A private syndicate has been negotiating for some time for the right to mine and work this property, which is at Rietkuil. The mine has now been leased, and John Wessels, late manager of the Robinson Deep, is now manager of the company. It is said to be the intention of the management to move the ten-stamp mill already on the property to the top of the hill contiguous to the mine incline shaft and add ten additional stamps. Supplies of coal are being transported to the mine, which will soon be in operation. The mine is operated by the Afrikander Proprietary Gold Mines, Ltd.

QUEENSLAND

Interest in Mount Coolon Goldfield Revives—Gold Found at Six Mile—Mount Elliott Raises Additional Capital—The Sardine Tin Mine

From Our Special Correspondent

Brisbane, Jan. 9—Renewed interest is being taken in the Mount Coolon gold field, which was discovered seven or eight years ago but which many think has not received the attention it deserves. The field lies between Clermont, 1[illegible] miles away, and Charters Towers. For some years the principal workings have been confined to one or two mines, and the owner of one is reputed to have made a good deal of money out of his holding and the small battery at which he crushes his stone. Since 1917 this mine, the Native Bear, has given good returns, recovering in one year a value of £7,000 from 1,140 tons crushed and cyanided and in 1920 [illegible] 18,000 from 2,270 tons.

Good results obtained from another mine called the Golden Horseshoe [illegible], attracted renewed attention to the field, and buyers have been offering £[illegible] each for shares in this claim, on which only £15 have been called up. There have been two crushing batteries of ten stamps each on the field, and a third has just been erected by a company that is working its mine as an open cut.

A new gold find within a few miles of the northern port of Cooktown that was briefly mentioned in these notes some months ago has been examined and reported on by a government geologist. At this place, called the Six Mile, a gold-bearing reef was discovered by a party searching for sandal wood, an occupation followed by a good many men in the Cape York Peninsula. From this reef some good returns were obtained, one picked lot of five tons yielding over 4 oz. per ton and an average sample of three tons returning 1[illegible] oz. per ton. Two other prospecting areas on which some work has been carried out have not yet proved as satisfactory as on the original area. In the same locality antimony has been found, but the prices ruling for this metal do not admit of its being mined profitably in any part of Queensland where it occurs.

W. H. Corbould, representing the Mount Elliott company, has succeeded in his mission to England to raise additional capital to provide for a resumption of operations by that company in the Cloncurry district. The company has [illegible] in view, which includes not only the development of its group of copper mine and the construction of eighty miles of railroad between the present end of the railway system at Dobbin and the company's [illegible] Mount Oxide mine northwest of Cloncurry, but the erection of a central treatment plant, which is to provide, by means of a method devised by Mr. Corbould, for profitably dealing with the company's low-grade ores on a large scale. The total cost of this plan has been estimated at about £1,000,000, but an initial expenditure of at least £300,000 was stated to be necessary, the estimated cost of the proposed railway. The news now received from England is that English and French shareholders in the Mount Elliott company have agreed to the plan for raising money, and that financial groups in these two countries are to underwrite £360,000 in equal amounts.

Interest is centering in the Sardine tin mine, in the Kangaroo Hills field, north of Townsville, which promises to become the "show" tin mine of Queensland and to attract world-wide attention. It is on Oakey Creek, four miles from the township of Ewan, which is sixty-four miles by road from the port of Ingham. The outcrop has been traced from the summit of a hill, from which a shaft has been sunk to a depth of 173 ft. The formation which ranges from 3 ft. to 25 ft. wide, is principally slate and quartzite. Workings have been carried on at four different levels, and the bottom level has been connected with an adit driven from the side of the hill. Excellent returns have been obtained from much of the upper ground right from the surface, and lower levels are proving better than the others. E. C. Saint-Smith, a government geologist, says definitely that the quantity of rich ore already in sight warrants the prediction that extremely profitable stoping can be carried on for the next two or three years at least. Lawrence Wilson, a mining engineer, asserts the probability of the rich ore persisting to a depth of 1,000 ft. or over, and predicts that the Sardine will become the richest and probably the most profitable tin mine in Australia.

CANADA

Ontario

Argonaut Buying Mill Machinery—Dominion Reduction May Treat Peterson Lake Tailings

Cobalt—Negotiations are under way between the Dominion Reduction Co. and the Peterson Lake company for the treatment of the tailings belonging to the last-named company. It is estimated that the tailings total about 250,000 tons, but not all of this can be re-[illegible].

It is expected that about March 1 the Coniagas will start diamond drilling the [illegible] property, on which it took an option a short time ago. Some rich ore has been recovered from the Ruby, and it is considered to be a property of much promise.

The recent find made by the Victory Silver Mines, near the Temiskaming, is showing improvement. The discovery was a blind vein which came into the shaft, and which, in places runs from 2 to 6 in. of 1,500-oz. The shaft will be continued to the 500 level.

Developments on the A-53 property are satisfactory, and it is stated that on the 60 level good milling values have been developed over a length of about 75 ft. and a width of 10 ft.

The Bailey, Coniagas and La Rose companies were the only shippers of silver ore from the Cobalt district during January, in all 110 tons being sent out.

During the week ended Jan. 27, two companies shipped ore from Cobalt. The Bailey Mines sent out one car of [illegible],000 lb., and the La Rose a car containing 68,000 lb.

Kirkland Lake—The Argonaut is placing orders for machinery for a mill having a capacity of from 100 to 150 tons a day. The old mill was burned about a year ago.

Good results are being obtained on the 400 level of the Bidgood.

The Ontario-Kirkland recently intersected its main vein on the 150 level, where good values were cut over a width of 6 ft.

The Crown Reserve is putting in a complete mining plant at the propery in Larder Lake which it has under option. The shaft will be sunk to a depth of 300 ft.

Porcupine—Owing to somewhat improved conditions, the Northern Canada Power Co. officials state that the company will have no difficulty in maintaining its present power supply to the Porcupine mines. The power rights recently taken over from the McIntyre will be controlled by the Northern Canada Power Co. The plant will be situated twenty-eight miles north of Porcupine, at Sturgeon Falls, on the Matagami River, and will have a capacity of between 6,000 and 7,000 hp. It is stated that orders will be placed for material immediately upon the signing of the agreement, that construction will be started by spring, and that power will be available within a year.

It is stated that Hollinger's surplus, mainly in the form of bonds and cash, now amounts to $7,500,000.

A meeting of the McIntyre shareholders has been called for Feb. 23 to ratify a proposal of the directors to increase the shares from $1 to $5 par, and giving one share of the new stock for five shares of the old.

Following the completion of diamond drilling on the Beaumont, it has been decided to sink to the 1,000 level.

British Columbia

Trail—Shipments received at the Consolidated smelter from Feb. 1 to 7 inclusive totaled 8,855 tons. Shippers were as follows: Bell, Beaverdell, 40 tons; Josie, Rossland, 74; Paradise, Lake Windermere, 30; Queen Bess, Sandon, 30; and company mines, 8,681.

P. S. Leggatt, of Thomas Summerson & Sons, Ltd., passed through British Columbia recently on his way to New Zealand, where he is interested in planning the establishment of an iron and steel industry. Mr. Leggatt is quoted as asserting that in New Zealand he purposes making immediate arrangements for the erection of a plant to handle titaniferous magnetites by the electro-thermic method.

MEXICO

Nayarit

National Railways Building Line From San Marcos to Tepic

Tepic—The situation all over Mexico is said to be increasingly good. The rebuilt section of the Southern Pacific into Tepic is in operation, and work is being actively pushed on the line between La Quemada and Tepic. The automobile road from Guadalajara to Ixtlan del Rio is completed to La Venta, and will be entirely constructed by May 1.

The National Railways have surveyed an extension from San Marcos to Tepic and are now letting the contracts for construction. The government has already appropriated $5,000,000 in gold for this work. The located line will be completed from San Marcos to Ixtlan del Rio within six months.

Coahuila

A. S. & R. Co. Opening Mines in Velardeña District

Torreon—The American Smelting & Refining Co. is resuming operations of the principal mines in the Velardeña district. A number of the old mine superintendents have been summoned to take charge of this work. Both the Terneras and El Cobre mines will resume after a long period of idleness. The railroad line running from the smelter at Asarco to the Cobre mine is being repaired and will again be used for hauling ores and supplies between Asarco and the mine.

Two copper furnaces and one on lead are being operated by the A. S. & R. Co. at the Asarco plant in the Velardeña camp. Aside from treating the ores from the company's properties, large quantities are being received from individual miners.

KOREA

Unsankinko—The Oriental Consolidated Mining Co.'s cleanup for January was $71,640. That for December was $102,000. There was insufficient water for milling purposes in January.

BURMA

Namtu—Lead production for December was 4,034 tons gross; refined lead production, 3,055 tons; refined silver production approximately 318,800 oz.

RUSSIA

Although important German interests have acquired large numbers of shares in the Russo-Asiatic Consolidated, no development of importance has yet taken place. The co-operation of the Germans was not, it is said, exactly sought; they suggested a working basis so that they might secure a part of the metals when production is resumed. The Bolshevists are beginning to recognize that without foreign capital the country cannot prosper or even be opened up. This is the beginning of a return to sanity.

ARIZONA

Inspiration and Ray Consolidated Receiving Mining Supplies—Oversupply of Unskilled Labor in Warren District

By JAMES H. McCLINTOCK

Bisbee—Stoping has been resumed in the Copper Queen by a force of men taken from development work, and ore shipments to Douglas are to be resumed soon. A dump of siliceous ore, taken from Sacramento Hill, is being steam shoveled to cars for shipment to the smelter.

Calumet & Arizona is putting on more men, generally from its old force, and will start shipment of ore as soon as the Douglas bins have room. Wolverine is hiring miners, and ore shipments are to start from the Boras and Night Hawk leases as soon as the smelters are ready for ore. No intimation is given of resumption of work on the Shattuck.

At Douglas, the Copper Queen is running two blast furnaces and the C. & A. two reverberatories. The former will turn out about 5,000,000 lb. of copper during February and the latter about 3,500,000 lb.

There is annoyance already in both towns from the influx of unskilled labor, much of it from Mexico. At present only skilled miners or furnace men are getting jobs, and these only when possessing a record of prior good service with the companies. Wages remain as before the date of last spring's shutdown.

Globe—It is believed locally that Inspiration is about to resume operation of a part of its large concentrator, said to have been kept in the best of condition through the period of idleness. Among the freight recently received by the company are seventy tank carloads of fuel oil, and large quantities of mine supplies have come in. Over 1,000 men are now reported to be employed in the various sections of the mine, cleaning up and preparing for production. Both mine and crusher bins have been filled by the ore produced in the course of this work.

Old Dominion is preparing for smelter and mine operation. Upon the smelter will depend the date for resumption of production by the Arizona Commercial, which has a force of forty men repairing and cleaning up.

Ray—Ray Consolidated is said to be receiving large shipments of coal and to have its mining and milling plants in good condition.

Jerome—The furnaces of United Verde Extension at Clemenceau have been fired and have started on about three months' supply of ore in the smelter bins. Several hundred men will find employment at the smelter, in addition to 150 now in the mines. United Verde is expected to follow, by starting its Clarkdale works some time this month. The old U. V. office building above Jerome is being wrecked, to permit operation of the steam shovels, which soon will be at work again toward the surface ores around the old shaft.

NEW MEXICO

Great Eagle Fluorspar Mine Shut Down—New Last Chance Mill Ready Soon

Santa Rita—Additional men have been put on the Chino mine force and at the mill at Hurley. They are engaged in cleaning up.

Al Owens is pushing development work on his new discovery five miles east of the Grand Central mill in the Blank Range twenty miles east of Santa Rita. All assays show good values. Nine men are at work.

Whitewater—Paul Larson and associates are shipping lead-silver ore to the El Paso smelter from their new discovery on the plains between Deming and Whitewater. The vein is 3 ft. wide and of a high grade. The operators are preparing to install a compressor and other improvements.

Silver City—Bell, Wright and associates continue to ship silver fluxing ore from their lease on the Bohemian Mining Co.'s property at Chloride Flat.

Lordsburg—The new Last Chance mill will be finished in sixty days. A 7-ft. vein of $20 rock has been cut in an exploratory drift, J. G. Nicholas is in charge. The Great Eagle fluorspar mine has been closed down pending a change in management.

Carrizozo—The Helen Ray mine, under the management of W. C. Roberson, is working its full force. Two gold bars weighing 22 lb. have just been brought in and are on exhibit at the Lincoln State Bank. They are valued at $4,500. This makes a total of 74 lb. of gold from recent runs of the mill. The mill is to be enlarged immediately. The mine is in Dry Gulch near Nogal. It is claimed that 900,000 tons of $10 is completely blocked out.

Mesilla Park—The Tortuga fluorspar mine, which is under lease from Alford Roos and associates to W. Fink and Basil Prescott, continues to ship concentrated pulverized fluorspar to eastern markets. A second unit of the concentrator is completed and running. A new grinding plant has been installed.

COLORADO

Telluride's Output Chiefly From Smuggler Union and Tomboy Mining Properties

Telluride—Shipments of ore and concentrates from Telluride for January aggregated 143 cars, as against 130 cars in December and 105 in November. Ninety per cent of the output was in the form of concentrates which were shipped by the Smuggler Union and the Tomboy mines.

Ouray—The Mountain Top Mining Co. is handling approximately 1,000 tons of ore monthly in its underground mill, which is situated at the crest of the range between Ouray and Telluride. The mill is entirely underground, employs concentration and flotation, and has been successfully operated for several years. The values are chiefly in silver and lead.

CALIFORNIA

Shasta Zinc & Copper Co. Building Refining Plant

(From Our Special Correspondent)

San Francisco—Northern California has been dependent for its mining activities upon gold dredging and small gold mines. The most important development in these activities of late is [illegible] the addition of about forty men to the force by the Shasta Zinc & Copper Co. at Winthrop for the construction of a refining plant, which is to be an accessory to the zinc and copper smelter recently built and tested. The zinc oxide product was not completely satisfactory and a refining process was developed. It is expected that mining and smelting operations will be resumed upon the completion of the plant.

Excellent ore has been reported discovered in the South Star mine, in the Deadman's Flat district. Prospective improvements include a hoisting plant, compressors, and drills, together with mine buildings. Local reports announce the completion of payments upon the Normandie-Dulmaine group and the continuance of shaft shinking, which has reached the 100 level. The Roman Group Co., with a property at Sierra City, is preparing to resume work upon its mine near the Sierra Butte mine. The Brush Creek mine, at Mountain House, below Allegheny, is to be reopened during the spring. Near Greenville, in northern Plumas County, machinery has been erected and buildings have been repaired preparatory to development of the Arcadia and Southern Eureka groups by the Madre Mines Co. Diamond drilling is to be started at once upon the Gruss mine, in Plumas County, by the Diamond Drilling Company.

Recent storms have interfered with the operation of the Plymouth Consolidated, at Plymouth, and power was cut off for a short time. T. E. Kelso and W. H. Holmes are sinking a new shaft at the Princeton mine, one of the old properties of the Mariposa Grant, nine miles southeast of Bagby.

The Pattison mine, near Tuttletown, after operating its new mill one month, has shut down. Local reports indicate over-optimism in the judgment of ore reserves.

The Grady lease, in the Randsburg mining district, has just started shipping. It has produced in the last year $1,000,000 worth of silver from ground 125 ft. square by 440 ft. deep.

Two more mines were opened last summer, the Coyote and the Bisby. The Coyote is about 1,500 ft. southeast of the Kelly property and the Bisby 2,500 ft.

The Johannesburg Mining & Milling Co. owns the Silver Moon and Silver King properties. The Silver Moon joins the Kelly on the southwest and starts about 500 ft. from the Kelly mine. This property is being developed by a 5 x 7-ft. shaft and is now near the 300 level and is in the same formation as the Kelly.

MONTANA

Anaconda To Run at Capacity When Skilled Labor Supply Permits—Tuolumne Cuts New Copper Vein

By A. B. Keith

Butte—The Anaconda Copper Mining Co. plans to resume at capacity as soon as the experienced labor can be had. A number of the properties are in need of some minor overhauling, such as the replacement of rails on different levels, repairing of chutes, and cleaning up of workings, but this work will not require much time. To build up forces, however, with the right kind of labor will prove more difficult, judging by the results obtained thus far. Green men who have been worked in between older hands are expected to show improvement in time, and this will make practicable the sending of new hands underground and gradually breaking in an efficient force.

The company now has four of its larger mines well under operation, with production about ready to start at three more, and probably four or six more properties will be ready for resumption soon. Anaconda now has on its Butte payrolls more than 5,000 men, the forces at the other companies bringing the total up to about 7,000. The Butte & Superior now has employed about 700 men and is gradually increasing its shifts, with the 1,000 set as the mark. The Davis Daly company is planning to resume within two weeks, and this will put about 300 or 400 more to work.

Butte & Superior has opened from 17 to 19 ft. of ore on the 2,600 level of the Black Rock mine, with the grade of shipments to the smelter holding at 5 per cent copper and from 5 to 7 oz. of silver. Drifting has started on the copper vein at this depth, with the body promising a continuity of values of the same general character as are being had on the 2,200, although the greater width of ore is being shown on the deeper level, the deposit on the 2,200 level ranging in width from 11 to 15 ft. The Black Rock mill is operating at about 80 per cent of capacity, and it is believed that capacity will be attained within sixty to ninety days.

The Tuolumne Copper Mining Co., in sinking the Main Range shaft below the 1,700 level, has cut a new vein, one of the so-called northwest series, showing a width of about 4 ft., with well-defined streaks of gray copper. The vein appears to be improving with depth. It is standing perpendicularly, and in all likelihood will have the shaft in it for some time. The ore is not yet commercial, but is regarded as a good indication of increasing mineralization with depth. These "northwesters" show nothing at the surface, but experience has proved in the Butte district that with depth they often have developed orebodies of much importance and value. Sinking is progressing, with the 2,400 level the objective.

Drifting westerly on the 1,600 level of the Spread Delight has been halted temporarily, pending the cutting of more water tanks on this level to care for the flow of water met in the shaft. Chutes on the 1,000 level are being repaired preparatory to resuming production when the Anaconda smelters are ready to purchase custom ore.

East Butte has opened 1 ft. of ore on the 800 level, assaying more than 3 per cent copper and about 7 oz. of silver in a vein believed to be the westerly extension of the Spread Delight fissure of the Tuolumne.

Boston & Montana Development is shipping concentrates containing about 30 oz. of silver, over 3 per cent copper, and from $.60 to $2.80 in gold. In addition, lead concentrates are being shipped, running up to 45 per cent lead and 65 oz. of silver. The daily mill tonnage is 250, with an increase to more than 300 scheduled soon. The concentration ratio is five to one, with the recovery up to 93 per cent. Shipments of concentrates are being made to the Tacoma smelter of the American Smelting & Refining Co. Lower smelting schedules have been offered by the Anaconda and the East Helena smelters, it is said.

NEVADA

Operations at Tonopah Normal—Weather Stops Leasers at Royston

(From Our Special Correspondent)

Tonopah—Recent bullion shipments from the Tonopah district are reported as follows: Tonopah Belmont, $118,000; Tonopah Extension, $62,500; Tonopah Mining, $50,000; and West End, $62,000. This represents the clean up for the last half of January at these properties.

The Jim Butler mine is being operated by leasers, and several men are working on the West End, Fraction, and other veins with varying success.

No company work is being done. The West End continues to ship ore from a certain section which has been operated under lease by that company for several years. Favorable developments continue from the 900 level of the Halifax mine. The raise on the Halifax vein shows good ore, with but one wall in sight, and another raise being driven in the hanging wall of the main vein, following a 6-in. stringer of high grade, is producing good ore. Regular shipments are being made to the West End mill.

Royston—Practically all work by leasers has temporarily ceased on account of adverse weather conditions. The second shipment from the Betts lease of fifty-two tons, ran $311 per ton and had a gross value of $16,235. The ore contained 297 oz. silver, $8.60 in gold, and 20 per cent lead.

Spanish Belt—There is about 5 ft. of snow at the Spanish Belt mine, and operations have been so hampered that it has been deemed advisable to stop all work until weather conditions improve. About twenty men have been employed. Underground conditions are said to be excellent, and the mill has been running well.

UTAH

Columbus-Rexall Estimates Extent of New Ore Recently Found

From Our Special Correspondent

Alta—Snowslides in Little Cottonwood Canyon, although damaging the Michigan-Utah tramway and carrying away a corner of the South Hecla boarding house, have not been serious this season. It is intended to replace the Michigan-Utah tram with a new installation, as the old line is considered worn out, and in the meantime shipment will be made by teams. The capacity of the tram is thirty-five tons in twelve hours, and, with sufficient teams available, it is planned to increase the output.

The management of the Columbus-Rexall estimates that enough work has been done on the new ore to place its extent at 5 or 6 ft. in thickness, persisting throughout an equilateral triangle with a base of 160 ft. How much further the ore extends must be determined by development.

Eureka—The Empire mine of the Empire Mines Co., a consolidation of a number of properties under Knight control, is being sampled, and preparations are being made to reopen the Carisa and Spy sections of the property. Shipments from the Grand Central for the week ended Feb. 4 amounted to eight cars, and a larger output is expected the week following. A considerable amount of ore has been kept back in the mine, owing to the necessity of making repairs on the tramway. The power line extended from the Chief Consolidated is almost completed, and the work of installing a new compressor is well under way.

JOPLIN-MIAMI DISTRICT

Indian Land Regulations Causing Weakness in Ore Prices?—Webber Mine Producing Heavily

By P. R. Coldren

Joplin—There is a feeling in this section on the part of the officials of some of the larger companies that the recent regulations of the Indian Department concerning the leasing of mining lands may be having something to do with the weaker tendencies in ore prices. It is the belief of these officials that under the new regulations the Indian agent may and probably will require active mining operations to be started on a good many tracts that now are inactive. One of the largest companies in the field, for example, believes that it may be required to build concentrators on six leases that it owns, but which it has been holding in reserve. Such action would naturally increase the output of zinc ore, and the theory is that the smelters foresee this increased output and believe that the ore surplus will become greater in the months to come and will exercise a bearish influence on prices.

Output from the Commerce Mining & Royalty Co.'s Webber mine, in Kansas just north of Picher, Okla., has been heavy recently. For the week ended Feb. 7 a total of about 650 tons of concentrates was made, about one-half of it being lead ore. The same company's West Side mine, just east of the Webber, which was only recently opened, is also proving an excellent property.

The new West Side mine of the Commerce M. & R. Co. started operating Jan. 11, running rich lead ore through its new mill. It is just to the north and east of the Vinegar Hill Barr lease, in Kansas, and mining operations will be carried on under a portion of the Blue Mound.

Frank Childress, of Galena, and Chicago associates have taken over the Whitebird mine, at Picher, Okla. This is a different organization from that which took over the Muncie, Blue Ribbon, and Homestake mines about a month ago. L. Lehmie, of Chicago, represents the interests in that city in the negotiations for the Whitebird. The mine is not to be confused with the Eagle-Picher Lead Co.'s mine of the same name. It is about a mile to the east of the Picher property, and has been a steady producer for the last two years, up to several months ago, when it was shut down on account of low ore prices.

MINNESOTA

Consumption of Mesabi Ore Increases Slightly

Hibbing — According to available figures, the consumption of ore by furnaces supplied by the Mesabi Range shows a slight improvement. The tonnage consumed during December was 2,577,000, which compares favorably with 2,188,000 tons consumed in November, 1921. There was available 35,895,000 tons on hand on Jan. 1, 1922, with 8,434,500 tons at the docks and 27,461 tons at the furnace yards. The stated tonnage, in comparison with 38,047,000 tons on hand on Jan. 1, 1921, shows a small decrease.

Coleraine—The stripping work being done by Butler Bros. at the South Judd, a property of the Oliver Iron Mining Co., is rapidly nearing completion. The total amount of overburden to be removed was approximately 2,500,000 yd. It is anticipated that some ore operations will be carried on by the Oliver this shipping season.

Keewatin—The Bennett mine, operated by Pickands, Mather & Co., has resumed operations after long idleness. A day shift is being worked employing about 130 men.

Chisholm—The Oliver Iron Mining Co. has announced that stripping will be resumed at the Frazer open pit at once. This property has been closed about four months. It is planned to work one shovel and about 150 men.

Vermillion Range

Armstrong Bay Mine Now Producing

Tower—The Armstrong Bay mine, of the Chippewa Iron Mining Co., has entered the production stage and is now producing from sixty to seventy tons per day. This ore is being stockpiled and will be shipped the coming season. The spur leading to the mine will be completed early this spring.

MICHIGAN

The Copper Country

District's Output of Copper on April 1 To Be About 5,000,000 Lb. Per Month

By M. W. Young

Houghton—When Calumet & Hecla and three of its subsidiaries, Ahmeek, Allouez, and Isle Royale, have resumed about April 1, the actual increase in refined copper production from the Lake district will be only about 3,000,000 lb. per month. The output will be at the rate of about 5,000,000 lb. per month. The present metal output is between 8,000,000 and 9,000,000 lb. per month.

Since the shutdown of the mines last spring, Calumet & Hecla has continued to operate its smelter, smelting such mineral and mass copper and cupola blocks as had accumulated, and an average of more than 2,000,000 lb. a month of refined copper has been turned out. The smelter now has only enough material to keep it operating until a new supply comes from the mills upon the resumption of mining.

Calumet & Hecla will mine only its conglomerate lode when production is started. The conglomerate department produced 34,000,000 lb. of copper in 1920, but it will not approach that rate when mining is resumed. There has been considerable caving and crushing of the lode in the shafts, and not all of them will be in readiness April 1 for normal operations. Production for some months may not be greater than 2,000,000 lb., refined, monthly.

Ahmeek produced 20,000,000 lb. of metal in 1920. This property, it is expected, will nearly approach that rate of output soon after resumption of operations. Isle Royale produced 10,000,000 lb. in 1920 and Allouez at the rate of 5,000,000 lb.

Mohawk and Wolverine are producing at capacity. It is not expected that Copper Range and Quincy will increase their outputs for some months.

Both Champion and Trimountain, of the Copper Range company, showed a small increase in rock production in January, and Baltic maintained the rate which obtained in December. Champion is now sending 2,500 tons of rock daily to the mill, increasing its total from 62,000 to 65,000 tons for January, and Trimountain increased from 13,000 to 14,000 for the month. Baltic sent 16,000 tons to the mill. All drifts and stopes continue to yield ground fully up to the average for these mines. A normal amount of opening work is now in progress in Champion and Trimountain, but Baltic is still under normal. Champion made a net gain of about thirty men in January, the other mines holding their own in the labor turnover that is customary.

Mayflower has stopped work in the north drift, the heading of which is in about 200 ft. on the 1,450 level, and a south drift has been started.

Gogebic Range

County Inspector of Mines Makes Annual Report

Ironwood—The annual report of the Gogebic County Inspector of Mines for the year ended Sept. 30, 1921, has been published, and from it the following statistics are taken: Tonnage of ore shipped, 4,462,089; average total number of men employed at the mines, 4,196; average underground, 3,045; on surface, 1,151; open pits, 256. The number of fatal accidents was eleven, but this includes one which was in no way due to the hazards of mining. Serious accidents where the disability extended over six months numbered thirty-three. Accidents where disability was from one week to six months numbered 5[illegible]. Seventeen mines were operated by eight companies during the year.

The Oliver Iron Mining Co. employed 2,217 men and mined 1,911,356 tons. The Steel & Tube Co. employed 929 and mined 695,532 tons. The McKinney Steel Co. employed 353 and mined 303,776 tons. The Oglebay, Norton Co. employed 389 and mined 225,788 tons. The Charcoal Iron Co. employed 141 and mined 153,854 tons. The Hayes Mining Co. employed 174 and mined 84,794 tons. The Republic Iron & Steel Co. employed 106 and mined 64,57[illegible] tons. Pickands, Mather & Co. employed 184 men at its underground mine and mined 156,630 tons; and 173 men at its open pit mined 708,689 tons. The M. A. Hanna Co. at its open pit employed eighty-four men and mined 183,176 tons.

Menominee Range

Chapin and Aragon Mines To Resume—Cleveland-Cliffs To Do Diamond Drilling at Iron River

By William H. Newett

Iron Mountain—Orders have been received to resume work at the Chapin mine, at Iron Mountain, and at the Aragon mine, at Norway. Men are now being taken on as places can be made for them. The first work to be done is to provide trestles for stockpiling. All married men formerly employed are to be engaged, which will give a force of 525 at the Chapin and about 290 at the Aragon. The mines have been closed for the last eight months. No scale of wages has been announced.

Iron River—Diamond-drill operations will be conducted by the Cleveland-Cliffs Iron Co. on the property next adjoining the Spies, in the Iron River district.

The Bristol Mining Co. has increased its working force to sixty-two men, these being employed on a full time schedule. The company had been operating on half time throughout the winter. The McKinney Steel Co. wage scale has been adopted, this being somewhat lower than was paid on the half time plan. All work will be done on the 1,460 level, the lowest that was [illegible] in the shaft last summer and [illegible] was not [illegible] at that time. A shaft through the rock from the bottom of the shaft has been started to reach the orebody.

At the Odgers mine, development work is in progress. The pocket and crusher at the bottom of the new shaft are completed. The work of installing the tramming system will soon be under way. With the new shaft ready, the lower part of the mine will be opened and developed and considerable mining will also be done in the upper levels where ore is still to be extracted.

At the Carpenter and Monongahela mines, operations are proceeding quietly. At the latter it is reported that explorations made in the northwestern portion of the property are resulting favorably. The company continues to operate its diamond drills near Alpha, but reports that no ore has been found.

The Judson is the only mine operating at Alpha, where 125 men are engaged. These have been given work to aid the district during the period of depression.

Marquette Range

Draining of North Lake Completed by Cleveland-Cliffs Company

Ishpeming—The Cleveland-Cliffs company has finished draining North Lake, in the Ishpeming district, it having been lowered until now there is only a small pool in the deepest portion of the basin. This will probably not be removed until the ice melts. There are many fine trout in this pool, and it is the plan to save them and to use them in stocking the streams of this section. The removal of the water is to guard against its encroachment on the underground workings of the company's Barnes-Hecker mine, nearby.

No orders for resumption of work at any of the mines of this range have as yet been received and no sales of ore have been reported.

NEW YORK

Mining Operations in State Much Curtailed During Last Year

Iron mining in the Port Henry district in 1921 proceeded at the rate of approximately 40 per cent of that in 1920. The New Bed mine and the No. 4 mill, the low-phosphorus operations of Witherbee, Sherman & Co., suspended operations entirely April 1, and have been idle since. The curtailment of production resulted in a good deal of idle labor in the district throughout the year. Wages were reduced twice during the year and are now on the 1916-17 scale. Diamond drilling and [illegible] exploration have been suspended in the district since early last spring. There have been no new developments or plant additions. The companies are endeavoring to carry on with even low production until general business conditions improve. Small shipments of ore during 1921 resulted in the largest accumulation of ore in stockpile the district has ever known.

The Ramapo Ore Corporation, at Sterlington, has been idle all year. The Fort Mongomery Iron Corporation operated the Forest o' Dean mine continuously throughout 1921.

The only hematite mine operated in 1921 was the Clinton hematite mine, at Clinton, Oneida County. The mine was worked on a limited scale for the paint industry only.

The New York Pyrites Co., at Gouverneur, has been running its mine and mill, producing rich ore for fertilizer and paper trades.

The mines of the American Graphite Co., on Lake George, and those of Hooper Bros., at Whitehall have been idle. Foreign competition and the high price of coal in these remote localities are given as reasons. Resumption of operations is not looked for until electric power is obtainable.

Exploration work only was done during 1921 at the zinc mines of the Northern Ore Co., at Edwards, and at the plant of the Hyatt Ore Corporation, at Taleville.

The talc plants that worked continuously in 1921 were those of the International Pulp Co., and the W. H. Loomis Talc Corporation, both of Gouverneur. The former added to its milling capacity by remodeling one of its mills, and the latter, which entered the market in 1921, is installing additional machinery for larger production and finer grinding.

The two producers of rock salt, the Retsof Mining Co., at Retsof, and the Sterling Salt Co., of Cuylerville, produced their average tonnage in 1921. The Restof company is sinking a new shaft within a mile or so of the present operating shaft. This elliptical, concrete-lined shaft will be, when completed, 1,100 ft. deep. It will have two ore compartments and one cage compartment. The Dravo Contracting Co. of Pittsburgh is doing this work, and has already reached a depth of 550 ft.

The Cayuga Rock Salt Corporation, of Portland Point, late in the year started exploration of the salt beds in its shaft near Ithaca.

The production of garnet has been steady at North River, at the mines of the North River Co. and H. H. Barton Sons Co. The American Glue Co. also mined and milled a small quantity in the same vicinity.

The mine and mill of Kinkle Bros., at Bedford, have been producing feldspar on a limited scale. The Green Hill Mining Co., of Gouverneur, also has been shipping feldspar from its mine at Old De Kalb, in St. Lawrence County.

All the gypsum mines worked steadily during 1921 and reached their average tonnage. The increase in the variety of uses and the improvements in the manufacture of wall boards and various other products called for a steady production.

THE MARKET REPORT

Daily Prices of Metals

Feb.	Copper, N. Y., net refinery* Electrolytic	Tin		Lead		Zinc
		99 Per Cent	Straits	N. Y.	St. L.	St. L.
9	13.00	30.50	31.25	4.70	4.375@4.425	4.50
10	12.75@13.00	30.00	30.875	4.70	4.375@4.425	4.50
11	12.75@13.00	30.00	30.875	4.70	4.375@4.425	4.50
13	...	...		4.70		.
14	12.875@13.00	30.00	31.00	4.70	4.375@4.425	4.475@4.50
15	12.875@13.00	29.875	30.375	4.70	4.375@4.425	4.475@4.50

*These prices correspond to the following quotations for copper delivered: Feb. 9 13.25c.; Feb. 10, 11, 13@13.25c.; Feb. 14, 15, 13.125@13.25c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Feb.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
9	61⅜	62¼	67	154¼	156	21	20⅞	24⅛	24⅞
10	61½	62½	67	152¾	154¾	20¾	20⅝	24	24¾
11	.		.	...					
13	61⅝	62⅝	67	153⅛	155⅛	21	20⅝	24¼	25
14	61	61⅞	67	152	153¾	20¾	20⅝	23⅞	24⅝
15	60⅛	61⅛	66	149¼	151	20½	20⅜	24	24½

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Feb.	Sterling Exchange "Checks"	Silver			Feb	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
9	437	99⅝	65⅞	34⅛	13	....	...	..	34½
10	434¾	99⅝	65¾	34⅛	14	435½	99⅝	66⅜	34⅜
11	432	99⅝	65⅞	34⅜	15	435	99⅝	66⅛	34⅜

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Metal Markets

New York, Feb. 15, 1922

Conditions in the local metal market are virtually unchanged, though there is a feeling about that copper may show a stronger tendency any day and there was less tendency yesterday and today to cut prices. Tin is somewhat weaker, particularly in London, but lead and zinc are holding up well at current quotations.

Copper

The copper market has been decidedly uncertain during the last week. For several weeks the price declined steadily, and on last Thursday an extreme low of 13c. delivered was reached for a large lot. This seems to have cleaned up the market for metal at that level, however, and yesterday and today it was impossible, so far as we are aware, to obtain copper for less than 13.125c. delivered. Most producers were quoting 13.25@13.50c. all the week, and a fair tonnage was sold at the lower figure. In general this business was placed by the larger producers, the custom smelters and outside interests being obliged to shade these prices somewhat in the effort to make sales. Inquiries and orders have not been of large proportions, but have shown a gain over last week, and it would not be surprising to see sales improve again from now on. A novel explanation of the decline was published in today's papers, to the effect that a loan had been called, for which eight or ten million pounds of copper had been held as security. The sudden marketing of this was supposed to have weakened the market. This sounds exceedingly pictorial. The smaller interests would hardly be likely to have as much copper as this on their hands, and the larger companies have been in no such urgent need of money after the successful business of the last quarter as to compel such a sudden liquidation. Furthermore, copper is now excellent security.

Export business has improved, sales to Germany and France being more satisfactory than for some weeks. Oriental inquiries have also been more encouraging. Prices have without doubt had some influence, for it is understood that the Copper Export Association is actively competing for business and has taken some of it from the English metal dealers.

Lead

Lead has continued to pursued the even tenor of its way during the last week. The official contract price of the American Smelting & Refining Co. continues at 4.70c., the level of recent months. Sales of normal volume have been made at this price by the Smelting company and others, though favored brands command a 5-point premium. There is little choice between desilverized and chemical lead; the premium on the former, which existed for a time, seems to be gradually disappearing. In the Middle West most of the sales have been made at 4.40c., though it is reported that lead can still be obtained from one or two producers at 4.375c. At the other end of the scale some companies have netted 4.425c. on practically all of their sales made on a St. Louis basis. The Chicago price for common lead has been 4.50@4.525c. There is no interest in forward metal. The London market continues soft.

Zinc

The zinc market has been exceptionally quiet, remaining for the entire week at practically 4.50c., some sales at slight concessions being made yesterday. Industrial conditions are still unsatisfactory as regards the galvanizing trade, inquiries from those quarters showing no improvement. Several of the larger producers are still out of the market. Monthly statistics issued by the American Zinc Institute show a diminution of stocks during January. Stock on hand Jan. 1 was 66,608 tons; production in January, 23,706; shipments, 24,636; and stock on hand Jan. 31, 5,678. Average number of retorts operating during the month, 43,873.

High-grade zinc was sold in good volume at unchanged price, 6c. per lb., with freight allowed.

Tin

Tin has been weak in London, today's quotation being within £1 of the lowest price in years. Improved sterling exchange recently has prevented the New York price from approaching the low records of last year, however. Continued uncovering of hidden stocks held in the Far East has no doubt had a depressing effect on the market. Possibly the price is being depressed to cause a curtailment of production. Local sales continue in fair volume. The tin-plate business is flourishing and is perhaps the brightest spot in the steel business at the present time.

Tin for May delivery was quoted as follows: Feb. 9th, 30.875@31c.; 10th, 30.50@30.75c.; 11th, 30.50@30.75c.; 14th, 30.50@30.75c.; 15th, 30@30.125c.

Arrivals of tin, in long tons: Feb. 8th, Liverpool, 75; Rotterdam, 100; 9th, London, 250; Straits, 5; 10th, Straits, 500; 11th, London, 485; 14th, London, 50.

Gold

Gold in London: Feb. 9th, 95s. 1d.; 10th, 95s. 1d.; 13th, 95s. 6d.; 14th, 95s. 4d.; 15th, 95s. 4d.

Foreign Exchange

Sterling has fluctuated through somewhat wide limits, and some expect a reaction before higher levels are reached. European exchanges generally have shown firmer tendencies. On Tuesday, Feb. 14, francs were 8.635c.; lire, 4.86c.; and marks, 0.505c. New York funds in Montreal, 5 per cent premium.

Silver

The market has been dull and narrow, with sales by China and the Indian bazaars buying intermittently. So long as this condition continues, and the trend of sterling exchange rates remains obscure, it is impossible to predict the future of silver.

Mexican Dollars—Feb. 9th, 50⅛; 10th, [illegible]; 11th, 50½; 14th, 50½; 15th, 50⅜.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 4.45c.; market dull. W.C.C. brand, 5¼@5¾c. per lb. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6¼@7c.

Arsenic—7½c. per lb. Strong.

Bismuth—$2@$2.10 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Iridium—Nominal, $170@$190 per oz.

Nickel—Standard market, ingot and shot, 41c.; electrolytic, 44c. Small tonnages, spot, nominal at 32c.

Palladium—Nominal, $55@$60.

Platinum—$85@$90 per oz.

Quicksilver—$48 per 75-lb. flask. San Francisco wires $47.30. Firm.

The prices of **Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of Feb. 4.

Metallic Ores

Bauxite — American, crushed and dried, $6@$8 per gross ton; pulverized and dried, $12@$14 per gross ton; calcined, $20@$22 per gross ton, all f.o.b. shipping points. Foreign bauxite offered at $6@$8 per metric ton, c.i.f. Atlantic ports, depending upon grade.

The prices of **Chrome, Manganese, Tungsten, Molybdenum, Tantalum, Uranium, Vanadium,** and **Iron Ore, Zircon** and **Zirkite** are unchanged from the prices in the issue of Feb. 4.

Zinc and Lead Ore Markets

Joplin, Mo., Feb. 11—Zinc blende, per ton, high, $29.85; basis 60 per cent zinc, premium, $26@$27; Prime Western, $25@$23; fines and slimes, $23@$20. Average settling price, all grades of blende, $26.39.

Lead, high, $64.35; basis 80 per cent lead, $60. Average settling price, all lead ores, $62.41 per ton.

Shipments for the week: Blende, 7,776; lead, 2,407 tons. Value, all ores the week, $355,520.

Shipment and production are paralleling each other so closely that zinc stocks are increasing only slightly at the mines. Sellers are holding against further reductions in price offerings, and as a result one buyer found it necessary to advance offerings $1 on one lot of premium-grade ore. One other lot sold on $26 basis, with the bulk of Prime Western bringing $25, though it is claimed a few purchases were made on $24 and $23 basis. Lead production is larger, and it is through the association of the minerals that zinc production is increased. Mines operated for lead are paying expenses from its production and holding the zinc for a stronger market.

Platteville, Wis., Feb. 11.—Blende, no sales. Lead ore, basis 80 per cent lead, $60 per ton. Shipments for the week: Blende, 152; lead ore, 147 tons. Shipments for the year: Blende, 1,703; lead ore, 457 tons. Shipped during the week to separating plants, 217 tons blende.

Non-Metallic Minerals

There are no price changes from those indicated in the market report of the issue of Feb. 4 covering **Asbestos, Barytes, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur** and **Talc.**

Mineral Products

The prices of **Copper Sulphate, Potassium Sulphate, Sodium Nitrate,** and **Sodium Sulphate** are unchanged from the issue of Feb. 4.

Ferro-Alloys

Ferromanganese—Domestic, 78 to 82 per cent, $59@$60, f.o.b. furnace; English and German, $62.50, c.i.f. Atlantic seaport. Spiegeleisen, 18@20 per cent, $25@$27 per gross ton, f.o.b. furnace.

Ferrovanadium—$4 per lb. of V contained, according to analyses and quantity.

The prices of **Ferrotitanium, Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotungsten** and **Ferro-uranium** are unchanged from the issue of Feb. 4.

Metal Products

Copper Sheets—Current New York list price, 21.25c. per lb.; wire, 14.50@14.75c. This price should also have been quoted last week.

The prices of **Lead Sheets, Nickel Silver, Yellow Metal and Zinc Sheets** are unchanged from the issue of Feb. 4.

Refractories

The prices of **Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick,** and **Silica Brick** are unchanged from the issue of Feb. 4.

The Iron Trade

Pittsburgh, Feb. 14, 1922

The report of steel-ingot production in January shows that demand for steel was increasing more rapidly than the mills were reporting during the month. Competition for orders, even for small ones, became keener at the beginning of the month.

The average rate of ingot production in January was about 22,750,000 tons a year. Production during December had been decreasing, with an average rate of about 19,750,000 tons during the month, so that January presumably started with a rate under 18,000,000 tons and ended with a rate above 23,000,000 tons, and the rate may now be up to about 25,000,000 tons. Practically all buying is from hand to mouth, for prompt shipment.

Regular prices for the leading steel products are unchanged, but in most lines, sheets being an exception, concessions have become common, even on relatively small orders. Most mills have not been earning their overhead, but they are doing somewhat better as operations increase.

Pig Iron—The market remains quotable at $19.50 for bessemer, $18 for basic, and $19 for foundry, f.o.b. Valley furnaces, but on a large lot probably any one of these prices would be shaded.

Coke

Connellsville — Furnace, $2.85@$3; foundry, $3.75@$4.25.

The Copper Market Has a Reaction

EDITORIAL MARKET STUDY

COPPER has taken a slump. The rise that began last August, when copper sold for 11½c. delivered, and which carried the metal close to 14c., has been partly dissipated by the decrease of the last few weeks. It is the first heavy decline for almost six months. Several copper companies, no doubt impressed by the gradual advance in copper until a short time ago, recently announced a resumption of operations. Anaconda was the first to take this step. The companies that have resumed or contemplate soon doing so are now

Anaconda Copper Mining Co.
Calumet & Hecla Mining Co.
Ahmeek Mining Co.
Allouez Mining Co.
Isle Royale Mining Co.
Old Dominion Copper Mining Co.
Copper Queen Mining Co.
United Verde Extension Mining Co.
Calumet & Arizona Mining Co.

Although these producers will operate at greatly reduced capacity, they will furnish an appreciable addition to current supplies, which should make itself felt after May. With copper between thirteen and fourteen cents per pound, the price was doubtless attractive enough to warrant production (the average price in 1909-1913 period, inclusive, was 13.94c.) as it is conceivable that the loss sustained by selling copper in a market at that level might be less than that entailed by a total shutdown. The eagerness of other producers to resume will probably be tempered by the recent drop in the market.

It is noticeable that the porphyry coppers are still closed down, and seem determined to remain so until industrial conditions have shown greater improvement. It would be calamitous at this time to plan for a wholesale resumption by the large companies. Producers such as Utah, Ray, Chino, Nevada, and other companies deserve great credit for their decision not to produce copper at present and for their attitude toward the market. In general those companies which have a common selling agency and operate their own properties have acted as a stabilizing influence in the copper market, refusing to sell when the market dropped to abnormally low levels and in refraining to press the metal upon an unwillingly receptive market. Owing to their financial strength, these companies were able successfully to carry out the policies noted. One would hesitate to conjecture how low the price of copper would have sunk had the larger producers been free sellers in the market.

HEAVY SALES MADE FOR FUTURE DELIVERY

On the other hand, those copper companies which do a custom business actively compete for all business available. It is maintained that this attitude is warranted by the constant intake, which is bought at specified prices. If a compensating outgo of metal is not provided for, a tendency toward speculation would be introduced. Bitter experience in the past has shown the folly of holding metal from the market. Thus two selling principles have been evolved in the copper trade.

Although the decline in price can be attributed to the prospect of increased supplies of copper, other factors in the market may be considered equally important. Thus, domestic buying evidently overdid itself in the last scramble for copper. One of the features of that buying movement which probably was not greatly emphasized at the time was the great preponderance of purchases for future delivery. Sales for delivery, one, two, three, or more months ahead were the rule, not the exception. In fact respectably sized quantities were sold for delivery as far ahead as next winter. Normally, copper producers are not interested in the market so far ahead. Some of them distinctly discourage forward buying by quarters.

As a result of the heavy sales of copper early this winter, for forward delivery, the market has behaved as one consumer felt it would, the demand at that time absorbing metal that would have been taken later. Consumers who purchased copper a few weeks ago are now not so active. Copper buying comes in waves, and an ebb is taking place from the last one. These waves, however, work neither to the interest of the producer nor to that of the consumer. The movements in the lead market are in striking contrast to those of copper. Since last September lead has been practically stabilized at a 4.70c. level, whereas copper has moved sharply up and down. Of course, in the lead market buying has also been uniform and conducive to this stability; buying of copper has come in flurries.

ACTIVE COMPETITION FROM ALUMINUM WIRE MANUFACTURERS

This journal has frequently pointed out the danger that faces copper in possible competition with aluminum owing to the low prices for which aluminum has lately been selling. Tangible evidence is reported that this competition has assumed serious proportions. One copper-wire manufacturer maintains that he has lost five million dollars' worth of high-tension transmission wire business to aluminum-wire manufacturers who hopelessly underbid him. Aluminum has been successfully used in high-tension electrical transmission, and competition in this field is largely a matter of the relative prices of the two metals. Although for the same cross-section copper is a superior conductor of electricity, weight for weight the advantage lies with aluminum when roughly, the price of copper is more than half that of aluminum. However, other factors have to be considered, such as the longer span lengths that can be used for copper and the consequent saving in the cost of constructing towers. Nevertheless, with the present spread between the price of aluminum and copper, the former metal is a heavy favorite. The relation is shown as follows:

	Present Price of Ingots	Present Wire Prices
Copper	13.25c.	14.50@14.75c.
Aluminum	17.50c.	18.75@19c., est.

It is difficult to obtain a satisfactory open market quotation for aluminum wire. Much depends upon the particular lot desired. If the assumption is made, as in the quotation above given, that the same spread exists between aluminum ingots and aluminum wire as exists between copper ingots and copper wire, then it is likely that aluminum transmission business can be taken at 20c. per lb. Copper ingots to compete would have to sell at less than 10c. Fortunately, high-tension transmission line business is only a fraction of the electrical field. There are many uses of copper in machines with which no other metal has been able to compete. Then there is the great field of alloys, brass, and bronze, that takes great amounts of copper each year. But all prospective business taken from the copper producer at this time detracts from the speedy recovery of the market.

MEDIOCRE EXPORT BUSINESS

Another factor contributing to the present decline in copper is the falling off in foreign buying. The recent rise may have discouraged European buying, and it is altogether likely that the labor troubles in Germany have been a contributing cause to the falling off in export demand. The London market has dropped with that in New York.

Looking back upon the market for the last few weeks, it is easy to conclude that the recent advance was too sharp, and that a slower advance to a lower height which could have been sustained would have been more satisfactory. Possibly this circumstance will serve as an indication that a full recovery will have to feel its way gradually and will be much more prolonged than has generally been anticipated.

MINING STOCKS

Week Ended February 11, 1922

Stock	Exch.	High	Low	Last	Last Div.	
			COPPER			
Ahmeek	Boston	62½	61	61	Sept. '20, Q	$0.50
Alaska-Br. Col.	N. Y. Curb	...	...	...		
Allouez	Boston	21	18½	18½	Mar. '19	1.00
Anaconda	New York	48⅞	47⅜	47½	Nov. '20, Q	1.00
Arcadian Consol.	Boston	2½	2½	2½		
Ariz. Com'l.	Boston	8¾	8½	8½	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*26	*22	*24		
Bingham Mines	Boston	11½	11	11½	Sept. '19, Q	0.25
Calumet & Arizona	Boston	59	58	58½	Dec. '21, Q	0.50
Calumet & Hecla	Boston	285	275	280	June '20, Q	5.00
Canada Copper	N. Y. Curb	*27	*26	*26		
Centennial	Boston	12½	12	12	Dec. '18, SA	1.00
Cerro de Pasco	New York	34½	33¼	33½	Mar. '21, Q	0.50
Chile Copper	New York	17¼	16	16⅜		
Chino	New York	27	26	26	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*29½	*25	*25		
Consol. Arizona	N. Y. Curb			3	Dec. '18, Q	0.05
Consol. Copper Mines	N. Y. Curb	1½	1¼	1¼		
Copper Range	Boston	43	41½	42¼	Sept. '20, Q	0.50
Crystal Copper	Boston Curb	*61	*57	*58		
Davis-Daly	Boston	8½	7¾	7¾	Mar. '20, Q	0.25
East Butte	Boston	11¼	10¾	10¾	Dec. '19, A	0.50
First National	Boston Curb	*70	*65	*65	Feb. '19, SA	0.15
Franklin	Boston	†1½	†1¼	1½	....	....
Gadsden Copper	Boston Curb	*50	*40	*50	....	....
Granby Consol.	New York	28½	27¼	28½	May '19, Q	1.25
Greene-Cananea	New York	27¾	27½	27⅞	Nov. '20, Q	0.50
Hancock	Boston	†2½	†2¼	2¼		
Howe Sound	N. Y. Curb	2⅝	2½	2⅝	Jan. '21, Q	0.05
Inspiration Consol.	New York	39	37½	37½	Oct. '20, Q	1.00
Iron Cap	Boston Curb	*7	*7	*7	Sept. '20, K	0.25
Isle Royale	Boston	25½	24	24	Sept. '19, SA	0.50
Kennecott	New York	28½	26½	27¼	Dec. '20, Q	0.50
Keweenaw	Boston	†1½	†1¼	1	....	...
Lake Copper	Boston	2½	2½	2½	....	...
La Salle	Boston	2	1¾	2	....	...
Magma Copper	N. Y. Curb	32¼	30	30¾	Jan. '19, Q	0.50
Majestic	Boston Curb	†*6	†*3	*3	......	..
Mason Valley	Boston	†1½	†1½	1⅝		
Mass Consolidated	Boston	2½	2	2½	Nov. '17, Q	1.00
Miami Copper	New York	26¾	26¼	26½	Nov. '21, Q	0.50
Michigan	Boston	†2½	†2	2½		
Mohawk	Boston	57½	56	57	Nov. '20, Q	1.00
Mother Lode Coa.	N. Y. Curb	8⅜	7¾	8	...	
Nevada Consol.	New York	14¼	13¾	13½	Sept. '20, Q	0.25
New Cornelia	Boston	18½	18	18½	Aug. '20, K	0.25
North Butte	Boston	12¼	11¾	11⅞	Oct. '18, Q	0.25
North Lake	Boston			*25	....	....
Ohio Copper	N. Y. Curb	*10	*10	*10	.....	....
Old Dominion	Boston	25	24	24	Dec. '18, Q	1.00
Osceola	Boston	34	32	32	June '20, Q	0.50
Phelps Dodge	Open Mar	†190	†175	..	Jan. '22, Q	1.00
Quincy	Boston	43	42	42	Mar. '20, Q	1.00
Ray Consolidated	New York	14¼	13¾	13¾	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*4	*2	*3		
St. Mary's Min. Ld.	Boston	46½	44	44	Dec. '21, K	1.00
Seneca Copper	Boston	..	..	16¾		
Shannon	Boston	1	1	1	Nov. '17, Q	0.25
Shattuck Arizona	New York	8	8	8	Jan. '20, Q	0.25
South Lake	Boston	*65	*65	*65		
Superior & Boston	Boston	1¼	1	1⅛	....	
Tenn. C. & C. cfs.	New York	11⅛	10⅞	10⅞	May '18, I	1.00
Tuolumne	Boston	*65	*60	*60	May '13,	0.10
United Verde Ex.	Boston Curb	29	28½	29	Feb. '22, Q	0.25
Utah Consol.	Boston	2¼	2	2¼	Sept. '18,	0.25
Utah Copper	New York	63¾	60½	61½	Dec. '21, Q	0.50
Utah Metal & T.	Boston	1⅛	1⅛	1⅛	Dec. '17,	0.30
Victoria	Boston	2⅜	2	2 3/16	....	....
Winona	Boston	½	½	½	....	....
Wolverine	Boston	10½	10	10½	....	....
			NICKEL-COPPER			
Internat. Nickel	New York	12¾	12¼	12½	Mar. '19,	0.50
Internat. Nickel, pfd	New York	69¾	68¾	69½	Nov. '21, Q	1.50
			LEAD			
National Lead	New York	92	88½	88¾	Dec. '21, Q	1.50
National Lead, pfd	New York	112	112	112	Dec. '21, Q	1.75
St. Joseph Lead	New York	14⅛	13¾	13¾	Dec. '21, Q	0.25
			QUICKSILVER			
New Idria	Boston	†1¼	75	1	....	....
			ZINC			
Am. Z. L. & S.	New York	13¾	13	13¾	May '20,	1.00
Am. Z. L. & S. pfd.	New York	13½	13	13½	Nov. '20, Q	1.50
Butte C. & Z.	New York	6	5¾	5¾	June '18,	0.50
Butte & Superior	New York	28¾	25½	25⅞	Sept. '20,	1.25
Callahan Zn-Ld.	New York	5¼	5⅛	5½	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	136	133¾	156	Feb. '22, Q	2.00
Yellow Pine	Los Angeles	...	...	*50	Sept. '20, Q	0.03

Stock	Exch.	High	Low	Last	Last Div.	
			GOLD			
Alaska Gold	New York	⅜	⅜	⅜	....	..
Alaska Juneau	New York	¾	⅝	⅝	....	..
Carson Hill	New York	15⅞	13¾	15	....	
Cresson Consol. G.	N. Y. Curb	2 11/16	2⅝	2⅝	Jan. '22, Q	$0.10
Dome Extension	Toronto	*80	*80	*80	....	
Dome Mines	New York	23¼	22¾	23⅜	Jan. '22, Q	0.25
Florence Goldfield	N. Y. Curb	*23	*20	*22	.....	
Golden Cycle	Colo. Springs	*51	*51	*51	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb			*4	Dec. '19,	0.05
Hollinger Consol.	Toronto	8.53	8.41	8.50	Jan. '22,	0.05
Homestake Mining	New York	†69½	†57	57	Jan. '22, M	0.25
Kirkland Lake	Toronto	*32½	*30	*30¾		
Lake Shore	Toronto	1.47	1.44	1.44	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	2.55	2.44	2.55	Jan. '22, K	0.05
Porcupine Crown	Toronto	*19½	*16	*19	July '17,	0.03
Porcupine V. N. T.	Toronto	*23½	*20	*23½	....	
Portland	Colo. Springs	*39	*38	*39	Oct. '20, Q	0.01
Schumacher	Toronto	*36½	*34	*36	....	..
Silver Pick	N. Y. Curb	*2	*2	*2	....	....
Teck Hughes	Toronto	*30	*29	*29¾	....	....
Tom Reed	Los Angeles	*80	*70	*80	Dec. '19,	0.02
United Eastern	N. Y. Curb	2⅛	2	2	Jan. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*22	*22	*22	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*3	*3	*3	....	...
Yukon Gold	N. Y. Curb	1¼	1⅛	1⅛	June '18,	0.02½
			SILVER			
Batopilas Mining	New York	†¼	†⅛	†⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*21	*19¾	*20	May '20, K	0.03
Coniagas	Toronto	1.25	1.00	1.00	May '21, Q	0.12½
Crown Reserve	Toronto	*15	*12¾	*15	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3⅝	3¼	3¼	Jan. '22, Q	0.12½
La Rose	Toronto	*40	*34½	*36	Apr. '18,	0.02
McKinley-Dar.-Sav.	Toronto	*18½	*17	*18	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.20	1.10	1.13	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅜	5⅞	5⅞	Jan. '22, Q	0.15
Ontario Silver	New York	5	4⅞	5	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	.		*12	Jan. '12,	0.10
Temiskaming	Toronto	*34	*32	*34	Jan. '20, K	0.04
Trethewey	Toronto	*5½	*4	*4⅛	Jan. '19,	0.05
			GOLD AND SILVER			
Boston & Montana	N. Y. Curb	*51	*45	*46	....	....
Cash Boy	N. Y. Curb	.	. .	*5	....	....
Dolores Esperanza	N. Y. Curb	1⅛	1	1⅛	....	....
El Salvador	N. Y. Curb	*4	*4	*4	....	....
Jim Butler	N. Y. Curb	*6	*6	*6	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	*4	*4	*4	June '16,	0.05
MacNamara M. & M.	N. Y. Curb	*7	*6	*6	May '10,	0.02½
Tonopah-Belmont	N. Y. Curb	1½	1 7/16	1½	Jan. '22, Q	0.05
Tonopah-Divide	N. Y. Curb	*65	*60	*61	..	
Tonopah-Extension	N. Y. Curb	1 7/16	1⅜	1⅜	Jan. '22, Q	0.05
Tonopah Mining	N. Y. Curb			1 9/16	Oct. '21, SA	0.05
West End Consol.	N. Y. Curb	*78	*73	*73	Dec. '19, SA	0.05
			SILVER-LEAD			
Caledonia	N. Y. Curb	*6	*5	*5	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	1.07½	1.02½	1.07½	Dec. '20,	0.15
Chief Consol.	Boston Curb	3¾	3½	3½	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	19¼	18¼	19	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†2.50	†1.00	. .	July '20, Q	0.10
Daly-West	Boston	2¼	1¾	2	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	2 9/16	2½	2 9/16	Apr. '21, K	0.05
Electric Point	Spokane	*5	*4¾	*5	May '20, SA	0.03
Federal M. & S.	New York	†12	†7	...	Jan. '09,	1.50
Federal M. & S., pfd	New York	40⅝	38⅝	38½	Dec. '21, Q	1.00
Florence Silver	Spokane	*19	*18	*19	Apr. '19,	0.01½
Grand Central	Salt Lake	*41½	*40	*40½	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	5¼	4 15/16	5	Dec. '21, Q	0.17
Iron Blossom Con.	N. Y. Curb	*19	*18	*19	Dec. '21, Q	0.02½
Judge M. & S.	Salt Lake	3	3	3	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	...	. .	*4	June '21, I	0.02
Prince Consol.	Salt Lake	*8	*7½	*7½	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*5¼	*5	*5¾	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*7	*6	*6		..
South Hecla	Salt Lake	†*60	†*35	.	Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*12	*10	*12	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*3	*3	*3	Dec. '15,	0.05
Tamarack-Custer	Spokane	1.75	1.75	1.75	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.20	2.07	2.10	Dec. '21, Q	0.05
Utah Apex	Boston	3¼	2¾	3	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	....	....	*1	Nov. '17,	0.01
			VANADIUM			
Vanadium Corp.	New York	35⅞	33½	34	Jan. '21, Q	1.00
			ASBESTOS			
Asbestos Corp.	Montreal	48½	44	45½	Jan. '22, Q	1.50
Asbestos Corp., pfd.	Montreal	....	....	78	Jan. '22, Q	1.75
			SULPHUR			
Freeport, Texas	New York	14½	13¼	13¾	Nov. '19, Q	1.00
Texas Gulf	New York	45½	42	42⅛	Dec. '21, Q	1.00
			MINING, SMELTING AND REFINING			
Amer. Sm. & Ref.	New York	46¾	45⅛	45⅛	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	91	90	91	Dec. '21, Q	1.75½
Am. Sm. pf. A.	New York	87	87	87	Jan. '22, Q	1.50
U. S. Sm. R. & M.	New York	35	32¾	32¾	Jan. '21, Q	0.50
U. S. Sm. R. & M. pf.	New York	43½	42½	43½	Jan. '22, Q	0.87

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil, Colorado Springs, The Financial Press, N. Y.

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Engineering and Mining Journal

A Weekly Journal of the Mining and Mineral Industries
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Volume 113 New York, February 25, 1922 *Number* 8

Mining and Salesmanship

WE DO NOT FEEL that the copper producers have yet embarked upon an adequate campaign for the cheap delivery of their finished product to the ultimate consumer, or for the popularization of their wares to the small individual buyer, who in the end determines the major market prices for their metal. We believe that we are in a new era, where the consumption and the price of copper will depend on the skill of those interested in merchandising it; and the sooner all frankly realize this situation the better for all. This is a complex age, an age of makeshifts and ingenious substitutes. A saucepan, or a roof, or a screw may be made of a dozen things; and whether it is one or the other which we will buy when we drop into the hardware store depends upon the efforts of the producers in manufacturing, merchandising, and salesmanship.

The aluminum manufacturers studied and perfected their methods first among metal manufacturers. Then came the zinc people, earnestly endeavoring; and the copper producers ponderously brought up the rear. The merger of the Anaconda and American Brass offers great possibilities to the latter, and may blaze the trail for a program for the whole industry. The marketing of molybdenum by the American Metal Company, the owners of the Climax mines, in Colorado, is the best example that we know of the science of merchandising applied to metals and one whose study is recommended.

No doubt this is the indicated line of development for all the mining industries, so that the producer may receive more through the ultimate small consumer paying less. It is the problem of the farmers also; the reduction of the number of middlemen and of their excessive profits, which profits are necessitated by unscientific methods of merchandising. Only the gold producer is free from this necessity of turning merchant, and following his product from the mine to the manufactured small article. He may continue to market his crude product at the established price. This also applies to the domestic producers of silver, as long as the Pittman Act remains effective. But for all the rest, manufacturing, merchandising, and salesmanship are now the big factors in the miner's problem.

The Pyrites Markets

PREVIOUS TO THE WAR, Spanish pyrites was imported in great quantities into the United States. The cheap freight rates made possible by its being brought over as return cargo on ships that otherwise would have returned empty from Europe, joined with the cheapness of production of the great Rio Tinto mines, effectually prevented the development of an important competitive pyrite mining industry in this country. During the war, however, the use of ships for importing pyrites was practically discontinued, owing to the necessity for using the inadequate existing shipping to a maximum efficiency for pressing war purposes; and, coincidentally, the Government encouraged the development of a domestic pyrites industry, which, obedient to these circumstances, sprung up, especially in the middle south Atlantic states, such as Virginia and North Carolina. These incompletely established industries were halted by the Armistice and the consequent cessation of war demand for their product; and the natural remedy that occurred to the pyrite miners was the establishment of a tariff on foreign pyrites.

Meantime, however, the sulphur deposits of the "domes" on the coast of the Gulf of Mexico, in the Texas-Louisiana region, had become developed to such an extent that a superabundance of cheap sulphur became available; and this was put upon the domestic market at such prices that, except in rare instances, pyrites could not compete with it as a source of sulphuric acid. The result was that not only the domestic pyrite industry became dormant, but the dreaded foreign importations also shrunk to a small fraction of their pre-war volume.

In the first ten months of 1921, only 132,754 tons of Spanish pyrites was imported, against 1,093,980 tons in 1916. That the Rio Tinto pyrites will regain its lost market in the United States is extremely doubtful. This could only be attempted by a campaign of lower costs and a sacrifice of profits; and in such a contest it is likely that American sulphur producers could carry the war into the enemy's camp, and compete for the European markets also, against the Spanish pyrites supply. Under these circumstances, a truce, or a division of the world markets, is likely to be maintained.

The Wireless Telephone Now a Practical Instrument

THE USE OF THE WIRELESS telephone has become what almost might be termed common in the vicinity of New York during the last year. The radio aërials may be seen on thousands of housetops in the city and its environs, and so much copper wire has been used in this way that the business of the wire companies is reported to have appreciably improved. The apparatus is freely sold in most of the department stores, demonstrating receiving stations being maintained in each instance, and the New York *Globe* and the New York *World* every day publish columns of information and news. Over 700,000 sets have so far been bought.

Two factors have been responsible for the wide interest in this startling development of science. One is the practice of two or three of the big sending stations around New York of broadcasting news, weather reports, lectures, sermons, and various kinds of music and entertainment. Possessed of a receiving apparatus, one may recline quietly by the fireside and pick a good time out of the vibrating ether. The second reason for the popularity of radio equipment is its low cost. A simple crystal set may be obtained for as little as $15, and for about $150 one may obtain a truly luxurious outfit with an amplifier so that every one in a room may hear. The De Forest and Westinghouse companies, and possibly some others, are putting out a complete line of amateur equipment. A sending outfit is more expensive, and a license is required to operate it, but still a great many amateurs possess such equipment.

The possibilities of the radio telephone in the mining field are obvious. Even now the prospector in northern Ontario, in his lonely cabin far from human habitation, can sit and listen to (but not see!) the latest Broadway musical comedy sent broadcast at a special performance given for the purpose. Instead of hitching his wagon to a star he has only to hitch his aërial to a tree, or preferably to two trees, and he can hear things passing through the air to which the ordinary mortal is totally oblivious.

The wireless is being used by Government agencies to send agricultural market reports throughout virtually the entire country. Judging by the number of demands for telegraphic and special mail service on *Engineering and Mining Journal* metal-price quotations, it may be advisable to disseminate these by similar means, so that the mining company in the most remote district may be advised of the price he is to receive on the same evening that the information is collected in this office. Important mining news could also be sent by the air route. We shall be glad to hear from those of our readers who have receiving outfits as to what they think of the possibilities.

English, Language and Economics in Mining Schools

A QUESTIONNAIRE of the Mining and Metallurgical Society of America asks the following:

"To what extent and by what methods do you believe English should be taught?

"To what extent and how should foreign languages be taught? Give the languages you suggest in the order of preference.

"How and to what extent should economics be taught?"

A concise, clear use of English is one of the essentials of an engineer, and, for that matter, of every business man. Just to show that the universities are not above the need of this, we quote the following extracts from two different catalogs, letting the chips fly where they will:

> "The smelter laboratory is the center of the microscopical activities of the metallurgical research of the United States Bureau of Mines."
>
> "Description of the processes and implements used in the manufacture of copper, lead, zinc, tin, minor metals and of the precious metals. Study of the chemical and physical principles involved. Properties, further treatment and application of the extracted metals and some of their alloys."

Certainly there is need of precision in the use of words and language. We do not believe that a dab of English given in a one-hour course will reform a group of mining students. What is wanted is a conscientious instructor of English who will collaborate with the technical instructors.

The beginnings of language instruction should be started in the high school. Students of marked ability should be encouraged in the university to continue their language studies until they have a good reading knowledge of some foreign language. A man's horizon is distinctly broadened by knowledge of languages other than his own. Either French or German, or both, should be studied; Spanish has a utilitarian value to some mining engineers, and those students who intend to operate in Spanish-speaking countries should be advised to take this subject.

For an engineer, economics is essential. The groundwork of the principles of economics should be taught and then followed by the economics peculiar to the mining industry, together with a thorough review of metal and mineral marketing.

The World's Water Power

WITH THE INCREASED APPLICATION of electricity (especially with the perfection of long-distance transmission), the possession of water power becomes more and more a prime factor in determining the wealth and prosperity of an otherwise vigorous people. Water power may, in a large measure, take the place of the fuel minerals, coal and oil; or it may conserve those even where they are produced in relative abundance, and divide work with them for greater average efficiency.

The Geological Survey recently estimated that the United States possesses 40 per cent of the developed water power of the world, water wheels having a capacity of 9,243,000 horsepower having been installed. Canada comes second among nations, with 2,418,000 horsepower, or over 10 per cent of the world's total. New York State leads the states, with 1,300,000 horsepower, and California is next with 1,111,000.

Compare these figures with the developed horsepower in some of the most advanced European countries: France has the largest developed power in Europe, but, with 1,400,000 horsepower, hardly more than that of New York State. The Scandinavian peninsula is rich in water power: Sweden has 1,200,000 horsepower, and Norway 1,350,000. Little Switzerland, with her Alpine rivers, has 1,070,000 horsepower.

Niagara Falls has the largest water-power development in the world. Increases in capacity now being made will bring the total to 1,284,500.

These figures are for developed power. How about ultimate possibilities? The total potential water power of the world is estimated at 439,000,000 horsepower. In these potentialities, Africa leads by far all the continents, according to the estimate, with 190,000,000 horsepower; and this fact may at some distant day determine Africa as a great industrial continent. Asia, for all her vast area, has only 71,000,000 horsepower, while Europe has 45,000,000. North America has the considerable figure of 62,000,000, of which 28,000,000 only are in the United States. South America has 54,000,000 horsepower.

When we consider the various sources of power, especially coal and water power, we are safe in assuming that for many centuries North America will continue an industrial area of the highest degree of importance.

Without hydro-electric power, many of our mines could not be operated at all: and more and more will electricity form part of the chief problems of every important mining operation. Besides the power function, it is altogether likely that the time will come when electric smelting will solve the problem of many of our refractory, because perplexingly and intimately mixed, ores.

On the Ground Floor

EVERY DAY INVESTMENTS are being made more attractive. The prize one, where you get the most for the least money, is one offered in a circular over the letterhead of the First State Bank of Burnet, Texas, and coming from the office of W. C. Galloway, cashier. The picture of Mr. Galloway's Fort Worth office—a twelve-story building—adorns the letterhead.

This circular invites you to be a stockholder in a "Syndicate," or "Ground Floor Crowd." What the assets, holdings, or development plans of this "Ground Floor Crowd" may be, is not revealed. It really doesn't matter; the inference, let drop incidentally, that this is or is to be an "oil company" is quite sufficient. You are invited to be a stockholder in this "Ground Floor Crowd"; more than that, the circular, printed and with a printed signature, invites you to be a Director! "On account of your familiarity with different oil companies, and on account of the treatment which you have received at the hand of the different oil companies" (Oh, bitter recollection!) "your experience and judgment should be of material benefit to the success of the company, and I want you to accept a place as one of its Directors." This to "Dear Friend," printed.

It is understood that "Dear Friend" might not be able to attend all the Directors' meetings, "but some of the other Directors also live out of Fort Worth," and you "could write your opinion and view by mail." There is here evinced a magnificent disregard of the law that "Directors cannot delegate their authority nor appear by proxy at meetings, but must be personally present in order to act thereat." (Conyngton on "Corporate Management.")

How much must you invest to become a Director? One hundred dollars if you have it. "Any one of your earning capacity and ability is amply able to invest $100, and you should do it, thereby availing yourself of the opportunity to its fullest extent." If, however, you are not prepared to go the limit, "if you cannot invest that much, you may send your check or note for a smaller amount." What we should like to know is whether we can be a Director for as little as fifty cents. And in this connection, we note that the Texas law (Overland, "Classified Corporation Laws"), prescribes that Directors shall not be more than thirteen in number. A maximum of thirteen hundred dollars may therefore be raised (within the law).

While no assets of lands or oil are dangled before the eyes of the hundred-dollar Directors, a more sensible and productive scheme is unfolded—in fact, these suckers are promised that they shall feed on other suckers.

"As one of the organizers, $100.00 gets for you 1,000 shares, whereas after the company is organized, it will take $1,000.00 to get 1,000 shares. This will get you a quick profit of ten for one. After the company is organized, and the advertising campaign started, a contract is to be made with two brokers; one to organize a sales force to sell stock to raise money with which to drill a well; the other to organize a sales force to sell the stock belonging to the organizers or ground floor men, and his efforts, together with the efforts of the organizers or ground floor men themselves, should in a short time enable each ground floor man to get his money back. Then if you wanted to sell more stock and make $7.00 or $8.00 on each $1.00 invested, you could do so, or if you wanted to ride the balance through until the well was completed, if it should be a gusher, it would make you an independent fortune."

Who would take a chance on striking oil when he can make 700 to 800 per cent by such a quick and safe turnover? The other road to fortune is long, involved and tortuous—after (1) the company is organized and (2) the advertising campaign started, (3) a contract is to be made with a broker, (4) to organize a sales force, (5) to sell stock to raise money, (6) to drill a well. Then (7) if it should be a gusher! Ah, if!

Says Galloway, "I want to treat you in a fair and honorable way. I do not want you nor any one else to be able to say that Galloway snatched this opportunity away from you while you were hesitating and undecided."

Does Galloway get the prize?

E. & M. J. Index

THE INDEX for Vol. 112 of the *Engineering and Mining Journal* is now ready for distribution and will be mailed only to those who request it. Those who wish a copy of the Index are requested to send for it promptly. A postcard will do.

WHAT OTHERS THINK

Drilling Results and Dredging Returns

In the various articles relating to the discussion and comparison of the estimated value of dredging ground by the examining engineer and the actual recovery by dredging, the burden of proof seems to have been placed upon the engineer. Though there is a consensus of opinion that the types of drills used are not mechanically perfect and that the human equation is a variable, the same stress has not been laid upon the dredge and its operators.

It is admitted that the modern dredge and its equipment are efficient and that the percentage of loss is small after the material is once on board. However, a slight negligence on the part of the winchman will set at naught the gold-saving devices of the dredge.

In lode mining, it is easily ascertainable if all the estimated tonnage has been extracted, and by assaying the tailings it is possible to calculate the percentage of error, but in dredging it is not the practice to resample the area after dredging to ascertain if all the estimated values have been extracted. Tailings from the dredges are sampled, but this will show only the percentage of loss of the amount placed on board.

The prospecting of dredging ground is usually under the direct supervision of the engineer in charge, and every effort is made to secure as accurate results as possible with the given tools. The methods used vary in detail but not in principle.

In drilling, when the hole reaches bedrock it is continued into it, and, if possible, a core is pulled, so that there cannot be a loss of gold due to failure of the pump. Will the winchman display the same amount of diligence and patience if he encounters a reef which is particularly troublesome? It is, of course, within the province of the engineer to estimate how much bedrock must be dug to recover the estimated values and whether this be economically possible.

At an Alaskan property, drilling showed that good values extended into the crevices of the shattered limestone for 6 ft. Subsequent shafts showed that it would be unprofitable to remove the bedrock for a depth greater than 25 ft. Therefore, gold recovered by drilling below this depth was disregarded, and values were estimated from surface to 25 ft. in bedrock. The estimated value was 61c. per cu.yd. and the recovery 61.8c. The gravels were lifted by hydraulic elevators and sluiced and the bedrock was observed.

A 6-ft. vein of hard quartz crossed the pit and formed a riffle, behind which there was a heavy concentration of gold. The point is that the estimated value and the recovered value closely checked, but, had the ground been dredged, the heavy concentration in the vicinity of the quartz vein would not have been recovered, and it is improbable that a dredge would be capable of digging to an equal depth.

The foregoing illustration is comparable to lode mining, where all operations can be observed. If, however, the same ground had been dredged, it is probable that the recovery would have been much below the estimate.

Character of bedrock greatly influences recovery, more particularly with respect to small dredges than on the larger types, which have the strength and power to move hard material.

In the various examples cited in the articles published, the estimated values are stated and also the actual recovery by subsequent dredging. However, the expected percentage of recovery and the loss in tailings are not stated, so that a fair comparison of estimated value against recovery cannot be made. It is usual to estimate a certain percentage of testing results as recoverable, this percentage being dependent on the character of gravel, especially with regard to clay content, the character of the gold, whether coarse or fine, the character of the bedrock, and the experience of the engineer.

The generally accepted practice of drilling one hole per acre does not seem to me to be sufficient for an accurate estimate, except in operations where the test values are greatly in excess of maximum operating cost.

In the example above cited, the bedrock consisted of a series of shales and limestones, with a dip of 15 to 20 deg. The shales could have been easily dug, and a high recovery by dredging was possible. The limestone was shattered and full of crevices, making the digging hard and a high recovery impossible. The alternate beds of shales and limestones were thin, so that, had the deposit not been drilled at 100-ft. intervals, it would not have been possible to estimate the percentage of favorable and unfavorable bedrock upon which to base an estimate of the percentage recovery, and as the values were consistently higher in the limestone area than in the shale area, it would not have been possible to give the drill-hole values the proper weights.

I believe that the lack of sufficient development is owing to the fact that in earlier development the nature of gravel deposits was not fully understood and that the gold was believed to be distributed more evenly than has been found to be the condition in practice. It is certain that, as the industry has developed, the testing of the gravels has become more rigid. Nevertheless, the amount expended for the development does not approach the sums expended for this work in other branches of metal mining. The money spent for development in lode mining before the installation of reduction equipment is from three to five times that spent on examination and development of dredging properties, figured on the basis of dollars developed per dollars expended, which is probably due to failure to note that usually the examination and development of a dredging property are carried on simultaneously and the cost of examination seems excessive, whereas, as, a matter of fact, part of this cost should be considered as a development charge.

The usual procedure in lode mining is to make a preliminary examination of the prospect. If satisfactory, a development campaign is started, and when it is sufficiently advanced, a thorough examination is made, the orebodies are sampled, the tonnage is calculated, and estimates are made for the proper size of plant to extract the metals economically. The engineer examining a lode mine has an advantage over the one examining a dredging property, in that he can more closely observe the working conditions and make allowances more accurately for losses or barren zones and the character of the wall rock, which may be soft and cause dilution of values. However, admitting the imperfection of drilling methods, like imperfections of method occur in lode sampling, with perhaps a lesser percentage of error. I believe that with the same proportionate amount expended upon development of a dredging property as on a lode property a comparable degree of accuracy would be obtained.

New York. EUGENE H. DAWSON.

Engineering Education

In *Engineering and Mining Journal* of Feb. 11 is a letter by T. T. Read in which he records some observations on engineering education. If I understand his remarks correctly, he would have many of the applicants seeking entrance to engineering colleges turned away and sent to vocational schools, because "we need more foremen and assistant superintendents and fewer educated engineers of the type of Rossiter Raymond and Pope Yeatman," to quote him approximately.

This is a startling suggestion. Many teachers of engineering students, including myself, have been laboring under the belief that the world needs, not so much foremen and petty bosses, as broad-minded, cultured engineers like Herbert Hoover, to take a younger man as an example. Every week or so we hear of Hoover being suggested to direct this or that difficult job. Apparently engineers of his wide knowledge and social insight are much in demand. If there were more Hoovers in power at Washington and more of them in important positions in industry throughout the country, the benefit would be enormous. I think the country could use several thousands of Hoovers at least, to replace that number of lawyers, bureaucrats, and rubber-stamps now in office. Should not, then, the engineering colleges seek to develop as many broad-minded, cultured engineers as possible instead of the somewhat narrow, unimaginative type of engineer that Philip Cabot condemned in a recent address?

There is, of course, the difficulty that independent, imaginative individuals like Hoover are frowned upon and discouraged immediately upon leaving college, because they have a mind of their own and do not defer to the assistant superintendent. Hoover, himself, spent his formative years abroad, finding more encouragement for his ability in Australia, China, and London than in the United States. This, however, is a fault of the American employer, not of the American engineer; and if more engineers of broad vision and imagination were being produced, the industrial system might learn to absorb them in place of the inferior types now favored.

New York. P. B. MCDONALD.

THE POMONA COAST OF SOUTHWEST AFRICA

The Diamond Fields of Southwest Africa

Wind Action and Ancient Rivers Responsible for Presence of Precious Stones in Loose Sand and Gravels on Face of Desert Agreement of Producers Controls Diamond Output of Southwest Africa and Protectorate — Mining and Milling Practice Simple

BY JOHN WELLINGTON FINCH

Written for *Engineering and Mining Journal*

THE TERRITORY owned or held under lease by the Consolidated Diamond Mines of Southwest Africa, Ltd., and by its subsidiary, the South West Finance Corporation, Ltd., is shown on the accompanying map. The properties cover a great part of the known payable diamondiferous land of the Protectorate, formerly German Southwest Africa. Diamondiferous gravels are found in an area extending ninety miles along the seacoast, but the important deposits lie in a strip beginning east of Luderitzbucht, in the Kolmanskop diamond company area, and extending sixty miles south. The maximum distance of diamond deposits from the coast is nine miles. This area yielded 606,423 carats in 1920, 90 per cent of which was produced by the Consolidated Diamond Mines company.

The following table gives the particulars of output and diamond sales under the German regime:

	Diamonds Received, Carats	No. of Diamonds, per Carat	Diamonds Sold, Carats	Value
1909-10......	560,977	5	560,977	£836,000
1910-11..	798,865½	5¾	798,865½	1,069,000
1911-12..	816,296	6½	816,296	1,045,000
1912-13....	902,157	6.09	902,157	1,324,500
1913-14........	1,570,000	4.97	1,284,727	2,698,500

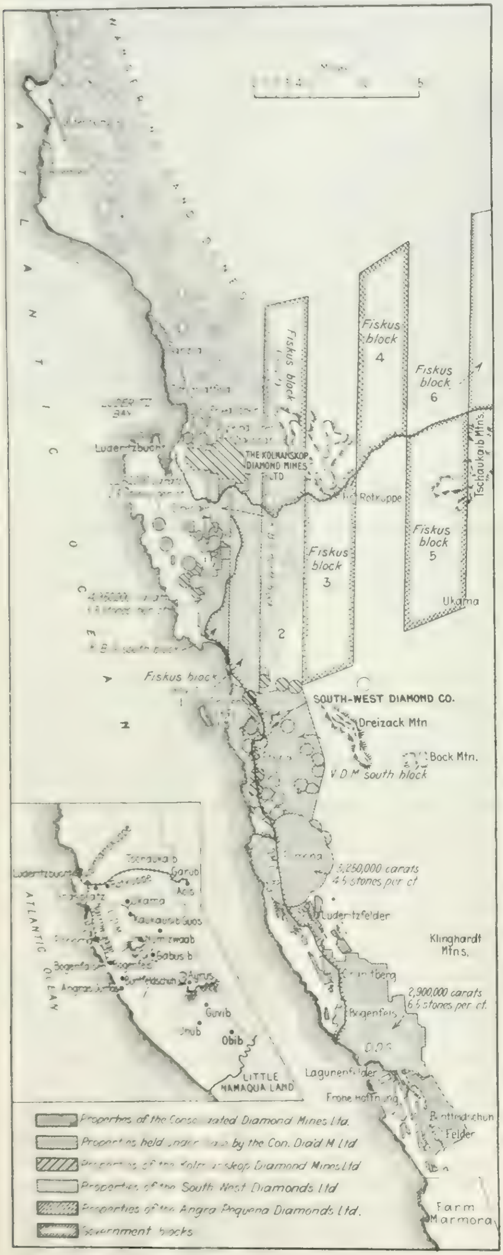
Stock carried forward, 285,273 carats.

Aside from the more than ample living quarters for white employees and excellent offices at Luderitzbucht and Kolmanskuppe station, the principal equipment of the company is the power plant at Luderitzbucht, a large milling plant at Kolmanskuppe, and smaller mills on the principal properties formerly owned by the German-controlled companies; also a narrow-gage railway serving the mining areas. The power plant, operated by a separate company, though not modern, is well constructed and reasonably efficient, and is capable of supplying more power than the field will ever require, not only for the Consolidated company but for any outside demands. Natal coal is used for producing gas.

Power sales in 1920 were: 679,016 kw-hr., Consolidated Diamond Mines Co.; 349,076 kw.-hr., Kolmanskop Diamond Mines, Ltd., and 94,400 kw.-hr., used by the town of Luderitzbucht and also by other minor consumers.

The power plant is equipped as follows: Two gas-engine units of 1,000 hp. each; two gas-engine units of 600 hp. each, and one gas-engine unit of 155 hp. All units are direct coupled to three-phase, alternating-current electric generators producing current at 3,000 v. There is also the requisite direct-current unit for excitation. The current is stepped up to 30,000 v. as transmitted to the mines and railway. A 208-v. current is delivered to consumers in Luderitzbucht. All transformers and transmission lines belong to the operating company.

The diamonds are found in loose sand and gravels on the face of the desert, left there by wind and water. The "river diamonds" of the Union show much wear by attrition, because they have been transported by streams considerable distances from their places of origin. The diamonds of Southwest Africa exhibit practically no wear, indicating that they were brought from near-by sources by the ancient rivers, remnants of whose beds are to be seen at many points in the fields. This has led geologists and others to assume that a diamond-bearing kimberlite pipe should be found somewhere inland and near at hand. Pipes have been found, but tests have shown them to be practically barren of diamonds. The pipes of the Union are situated in a great inland plateau, which, as compared to the coast areas of the Southwest diamond fields, has undergone only a moderate amount of erosion since the pipes were intruded. Doubtless thousands of feet of the original vertical extent of the Protectorate pipes have been removed. It is possible, therefore, although it is entirely theoretical, that the Protectorate pipes have been cut down to such a depth that the more highly diamondiferous parts have been removed, and that discovery of payable pipes is not now to be expected. Nor, on the whole, are they wanted. The company has abundant diamond deposits in a more desirable form.



MAP OF SOUTHWEST AFRICAN DIAMOND AREA

There is some reason to believe that the diamonds of the Protectorate came from a single pipe. Over the entire field they are uniform in quality, appearance, and habit of crystallization, whereas no two of the productive South African pipes yield diamonds identical in quality or appearance.

POMONA CONGLOMERATES SHOW DIAMOND CONCENTRATIONS

The two principal oldest river channels crossed the region just south of the Pomona area and into the Fiskus No. 1 and K. B. G. blocks. From the latter, diamonds have been redistributed by two transverse second-period river channels, one of which entered Elizabeth Bay in the South Block K. B. G. In the latter region a later river of a third period, redistributing diamondiferous gravels of the two former periods, entered the sea at approximately the same point. The rich conglomerates within the Pomona area are, in my opinion, a concentration of diamonds by an old river of the first period combined with wave action along an ancient shore line. The topography of the Pomona area is somewhat rugged, and this first-period river channel has been removed at inland points. The former rivers were probably intermittent flood rivers, as are those today, and materials brought toward the coast by them were reworked by the winds concurrently, as now.

WIND ACTION IMPORTANT IN DIAMOND DISTRIBUTION

That the present wide distribution of the diamonds has been accomplished by wind transportation is unquestionable. The diamonds of the Pomona and D. D. G. areas gradually decrease in size northward from the old river deposits in that region; then again about the mouths of the river channels of the several periods in the Elizabeth Bay region coarse diamonds are found, thence gradually decreasing in size northward to the limits of the field. In the latter region it is clear that the winds have moved and redeposited the diamonds and other associated materials for a distance of fifty kilometers, or over thirty miles, and fine sands several times further. This is not at all astonishing to one who visits the fields and watches the wind in operation. Its most important economic effect has been a concentration of diamonds which is largely responsible for the payability of the fields. As the sands and gravels advance northward, barren fine sands are removed and carried beyond into the great group of dunes shown in the northern area on the map herewith. These are of such size as to resemble a mountain range, and this vast bulk of worthless material has been removed by nature from the diamond deposits.

Along the coast the Southwest Protectorate is an absolute desert of the most forbidding type; inland it is semi-desert and most unpromising for the development of agriculture or any other considerable source of public revenue. Before the war, when it was a German province, it was looked upon by the imperial government as an entering wedge to political expansion toward the Province of German East Africa. Its value was more strategic than actual. It was not self-supporting, and its commercial future depended fundamentally upon the development of mineral resources. Aside from copper deposits which were discovered in the northern part of the province and have since been profitably worked, the diamond fields, on which mining was started in 1909, gave the greatest promise of an economic future for the region. The German imperial government, having ambitious plans for the province, as soon as the diamond fields were brought to a considerable stage of production, naturally exacted taxes to the utmost limit, and several of the original companies were unable to make satisfactory profits at the prices then prevailing for diamonds.

WELL OF BRACKISH WATER, SOUTHERNMOST DIAMOND FIELDS

After the province had been handed over by mandate to the Union of South Africa, all the rules and regulations which had become established under the German regime were respected and perpetuated. All properties are subject to a tax of 66 per cent of the gross proceeds of diamond sales, less 70 per cent of the cost of production. There is usually also 1s. 6d. per hectare land or claim tax and a Regie[1] tax of 2 per cent of gross proceeds, both allowed as working costs. A sixpence per carat is added arbitrarily to the working costs in the principal areas of the company's properties. Ten per cent interest on the unredeemed value of plant and buildings and 10 per cent depreciation on equipment and all things used in producing diamonds are also allowed as costs.

AMORTIZATION CONSIDERED AS WORKING COSTS IN TAXES

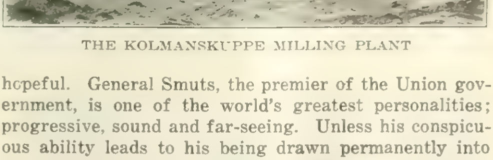
As compared with the diamond mines of the Union provinces, taxes in the Protectorate are higher, though a greater allowance is made in working costs. Amortization is regarded as a part of working costs, whereas in the Transvaal amortization is deducted from the gross profit, and the balance is called net profit, which is shared between the government and the mining company.

Government administration in the Protectorate is carried on in behalf of the Union government by an administrator appointed by the premier. Under him are local commissioners at the principal towns. The administrator has broad authority.

GOVERNMENT FOR BENEFIT OF COMMUNITY

I was considerably impressed with what appeared to me to be the spirit of the government of the Union of South Africa. Although in the recent election the radical labor party was defeated, the government nevertheless remains mildly socialistic, and governs its people and their business in a paternalistic manner. It appeared to me that a corporation in the Union of South Africa is not primarily regarded by the government as a source of profit to its shareholders, but as an organization existing for the benefit of the community. This is well illustrated by the increase of rates of the government railways in the Transvaal and Natal. In the effort to realize for the government by freight rates all that the traffic would bear, the coal-mining companies and practically all other industries particularly dependent upon railway transport are having a hard struggle for existence. The territory covered by the provinces of the Union is so poorly developed that the sources of revenue by taxation are few, and just at this time the government is far from self-supporting. Its revenues were principally from mining. The gold production is now greatly decreased because of the closing of many of the exhausted older mines and of others on account of high working costs. The revenues of the Union from the diamond industry have suddenly become practically nil. The government is so badly in need of funds that it is not to be expected that relief from taxes, or from other concessions which might contribute to greater profit to corporations, will be easily secured.

Though some of the foregoing statements may appear pessimistic, there is another point of view which is hopeful. General Smuts, the premier of the Union government, is one of the world's greatest personalities; progressive, sound and far-seeing. Unless his conspicuous ability leads to his being drawn permanently into the councils of the Empire in England (which is unlikely, on account of his great devotion to South Africa), an effort to give just and intelligent administration of public affairs will be made while he is at the head of the government. Corporations can count upon fair and reasonable consideration of grievances which are of sufficient importance to command the premier's personal attention.



THE KOLMANSKUPPE MILLING PLANT

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[1] The Regie was at first an organization established by the imperial German government to take charge of the sale of diamonds. It consisted of eighteen associated firms organized into a corporation, three of which represented producers, the others being banks in Germany. Later on, after much controversy, the producers secured a 50 per cent representation, the government took over 30 per cent, and representatitves of the diamond-cutting industry 20 per cent.

In the 1915 and 1916 period of the war, Protectorate diamonds were offered by the Union government of South Africa in large quantity. This threatened to undermine the control of the London Diamond Syndicate. The Syndicate and the De Beers company came to an agreement to tender for these diamonds on joint account in January, 1916. The De Beers company also acquired control of the Premier mine, and in Otcober, 1916, the Syndicate came to a further agreement to purchase the Premier output. Afterward an understanding was reached with the government, so that since February, 1917, the diamonds of the three great South African producers and those of the Protectorate have been sold through the one channel under fixed quotas. It has long been recognized, both by the government and the Union producers, that control of output is necessary.

The sales of the diamonds of the Protectorate are made through the administrator to the Syndicate. In a conference held in Pretoria on Dec. 31, 1919, it was agreed to limit for a period of five years the quantity of diamonds put upon the market to an amount salable to the Diamond Syndicate for £3,000,000 per quarter, the quota allotted to each of the companies being as follows:

	Per Cent in Value
De Beers Consolidated Mines, Ltd.	51
South West Africa Protectorate	21
Premier (Transvaal) Diamond Mining Co., Ltd.	18
New Jagersfontein Mining & Exploration Co., Ltd.	10

The quota of 21 per cent allotted at this time to the administrator included not only the Consolidated Diamond Mines company but all other producers in the Protectorate. An agreement has since been made whereby a special sales permit of £200,000 per annum is allowed to the other producers, leaving to the Consolidated Diamond Mines company the full quota of 21 per cent.

HIGH DIAMOND PRICES FORCED REDUCED DEMAND

The Syndicate, taking advantage of the period of abnormal demand for diamonds, had restricted sales, and prices had risen to an unprecedentedly high level, 170s. for Consolidated diamonds. War profiteers were apparently the principal purchasers. This period was followed by an abrupt reaction. The retail dealers found that there was no class of people in America or Europe willing to make large purchases of diamonds at such high prices. The trade has, however, passed through similar periods of depression in the past—for instance, in 1907—and no doubt is entertained as to the resumption of business when the world's purchasing power recovers.

HAND SCREENING AND SORTING, KOLMANSKOP DIAMOND MINES CO

In 1919 diamonds were produced in other countries as follows: Belgian Congo, 275,000 carats (now at the rate of about 250,000); Borneo, 5,000 carats (no probable increase); British Guinea, 20,000 carats (no probable increase); Brazil, 150,000 carats (large percentage industrial diamonds), a total of 450,000 carats, which is equal to 17½ per cent of world's output.

The important African diamond mines, excepting those of the Protectorate and the Congo, produce from kimberlite volcanic pipes by underground mining methods. Outside the Syndicate group, a source of small production is from the gravels of the river valleys draining the areas containing the pipes of Kimberley, Premier, and Jagersfontein. These diamonds appear to aggregate usually about 5 per cent of the carat production of South Africa, but digging was stimulated by recent high prices. The production has now become small again. It is not a stable business, being mostly done by a vagabond class of miners, always hoping to strike it rich, but seldom doing so.

ELECTRIC SHOVEL AT KOLMANSKUPPE

River diamonds average larger in size and better in quality than diamonds from the deep mines, and therefore represent considerably more than 5 per cent of the sales price of South African diamonds. In 1919, river stones sold at an average price of 261s. 6d. per carat, the diamonds from the kimberlite mines at 87s. 3d. per carat, and those from the Consolidated Diamond Mines at 112s.

The outside producers in the Protectorate have averaged from 2 per cent to 3 per cent of the total South African production.

South Africa furnishes normally about 85 per cent of the world's diamonds, 92 per cent of this coming from the mines of the Syndicate group, which, therefore, are to be credited with 78.2 per cent of the world's production. Hence the Consolidated Diamond Mines company supplies 16.4 per cent of the world's production.

America is the chief purchaser of diamonds, and is looked upon as the principal probable market for many years to come. For the last few years the sales to America have been as follows, including diamonds cut, uncut, and industrial:

1916	$36,382,321	1919	$85,523,086
1917	32,606,254	1920	47,221,511
1918	21,085,733		

Of these imports the diamond-cutting center at Amsterdam contributed 81 per cent in 1917, 80 per cent in 1918, and 83 per cent in 1919. These have represented practically the sales from the mines through the London Diamond Syndicate to the United States.

It is possible, of course, that new payable kimberlite pipes will be found. Many pipes have been discovered, but those containing diamonds in commercial quantities have been the exception. Moreover, the areas of the Union and Rhodesia have been thoroughly explored for them. There are unexplored areas in the jungle of the Belgian Congo which may contain pipes, but exploration will proceed slowly. The present producing deposits of the Congo are alluvial, which are very likely capable of increased production.

There are three active mining companies in the Southwest diamond fields besides the Consolidated company. Of these the Kolmanskop Diamond Mines, Ltd., probably has a reserve in unmined areas of 500,000 carats, and is making an average production of about 3,000 carats per month, selling at 75s. 8d. per carat, on account of small size. The other companies, in July, August, and September, 1920, produced at the rate of 870 carats per month.

So far as communication by sea is concerned, the diamond properties are favorably situated. Lüderitz Bay is a satisfactory harbor. The coast at other points, however, is rocky and offers no suitable landing places. The territory of the mines must, therefore, be served by railway.

MINING AND MILLING OF SIMPLEST CHARACTER

Except for minor adverse effects from desert conditions, a simpler operation of mining from the engineering point of view is hardly conceivable. The prevailing process is of the easiest type, the removal of loose or only moderately consolidated material from the surface of the earth; and the milling also requires the separation of only a single mineral, which lends itself to satisfactory concentration. But many refinements of method effecting profits will be developed as the work proceeds.

In general, the deposits consist of sand and gravel in varying relative proportions, a minor amount of which is semi-cemented in strata, as is usual in deserts. Such strata are generally specially rich in diamonds. On account of the presence of materials of this class, crushing is necessary in milling. Most of the materials mined are now screened by hand in the field to eliminate fine sand said to contain no diamonds of value. Coarse boulders are also picked out, and the remaining gravel is sent to the mills. Power shovels will do away with much of the present expensive hand work in the field, and it is likely that it will be found advantageous to treat in the mill practically all material mined.

New Caledonia Nickel Industry Barely Alive

The present condition of the nickel industry in New Caledonia is described in a recent number of the *Board of Trade Journal*, an abstract of the original article appearing in the *Journal of the Society of Chemical Industry*. The British consul at Nouméa reports that as there is no market for nickel most of the nickel mines in New Caledonia have been closed down or their production has been reduced. The Société le Nickel, of Paris, and the Société des Hauts Fourneaux de Nouméa are still working their mines, and a little work is being done at the Maconnaise and Gracieuse mines at Dumbéa, near Nouméa. The two first-named companies own large areas of undeveloped mining land and also nickel-smelting works. A large hydro-electric plant with a capacity of 30,000 hp. is being erected at Yate for the Société le Nickel and a nickel-smelting plant, erected at Nouméa by a Japanese company, has not yet begun operations.

Exports of ore and matte from New Caledonia have been as follows:

	[illegible]	
	Ore	[illegible]
1913	[illegible]	[illegible]
1914	94,154	[illegible]
1915	48,576	[illegible]
1916	[illegible]	[illegible]
1917	[illegible]	[illegible]
1918	15,612	[illegible]
1919	[illegible]	[illegible]
1920	3,246	[illegible]

The reduced export of ore is due to the development of local smelting plants, which will soon absorb the whole production. In recent years France has taken practically all the ore and the United States most of the matte.

Bureau of Mines Studying Purification Of Copper-Sulphate Solutions

At the Pacific Experiment Station of the U. S. Bureau of Mines, at Berkeley, Cal., the purification of copper-sulphate solutions resulting from the leaching of low-grade oxidized copper ores is being studied. The technical and economic solution of this problem would make possible the obtaining of high-grade copper by electrolysis instead of the low-grade copper product which must be smelted and refined.

The experimental work done has been chiefly on the precipitation of ferrous and ferric iron from copper-sulphate solutions by the use of limestone. Results show that the ferric iron could be almost completely removed without precipitating copper, and possibly the ferrous iron could be made to precipitate also. Further work on a larger scale is necessary to determine whether the process is commercially feasible.

Production of Lime Decreased in 1921

About 2,531,000 short tons of lime, valued at $24,536,000, was sold in the United States, including Hawaii and Porto Rico, in 1921, according to an estimate made by the U. S. Geological Survey, from reports made by the principal producers. This quantity is less than that sold in any year since the Survey has collected its statistics and is 29 per cent less than that sold in 1920. The average value per ton in 1921 is estimated at $9.69. In 1920 it was $10.52, and in 1919 it was $8.84. Of the forty-two states and territories that produced lime in 1921, five increased and twenty-seven decreased their output as compared with 1920. The five states that increased their outputs in 1921 made only small gains and were affected by local or special conditions, such as contracts made late in 1920.

The sales of hydrated lime in the United States in 1921 were estimated at 737,000 short tons, a decrease of less than 14 per cent as compared with those in 1920, whereas the sales of quicklime (including refractory lime or dead-burned dolomite) were estimated at 34 per cent less than in 1920. Of the thirty states that reported an output of hydrated lime in 1921, only seven showed an increase in production. The estimated value of the hydrated lime sold in 1921 was $7,673,000, an average value per ton of $10.41. The average value per ton in 1920 was $10.89.

Detonators

Compounds of Fulminate and Chlorate Used To Increase Efficiency—Methods of Testing—Factors Affecting Completeness of Explosion Composition Detonators

By Charles S. Hurter

Written for Engineering and Mining Journal

IN PRACTICE the detonation of high explosives is accomplished by means of an intermediate agent that will produce a violent impulse embodying both shock and heat. According to some investigators, the ideal condition would be to have a detonator of a special composition for each kind of explosive, as within certain limits some seem to be more sensitive to the heat factor and others to the sharpness of the shock. This, however, is not commercially practicable, and the aim of the manufacturers has been to make an all-round satisfactory detonator.

Until recently fulminate of mercury has formed the basis of nearly all commercial detonators, and at present, in most of them, this compound is the main ingredient. Mixtures of fulminate of mercury with other compounds are made with the object of increasing its sensitiveness to ignition and also for increasing the volume and temperature of the gaseous products, to give a greater effectiveness; detonating in its own volume, as it does, the effect of straight fulminate is too local. The compound most commonly used for the purpose noted is chlorate of potash.

Compounds of Fulminate and Chlorate

The chemical reaction involving fulminate of mercury and chlorate of potash for complete combustion of their products may be expressed according to the following equation:

$$3\,Hg\,C_2N_2O_2 + 2K\,ClO_3 = 6\,CO_2 + 6N + 3\,Hg + 2\,KCl$$

Molecular weights are 852.12 for the fulminate and 245.2 for the chlorate. At the detonation temperatures of fulminate of mercury the oxides of mercury cannot exist.

According to this reaction 852.12 parts of fulminate of mercury are mixed with 245.2 parts by weight of chlorate of potash to bring about complete combustion. This proportion can be expressed approximately as 78 per cent of fulminate and 22 per cent of chlorate. The mixtures used in detonators have varied from 95 per cent fulminate of mercury and 5 per cent chlorate of potash to 80 per cent fulminate and 20 per cent chlorate.

According to tests made by the Bureau of Mines (Technical Paper No. 125, "The Sand Test for Determining the Strength of Detonators") several years ago, the 80—20 mixture creates a more effective detonating impulse than the 90—10, the 95—5 mixture, or even straight fulminate.

Testing Detonators

In regard to testing detonators, it must be remembered that their efficiency is their ability to detonate high explosives. Consequently, the only true and reliable tests of detonators is to use them for this purpose and observe the results. As a general rule, blasting-cap manufacturers make up a special insensitive explosive for this purpose. There are a number of other tests that can be made which tell more of the condition of the detonator involved rather than afford an accurate comparison between different kinds or makes. As a matter of fact, the detonators can be varied in shape and make-up so as to improve the results obtained in these various tests without increasing their efficiency when it comes to detonating high explosives, and in some instances the modifications may even reduce their ability to produce the most perfect detonation.

The Lead-Plate Test

One of the simplest is the lead-plate test. This consists of cutting a 1½ in. square from 10-lb. sheet lead (about 5/32 in. thick) and centering this on the end of a short piece of 1¼-in. iron pipe in a special holder. This holder permits the placing of a blasting cap so that the end is held firmly and squarely on the lead plate. Two results are noted after the explosion of a detonator, one of penetration and one of radiating lines on the plate called "sunburst effect." This test is an indication of the comparative condition of a single kind or make of detonators.

Any method of concentrating the charge will increase the penetration effect. An increase in diameter of the copper shell, which concentrates the charge close to the plate, results in a much better penetration effect, but, as will be shown later, this same concentration, if carried to extremes, lowers the efficiency of a blasting cap when it is used to detonate high explosives.

The reduction of chlorate of potash in the detonator charge results in a more concentrated load, due to the high specific gravity of fulminate of mercury, with resulting better plate tests despite the fact that the 80—20 mixture is considered to be more efficient in the detonation of high explosives than the 90—10, the 95—5, or straight fulminate. Another point is that a cap having an indented end gives a better plate test than one with a flat end, and, further, this test will show poor penetration with a cap whose end bulges out in a convex form. On the other hand, when tested with explosives, the shape of the capsule end is shown to have no effect on the results.

The Sand Test

The simple test of the Bureau of Mines consists of (Technical Paper No. 125, "The Sand Test for Determining the Strength of Detonators") measuring the shattering effect of detonators in quartz sand. One hundred grams of sand screened through a 20-mesh and caught on a 40-mesh sieve are placed in a special container. The test consists of exploding the detonator in the center of this mass and then determining the shattering effect on the sand. In this test a long detonator with a smaller diameter will give a better test than the concentrated charge of one having a large diameter, on account of a greater amount of sand in close proximity to the explosive charge.

Another test is that of the Trauzl block. A hole is bored partly through a lead block of given weight.

The diameter of this hole is just large enough to admit a blasting cap. Then after exploding the cap the volume of the resulting cavity in the lead block is measured, the size being indicative of the strength of the detonator tested. Still another is to explode a cap on a plunger in a special apparatus, under certain standard conditions. This plunger acts on a thin sheet of copper, and the capacity of the resulting "dish" is taken as indicative of the strength of the detonator.

COMPLETENESS OF EXPLOSION DEPENDS ON AMOUNT OF EXPLOSIVE SET OFF AT START

The completeness of the explosion and the distance it travels through the charge depends on the amount of explosive actually set off at the start by the detonator. This is governed by two facts, the size of the detonator charge and its distribution. The first is self-explanatory. By using a small-diameter detonator which extends the charge, the amount of explosive acted upon by the detonator is increased and the consequent detonation wave started off with greater intensity. Another point is that no explosive attains its maximum rate of detonation or violence instantly in the first layers affected.

Even fulminate of mercury does not start its detonation at full speed. This, however, is attained quickly after the detonation is started. Consequently, in the smaller-diameter detonators, a larger percentage of the fulminate charge is exerting its maximum possible effect, owing to its being extended over a greater length, which gives it a chance to attain its maximum violence of detonation, which is not the condition with the larger-diameter blasting cap containing the same charge.

It is true that fulminate of mercury attains its full velocity more quickly in a large-diameter capsule, but with an explosive so sensitive this point is negligible when compared with the better results obtained from the explosive detonated by having a larger amount of this explosive brought under the direct influence of the fulminate. Also, it is possible with fulminate of mercury, as with all the other high explosives, to reduce the diameter of the charge to a point where the detonation wave cannot pass through it. The necessary diameter for good fuse limits the manufacturer to a minimum inside diameter of 0.221 in. for blasting caps. The making and placing of a substantial plug in electric blasting caps necessitates a minimum inside diameter at 0.260 in.

EFFECTIVENESS OF COMPOSITION DETONATORS

The subject of the effectiveness of composition detonators, referred to in some of the Bureau of Mines reports as reinforced detonators, is therefore of pertinent interest. It has been shown beyond question by the Bureau of Mines and other investigators that certain nitro-substitution compounds and nitrated carbohydrates, such as nitrovene, tetryl, tetranitroanilin, and nitromannite, each with a small quantity of fulminate-chlorate mixture as a primer, make, if anything, more efficient detonators than fulminate and chlorate alone. The compounds named must be kept in close confinement if they are to exert their full explosive force, and to obtain this the small amount of fulminate used as a primer is placed in an interior copper capsule which is seated firmly on the charge. In fact, good confinement is necessary for detonator charges as well as for all other explosives.

Some blasting caps that have appeared on the market will not detonate unless rightly crimped on the fuse. Even the straight fulminate-chlorate caps give a better test and improved detonation results when they are tightly fastened on the fuse than when only partly crimped or held loosely in place. The lighter specific gravity of these compounds results in a more bulky and extended charge in the shell, with a greater amount of explosive upon which a direct action is exerted as a result. Thus the detonation wave in the main explosive charge is started off with a greater intensity and a better explosive action, and more satisfactory results are obtained. This type of detonator is being received with favor, and with later perfections that will probably be evolved may largely if not completely replace the present-day fulminate-chlorate blasting caps.

The subject of the care of blasting caps and precautions to be taken in using them is so well covered in the explosives companies' catalogs and other literature that I have not considered it necessary to repeat them in this article.

Mining in Arkansas in 1921

BY TOM SHIRAS

Written for Engineering and Mining Journal

Mining in Arkansas was hit hard in 1921, the production being less than in any other year in the last decade. The price of zinc ore was so low as to prohibit operations, and not a mill in the north Arkansas field turned a wheel. Two carloads of hand-cobbed silicate, produced by the Odum mine, in the Zinc camp, was the only production reported. There was more ore developed in the ground at the mines when the price broke than at any other time in the history of the field. This ore will not be mined, however, at a price less than $35 a ton, the minimum at which a reasonable profit can be made. There was no prospecting or new development work in progress during 1921.

In the Batesville manganese field, in Independence County, some work was done during the year, but 2,000 tons will easily cover the tonnage shipped. A number of operators expect to conduct operations in 1922, however. In a recent interview with Colonel Allan, of Chicago, consulting engineer for the American Manganese Co., a Chicago concern, which during the last few years has acquired a considerable acreage and some of the best properties in the field, he states that uniformity in both production and grade would alleviate a great many of the troubles of the operators in the field. In making contracts with furnaces the operators should be able to furnish a certain tonnage and a certain quality. If shipments are irregular and there is a constant change in the quality of the ore the operator is soon put out of the market. These objections can be easily overcome by employing a chemist and by properly sorting and grading the ore before any attempt is made to treat or market it.

Interest centered in oil in Arkansas during 1921. The Eldorado field came in January, 1921, and the state went wild. Wildcatting all over the state became a popular investment with those who take long shots. There was hardly a county in the state that could not show a project of this nature, after the middle of the year. None of these wildcat projects has brought in another field. However, the final result of these tests cannot be determined yet, because many of them have not been completed.

Crushing-Surface Diagrams and Rittinger's Law

Discussion of Various Experimental Work Which Tends To Disprove The Theories of Kick and Stadler—A Thorough Understanding of Fundamental Laws Held an Aid to Economical Crushing and Grinding

By Arthur O. Gates

Written for Engineering and Mining Journal

I OFFERED some thoughts on crushing a few years ago, and took part in some discussions which at times perhaps became rather exciting and acrimonious even if they were not interesting. Perhaps my coinage of expressions like "mesh-tons" and "crushing-surface" were accountable. But mesh-tons appears to have stuck, for a number of writers use this and similar expressions in referring to the work done in crushing; and others are using the Crushing-Surface diagram in analyzing milling operations.

Some will recall a little controversy over the laws of crushing: the power proportional to volume reduction theory of Kick and advocated by Stadler, and the power proportional to surface produced, called the law of Rittinger, in Richards' "Ore Dressing." The war raged pretty strong in South Africa, where it was the subject of presidential addresses, and in Australia. The South Africans, backed by the British, were in support of Kick, and the Australians seemed more interested in Rittinger. And then, of course, Americans had to butt into it. And it was largely a fight of theory, supported by experiments made about the time Noah was a pup, and quotations from the ancients.

Re-establishing Rittinger's Law

I certainly would not have broken into the controversy had I not taken an inventive streak and found that the Rittinger law could be made use of in such a simple manner and graphically to show so many things which take place in crushing. When one adds a long column of figures and the result comes out in round numbers, it is well to go back over them and find out where the mistake occurs; it always is there. And so in the midst of a great work in determining all (I hoped) the resistances to crushing of all the rocks, came rumors of somebody in South Africa or elsewhere who had upset Rittinger's law—and all my work was gone to smash. And so it was necessary to look into the laws of crushing and get to the bottom of them. The bottom was not reached, but enough data had been obtained experimentally to give assurance that the Crushing-Surface diagram was on a fairly sound basis.

Certain of the theoretical proof which was offered for Rittinger's law in my original paper, "The Crushing-Surface Diagram," published in *Engineering and Mining Journal*, May 24, 1913, was criticised as based upon a confusion of work and force. I admit it—the original draft of the paper had the error there—but before it was submitted it was discovered, and for several days the bubble was burst, the boom had gone flat, and all the beautiful theory and that diagram were useless, and my time had been wasted.

Whether Rittinger confused the two, work and force, is not to be determined from Richards' "Ore Dressing," but I saved the Crushing-Surface diagram by making a statement that the distance through which adjacent particles must slip to make a break is the same regardless of the size of the rock of which they are constituents. One can see this when one thinks in terms of molecules, but when one thinks of the big pieces of rock in testing machines, and stress-strain curves, and elastic limits, the point is missed that it is breaks that are being considered. And then there was balm for the soul in an extract from an old *American Machinist* which J. D. Hoffman had put into his notes on Machine Design, to the effect that in punching steel plates the depth of penetrability varied not directly with the thickness of the plate, but that the punch had to go almost the same amount in each case before the punching freed itself; it was not a clean proof, but it was evidence, and there were experimental data.

Experimental Proof Offered by Bell

With all this controversy on the laws of crushing, I was the only one to offer experimental proof, until the work of Prof. B. W. Bell and his associates at McGill was published in 1916 or 1917.[1] This proof was more or less negative, however, because in the use of the Rittinger law there is all that surface between 200 mesh and 100,000,000 mesh (which is somewhere near the molecule) unmeasured, whereas Stadler, with his energy units and ordinal numbers, had only those between about 17 and 56 (corresponding to 100,000,000 mesh) to worry about. (These are based on Taggart's scheme for the use of Tyler standard screens; Stadler's would have been about 26 and 90). And he had an increasing quantity of power applied per energy unit as he went from fine to coarse; it should have been the same. My data were not as entirely convincing as to the correctness of Rittinger's law as they were to the error of Kick's. But the results at McGill left no room for doubt; the check on the error of Kick was complete, and there was a much better proof of the correctness of the Rittinger law. The McGill tests must have taken fully one hundred times the expense and effort that was attached to mine.

At one period I had corresponded with Dr. Porter, of McGill, with regard to his methods in the use of the testing machine, and had begged him, with tears in my Corona, to take back some statements of a preliminary nature which had come out from McGill to the effect that Kick's law was apparently correct. There was some rejoicing in the winter of 1917 when the prodigal returned to the fold.

Colleges Neglecting Their Opportunities

What irritates me in this whole controversy on the laws of crushing is the attitude of the majority of our mining-college faculties toward the subject. They seem dead on their feet, content to take a neutral attitude, explain both laws, say east is west, or north or south,

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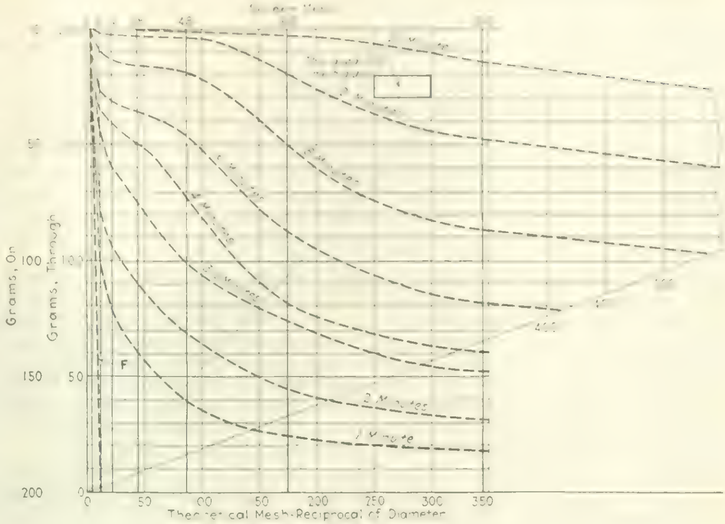
[1] "An Investigation of Rock Crushing Made at McGill University"; John W. Bell, *Trans.* Canadian Mining Institute, Vol. 19; and *Trans.* A.I.M.E., 1917.



CRUSHING-SURFACE DIAGRAMS
Time a variable.

and "let them row it out." The thing is so easy to prove. Luther Lennox showed one way different from mine, or from the McGill way, in which he runs a ball mill with a known charge of ore and known weight of balls for definite times, and in which time is the only power variable, and therefore is a relative measure of the work.[2] All that is needed is a small ball mill. Into it place about 200 grams of ore, run it for one minute, screen size and return for another minute, screen size and return for another minute, and so on until too fine for further grinding. Plot all on one Crushing-Surface diagram, figure up Stadler's energy units, as well as mesh-grams, and then plot both; estimate average size against time, and see if the thing is not conclusive. Every student could make a test of this kind and get it out in two periods, and then he would know. Only it should be tried by the "Prof." first.

Approximately 50 per cent of the cost of milling is charged against crushing. Can we know too much about it? Not only do the college professors seem content to let the matter of the laws of crushing settle themselves, but writers of textbooks (I refer particularly to the handy and valuable "Handbook of Ore Dressing" by A. W. Allen) prefer to straddle the subject, rather than make any decisions based upon the evidence presented. I do not see where the milling operators get anything from such neutral attitudes, for one certainly goes to textbooks for decisions rather than for indecisions.

Allen records both supposed laws, with examples for their application, and in the middle states that "Rittinger's law was disproved by Van Reytt as the result of actual demonstration. The tests showed that the ratio of actual work done to increased surface is fairly constant with coarse sizes, but with fine sizes the increase of surface is much more rapid than the work required to produce it." I have attempted at various times to study the Van Reytt tests as given in Richards' "Ore Dressing," and the best that I can make out of them is that the conclusions which Allen and Richards quote are based upon *feed* conditions rather than *product* conditions. I make out that Van Reytt intended to convey the impression that if the feed is coarse the surface in the resulting product is proportional to the power expended upon its production, but if the feed is fine it does not take nearly so much power to produce the same amount of surface.

VAN REYTT AND MCGILL RESULTS DO NOT CHECK

This does not check with other test data available, particularly the McGill tests, which were more elaborately done than Van Reytt's. The McGill experimenters' work showed that the more efficient of their tests with rolls gave practically the same amount of surface per effective horsepower with feeds of the following diameters in inches: 0.50, 0.29, 0.18, and 0.11. With the same rolls crushing a feed of 0.07 in., the surface produced is recorded as about 20 per cent less per effective horsepower than for the coarser sizes; Van Reytt had it just the opposite.

Professor Bell, of McGill, goes into the subject of the relation of the power applied to rolls to the tonnage, and it probably could be discovered in Van Reytt's experiments, if all the data were available, that practically all the power used on the roll tests was friction load, additional power being consumed with the larger pieces owing to greater friction in the bearings of the rolls caused by the excessive bearing pressures.

In my Purdue tests it was likewise shown[3] that it takes apparently more energy to produce a unit of fine surface than one of coarse, and it is explained that the minus-200 mesh is largely responsible for the surface unaccounted for.

Luther Lennox, in his article "The Crushing Resistance of Various Ores,"[4] makes use of the Crushing-Surface diagram, and that full credit for energy spent in fine crushing be given, carries his calculations for surface out in the minus-200 mesh sizes, and gets fairly good checks on surface produced per unit of crushing energy when he carries his curves of sized products out to 1,670 and to 2,500 theoretical mesh (reciprocal of diameter). Crushed products of two degrees of fineness are compared upon this basis.

Van Reytt's experiments and conclusions should be considered upon their merits, along with those of the others who have published results of experimental tests which apply to the distribution of work in crushing.

There are plenty of evidences in mill operations, especially in view of the fact that the types of crushing machines used have friction elements which are not influenced by crushing pressures as in rolls, that energy proportional to the mesh produced is essential for a given tonnage of ore.

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[2] *Bull.* A.I.M.E., August, 1918.

[3] "Kick vs. Rittinger," *Trans.* A.I.M.E., Vol. 52, p. [illegible]75 et seq.

[4] *Bull.* A.I.M.E., August, 1918.

The results of recent tests are reproduced here which have some interesting points and which may be used as one of the additional bits of evidence against the volume reduction theory of Kick and Stadler. The tests were made somewhat as suggested by Luther Lennox in the paper already mentioned. A definite charge of ore (in this instance 200 grams) was placed in an 8-in. ball mill and crushed by rotation of the mill. The numbers on the lines designate the number of minutes the test was run. In each test the 200 grams of feed minus-2 mesh and plus-8 mesh was run for the time specified, but, for purposes of checking, the products which had been run two minutes and four minutes were each run an additional four minutes, giving a total of six and eight minutes' run, which were averaged with the previous runs of those times.

In this work only one element of the energy applied was variable: time. It follows readily that energy applied to the work of crushing varies as the time.

It was not difficult for me to tell almost at a glance that these data were unfavorable to the so-called Kick's law, and so calculations were made just to determine the production of the so-called energy units, using the ordinal numbers for Tyler standard screens as proposed by Taggart,[5] with the exception that 20 is used for the minus-200 mesh, which is probably a little fairer than the 18 or 19 they seem to allow. The following table practically tells the whole story.

TABLE I—RELATIVE ENERGY UNITS PER UNIT WEIGHT

Minutes	Total	Total Less Feed	Per Minute, Total Period	Per Minute, Last Period
0 Feed	900	....		....
1	1,847	947	947	947
2	2,092	1,192	596	245
3½	2,548	1,648	495	340
4	2,753	1,853	463	308
6	3,009	2,109	351	128
8	3,472	2,572	321	231
12	3,742	2,841	237	67½
20	3,930	3,030	152	26½

Perhaps it is not fair to take into account the twenty-minute run in which nearly everything was "slimed," but if Kick's law were correct, all the figures in the last two columns should be approximately the same! So much for Kick; there are so many interesting things in this diagram that he can be dropped at this point.

Certain probable laws of crushing in mixed masses may be gathered from this diagram or in connection with it:

(*a*)—Each piece of rock broken by a single blow becomes a number of pieces varying in size between about half the original size and an extremely fine size which may be considered to have been produced by the rubbing together of the fracture faces. It is probable that the result of plotting the screen analysis of such a break would appear on the Crushing-Surface diagram as a hyperbola. The abrupt change in character of the curve of feed (*F* on diagram) after one minute in the mill, and the considerable amount of minus-200 mesh shown, indicates Curve 1 to be the summation of a lot of these hyperbolas.

(*b*)—In crushing mixed feeds, the character of the screen analysis of the product follows that of the feed. Note how the changes in the curves follow one another.

(*c*)—In any crushing operation on mixed feeds, the fines surrounding a coarse particle will be more easily reduced by the blow than the coarse particle, up to the point where the total resistance to crushing of the combined smaller particles exceeds that of the coarse particle; the weaker fail first. Note how increasingly difficult it is to break the coarse pieces as the material is ground longer and with finer surrounding product; note that the presence of a slow-grinding oversize did not appear until the mill had been run at least three minutes; the flattening of the 3½ curve between the 14 and 48 mesh indicating the retarding of action on the coarse, more clearly shown in the four-, six-, eight,- twelve,- and twenty-minute curves. It is probable that the feed (minus-2 plus-8) was too coarse for the mill, which was 8 in. diameter with 1-in. balls. Certain other tests on *finer feeds* practically eliminated the reverse curve.

(*d*)—In any crushing operation on mixed feeds, a greater amount of coarse pieces will be broken down in the first period of time than in any subsequent period of time; a greater amount of any size of the product will be produced during the first period than in any subsequent period. From the curves the following capacities through the sizes specified are obtained in one minute, for each of the periods from the start of crushing:

14 mesh—80, 27, 26, 8, 9½, 3½, ½
48 mesh—40, 30, 28, 12½, 13½, 4, 1
200 mesh—18, 14, 15, 10, 15, 10, 5

(*e*)—In any crushing operation,, there will be an increasingly greater amount of energy expended upon the finer and probably finished product as the period of crushing is increased. It may be recalled that in a preceding paragraph in this article, when it was shown how absurd the theory of Kick was made by these tests, I did not follow right up with another clean-cut proof for the Rittinger law. Before looking at Table II please notice the way the curves of screen size extend out into the vague and unknown minus-200 mesh sizes, and consider which of these areas would be proportionately increased by such extension and which proportionately decreased. The use of the last two columns in Table II will be described later; they are largely speculative, and can be considered only as suggestive at this time.

TABLE II—SURFACE IN MESH-GRAMS IN 200 GRAMS PLUS 345 RECIPROCAL

Minutes	Per Minute, Total Period	Per Minute, Last Period	Per Minute, Above 45 Deg.	Per Minute, Above 20 Deg.
1	11,000	11,000	3,125	4,875
2	9,375	7,650	2,875	4,250
4	8,325	7,275	3,412	5,500
6	6,950	4,200	2,900	5,150
8	5,250	5,400	2,960	5,655
12	5,200	2,500	2,500	5,300
20	3,375	990	.....	.....

The reader will surely agree that to consider simply the areas within the diagram as drawn as representing the relative work of crushing would be unreasonable, and that considerable allowance must be made for the surface to the right of the diagram, especially for the finest crushed portion. My first method was to plot on logarithmic paper (see *Engineering and Mining Journal*, April 18, 1914, page 797), and calculate from the plotted straight line down to something like 1 per cent, the mesh-grams and curves within the extended area. Luther Lennox's method, in which he estimates the shape of the curve out to 1,600 or 2,500 mesh, and assumes that the crushed-product surface beyond this point is equal to the surface in the feed between this point and 200 mesh, is another way. He does not claim this to be a scientifically correct allowance, but it is so much better than lumping all the minus-200 mesh, as nearly all others have done, that I am not disposed to criticize it until I am sure that I have something better to offer.

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[5] [illegible] Work of Crushing [illegible] A. F. Taggart, *Trans.* A.I.M.E., Vol. 4[illegible]

In any event, to get agreement among the mesh-tons produced per unit of work in a given time, one must go well out into the minus-200 mesh sizes. The last two columns of Table II are simply the results of an attempt to get agreement in mesh-grams per minute (or per housepower-hour) when crushing to different screen analyses, without extended calculation and from known values. The areas between the diagonal lines at 45 deg. (and at 20 deg. also), and the curves to the left of this line, are the basis of the last two columns. There were not enough data to plat the twenty-minute curve and get anything like reasonable results, so it is omitted. It probably would be as well, in using lines of this character on the Crushing-Surface diagram, to keep within the lower two-thirds of the diagram; above that point all the irregularities due to feed and other causes appear to occur. There is sufficient agreement in the last column, for the 20 deg. cut, to suggest a possible solution; however, more work must be done before it can be accepted.

(f)—The product formed in any crushing operation, beyond the point where irregular sizes of feed appear, will plot on the Crushing-Surface diagram in the form of a hyperbola with its origin at or near to the origin of co-ordinates in the diagram. These curves are of the form XY^n = constant, where X = tons, grams, per cents, or other factors; Y = reciprocal of diameter; and $n = 1\frac{1}{2}$ to 2, in this example.

The truth of the hyperbolic form may be found by plotting upon double logarithmic paper, in which procedure the hyperbola appears as a straight line. A large number of screen analyses have been tested in this manner; one of the prettiest of these can be made with the data from Luther Wagoner's experiments described on page 309 of Volume 1 of Richards' "Ore Dressing" (first edition). In the test with the Tustin mill on hard quartz, all points plotted on double logarithmic paper lie almost exactly on a straight line, n having a value of 1, exactly, in the above formula. On the talcose slate, however, the value of n is about 3, but still all points are in a straight line.

It might be mentioned in passing that the Tustin mill, to which reference is above made, is a free-discharge type of mill in which the fines have a chance to get out of the crushing zone as soon as produced. Is there any significance in the true hyperbola which results?

Here is another interesting thing about Luther Wagoner's experiments: when he crushed the hard quartz in a stamp mill, his screen analysis shows a straight line for the last four points, with a value of $n = 2$; and when he crushed the talcose slate in the stamps, the value of n became about 6. One could speculate nicely from this that n is made up of two factors, one of which is about 2 for the ratio of the mills, and the other is about 3 for the ratio of the ores. It looks as though there is some significance to these things; some future generation may find it worth while to tell us.

INCREASED GRAIN RESISTANCE

Increased crushing resistance at certain grain sizes is given as a reason why circulating loads build up in a closed-circuit ball- or pebble-mill unit. If there was such an increased resistance and a concentration of harder grains in the classifier circuit, there should be evidence of it in the discharge line of the Crushing-Surface diagram. The waves and departures from the regular form of a hyperbola would be evidence of it. Luther Lennox, in the paper already quoted, gives a number of Crushing-Surface diagrams. He calls the particular one I have reference to "plotted according to the Tyler direct cumulative diagram method in Figs. 7, 8, 9, 10."

This is not the Tyler method; they are true Crushing-Surface diagrams. The Tyler method had the sizes backward and was strictly qualitative. These diagrams have the regular shape, and there is no evidence of any peculiar hardness in any of them except two, those of the Alaska Gold Mines Co., and for the ore designated "Morenci, Phelps Dodge," both of which have marked waves in the product or discharge lines between 65 and 150 mesh. These waves might be due to change in character of grain size, and it is possible to predict that it would take more power per mesh-ton to reduce these ores below 65 mesh than above it. But in the milling of the rest of the ores it would hardly seem correct to charge a slowing down of the crushing effect to increased resistance at certain grain sizes; better charge it to the retarding effect of a lot of fines returned by the overloaded classifier.

CRUSHING IN CLOSED CIRCUIT, OR SERIES

The relative merits of crushing in closed circuit with a classifier, and open, series crushing have now to be considered. The closed circuit is the rule, and series crushing is resorted to only when it is impossible to get results in any other way. Most of the data available for analysis are too meager to make possible proper comparisons; either the screen analysis of the mill product is lacking, or horsepower or tonnage is missing at some point. But the preference for a single unit is the controlling factor, and faulty classification due to overloaded return circuits will be endured rather than adopting the alternative of fooling with a tandem or series system of crushing. The Crushing-Surface diagram indicates that it is advisable (economical) to cut out all of the finest 10 per cent of the feed from the first mill and pass it on to the second; to have increasingly greater classifying capacity as finer material is classified; and probably to discharge a finished product from the third mill (I would like to say fourth or fifth mill to hear them "holler") without further classification.

Of course, "old theoretical" doesn't stop to consider that smaller crushing units would take more power and attention than large ones, and would entail the added complication of more classification and such frightful things as bucket elevators. All he can say is that competent engineers are capable of designing reliable elevators, and that a series system will give better classification for economical crushing, with smaller classifier capacity, than the closed circuit will. He hopes to get hold of a little more closed-circuit data than are available at present. Perhaps analyses will then show that the data that he has been studying are out of date and hold only for isolated cases, and that the work is as efficient as can be expected.

In this article some probable *laws* of crushing have been referred to; it would have been better to have called them the *phenomena* of crushing, but perhaps an extreme term like that will bring about a discussion of some of these "laws" better than a milder statement would have done.

I know nothing of colloids, nor have I done any testing where these were involved. It has been hard to find anything definite about them in textbooks, except that they have different properties than granular slime, and also that they are little understood. So long as they are present and are the result of crushing, (so far as the millman is concerned), perhaps they could be hooked up with the laws of crushing in some way.

Now, granted the Rittinger law of surface proportional to energy, is it not fair to assume that the molecular forces which oppose the breaking of rock are electrical in their nature, and do not appear as such when the large pieces we deal with in rock crushing are considered; they are small compared with the volume of the rock. But when the hundred thousand and million mesh stuff is produced, and some of this probably is produced in every break, the ratio of these resisting forces to the volumes of the particles is so great that the energy spent takes the form of dominating electrical charges on the particles, causing them to coagulate or not to coagulate, or whatever it is they do that isn't nice.

In other words colloids are particles of such fineness that the energy absorbed on the surfaces, caused by breaking, is of such intensity (owing to the ratio of surface to weight) that it appears in the form of electrical charges which offer resistance to the force of gravity. Thus, colloids may be tied up with Rittinger's law, and perhaps they may prove the truth of the law better than any other way yet attempted.

Manganese Situation in Transcaucasia

There has been practically no new mining of manganese in Transcaucasia for the last few years, partly because of difficulties with labor but more particularly because of the general political and economic situation, according to *Commerce Reports*. Mine owners have not felt inclined to invest money in labor and other operating expenses with little or no probability of being able to profit or even to reimburse themselves by sales of manganese.

In July, 1919, the Menshevik government of Georgia, in place of an out-and-out nationalization, organized the so-called "Temo" Export Manganese Co. by combining twenty-seven different companies—two English, one French, two Belgian, nine Greek, two Armenian, one Russian, and ten Georgian, the ten Georgian companies representing 38 per cent of the mines. The formation of this combination did not result in any new mining, but did result in the sale abroad of certain manganese stores already on the top of the ground. From July, 1919, until February, 1921, the "Temo" company is said to have exported and sold abroad 75,000 to 80,000 tons, of which 75 per cent was washed manganese. The proceeds of these sales went in part to the Menshevik government of Georgia, and the remainder was divided among the different manganese companies.

At the present time there are said to be 60,000,000 poods (sixty-two poods equal one ton) of manganese on top of the ground at the mines in the Tchiatouri region, of which 35 per cent is washed manganese. There are also said to be 8,000,000 poods already at the port of Poti, on the Black Sea, convenient for shipment by boat. The mines are in a neglected condition, many roofs having fallen in, so that in some of the mines a year's work would be necessary before new manganese could be taken out. Under the circumstances, it appears safe to predict that no new mining will be undertaken so long as political uncertainties continue. At Tchiatouri there are twenty-eight manganese-washing installations, but none of these are working. Also, the manganese on top of the ground at Tchiatouri can probably not be transported to Poti (nine hours) because of the condition of Transcaucasian railways. Therefore the only manganese stocks immediately available for sale are the 8,000,000 poods already at Poti.

One shipload of 7,000 tons is now en route from Poti to Rotterdam; 4,000 tons of the cargo is already sold at a price of about £16 per ton, the exact price to be based on the analysis which will be made after the arrival of the manganese in Rotterdam. A representative of the "Temo" company states that the balance of the cargo is not yet sold. As soon as arrangements can be made for ships the company is planning to send a shipload of manganese to London and another to New York. The price for ordinary Transcaucasian manganese ore (48 to 52 per cent manganese) is said to be £8 per ton. According to a recent report, as yet unconfirmed, a ship is en route from New York with a load of flour which may be exchanged for manganese.

Wisconsin Zinc Ore Shipments in 1921

By J. E. Kennedy

Written for *Engineering and Mining Journal*

Shipments of zinc ore from the Wisconsin zinc district in 1921, compared with those of 1920, are given in the accompanying table. The stock of blende concentrates in bins at the end of the year 1921 in terms of 60 per cent zinc ore was 25,000 tons. Twelve concentrators operated during 1921, but of this number only one, the North Unity, operated steadily throughout the year.

WISCONSIN ZINC-ORE SHIPMENTS
In Short Tons

	Net to Smelters		Gross From Mines	
	1920	1921	1920	1921
Highland	2,551(*a*)	(*b*)	2,551(*a*)	(*b*)
Linden	50		1,869	
Mifflin	316		29,405	12,174
Mineral Point	25,592	4,964		
Platteville	1,887	220	1,887	220
Cuba City	18,289	5,898	11,278	1,848
Benton -New Diggings	14,372		50,501	2,269
Hazel Green			4,467	146
Shullsburg			3,024	
Galena, Ill.			17,966	8,324
Totals 1920 and 1921	63,057	11,082	122,948	24,981

	Net to Smelters	Gross From Mines
1919	100,135	164,731
1918	120,854	189,058
1917	148,766	247,993
1916	133,035	219,118
1915	104,670	163,916
1914	84,836	134,362
1913	76,017	105,887
1912	99,409	119,280

(*a*) Crude unmilled carbonate. (*b*) About 400 tons low-grade carbonate produced in 1921, but none shipped.

Carbonate deposits of Wisconsin district are apparently exhausted.

Lorraine Iron and Steel Industry Improving

By Reuters Agency

The *Journal Industrielle* learns from Metz that arrivals of coke for the iron and steel industry show a considerable improvement, although still variable and insufficient. The average for the Moselle region in a recent period was 5,000 tons daily. A certain number of blast furnaces have been relighted, and the situation is the same as at the middle of December when twenty-four furnaces out of sixty-six in the Moselle region were in operation.

Valuation of Placer Deposits*

By Wilbur H. Grant

*Contributed [illegible] to *Engineering and Mining Journal*.

THE ARTICLES by Gerald H. Hutton, "Valuation of Placer Deposits" (*Mining and Scientific Press*, Sept. 10, 1921, p. 365), and by Charles W. Gardner, "Drilling Results and Dredging Returns" (*Engineering and Mining Journal*, Oct. 22 and 29, 1921, pp. 646 and 686), indicate that present methods result in rough approximations of the value of placer ground. Mr. Gardner's article intimates that the present methods cannot be improved; that the judgment of experienced men is better than attempts to improve the methods, and that the results obtainable are satisfactory. Mr. Hutton's article contends that valuations made by present standard methods are not satisfactory; that methods of sampling and valuation should be evolved which will increase the accuracy of the basic data and eliminate personal judgment and guesses as much as possible, to the end that valuations of placer deposits thereby obtained will more closely approximate dredge recoveries.

The questions at issue are the following: Are the valuations of placer deposits by present methods sufficiently close to dredge recoveries to justify their use as a basis for financing the dredging projects? Can the accuracy of valuations be increased commensurately with an increased cost for the investigations? Can the methods of sampling and valuation be improved so as to obtain consistently closer approximations to actual values of the deposits without appreciably increasing the costs of the investigations? What is the logical order of approach to the problem of accurately valuing placer deposits?

ARE PRESENT METHODS SATISFACTORY?

Mr. Gardner presents specific data which show that the dredge recovery varies from 31 to 290 per cent of the drill-hole valuation of placer ground. It is probable that if the results of all investigations were available still wider variations would be found. Mr. Gardner assembles his records on the sampling of 3,743 acres of placer ground where all necessary data for valuation were complete. The aggregate areas were drilled by 1,749 holes, or one hole to every 2.1 acres. The average value per cubic yard obtained by drilling was 15.4c. and the average dredge recovery 13.55c., or 88 per cent of the valuation computed from drilling. This is as close an approximation to the value in the combined areas as miners and investors could expect. The different parcels of ground included in the summary vary from a gain of 41.6 per cent to a loss of 54.4 per cent. The investor who happened to finance the property where the gain was 41.6 per cent might not be satisfied with the accuracy of drill-hole valuation, but would undoubtedly be pleased with the returns. The investor who financed the property which showed a loss of 54.4 per cent would naturally be entitled to a grievance against valuating engineers and their methods and to a disappointment for the discrepancy.

Mr. Gardner states that with the same data different engineers would check closely on their estimates of yardage, but would vary greatly in their estimates of gross values and net profits. He says, further, that the results from additional inter-spaced holes or holes but a few feet away from those already sunk, would vary so greatly that decidedly different valuations would be obtained by using the new set of holes in the computations, even if sunk by the same crew. This suggests that the blame for inaccurate and inconsistent results would be placed more on the methods in vogue than on the investigator. The investigators are, however, responsible for perpetuating the present methods which permit such incorrect valuations.

It is probable that the present methods of testing any type of placer ground are satisfactory only to the careless investigator or the adventurous investor. Details of the methods of acquiring the data by drilling and computing from data acquired should be improved and standardized. The standard number of holes used is satisfactory for uniform deposits; the number, in my opinion, should be increased about eight times for ordinary deposits and the drilling method should not be used for coarse gold deposits in steep narrow streams.

ACCURACY IN RELATION TO COST OF INVESTIGATION

The standard practice is to drill not more than one hole to the acre, and frequently fewer holes than an average of one hole to the acre are put down. Mr. Gardner estimates that with a 6-in. Keystone drill, one hole to the acre would be equivalent to taking a sample 1 in. square in an area of a vein 100 ft. long and 9.86 ft. wide. This is one of the most startling facts brought out. It is the average practice in sampling veins by cuts to take samples spaced every 5 ft. along the strike and dip of the vein, on four sides of 100-ft. blocks, if possible, the cuts being 3 to 4 in. wide and 1 in. deep, at right angles to the lines of mineralization, and taken across the veins in as many separate samples as is necessary to represent each variation in the mineralization. It is evident, therefore, that the valuation of placer deposits can never be expected to be as close an approximation to actual value as is obtained by valuing ore in place unless the quantity of material in the samples is in the same proportion to the quantity of material in the deposit in each operation.

The probable conclusion as to the necessity of increasing the cost of investigation would be as follows: The increased cost is not warranted where deposits are being sampled which contain a fairly uniform distribution of relatively fine gold and gravel. A considerable increase in the number of drill holes and a consequent increase in the cost of the investigation are warranted in the average type of deposit, and the increased accuracy obtained will be in proportion to the cost of the investigation. Where the deposit contains coarse gold erratically distributed, no system of drilling is satisfactory, no matter how many drill holes are sunk in the deposit. Such deposits should be tested by some other method.

When a valuation of a given placer deposit is assumed, there should be as clear an understanding as possible between the investor and the valuing engineer as to the permissible cost of the investigation, and the investor should not expect from the engineer any greater degree of accuracy of valuation than the fee paid permits.

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*Presented at a meeting of dredge operators at Hammonton, Cal., Dec. 21, 1921.

Each variable factor in the present method of sampling and computing the value of placer deposits is more or less related to some other factor in the process. There are, however, fifty or more fairly distinct factors. Such an array indicates that many mistakes and errors may occur in an investigation.

In the gathering, interpretation, and computation there is a wide variation among engineers. Leaving aside the variations in the irregularity of occurrence, different engineers will get different results from the same drill hole, as they use different methods of estimating the amount of gold, the quantity of material in the core, and other data for determining the "constant." In addition, there is a still greater variation in the use of acquired data. Correct methods for gathering drill-hole data accurately have not been worked out from experience nor for valuation from the acquired data, which indicates that there is opportunity for engineers and miners interested in gold dredging to collaborate. They should contribute their experience into a common pool, and work out the details for developing standard methods of acquiring basic data, for computing valuations from such basic data, and for disseminating such standard methods among those who evaluate placer deposits.

Engineers should endeavor to balance all parts of their investigations so that each variable factor is determined with an equal degree of accuracy. As the amount of material in a drill hole sample is only a small part of the whole placer deposit, no great number of improvements in the refinements of the mechanical details of sampling and computation would have nearly as great an effect on the final results as has the irregular occurrence of the valuable metal in the gravel. Consequently, the deliberate or accidental location of holes has vastly more influence on the valuation of the deposit than all the other forty-nine or more variables put together.

It appears, therefore, that the most effective way of improving the present methods of sampling and valuation, without greatly increasing the cost, is to determine as definitely as possible the character and occurrence of the valuable metal in the deposit and change from a system of mechanically and uniformly spacing the holes to a system of decreasing the number of drill holes where the valuable metal is most uniformly distributed, and increasing the number where it is most irregular. If this cannot be done by studying the general features, such as the source of gold in place, topography of the bedrock, nature of water flow which brought in the material, and like factors, it can best be done by taking a large interval between holes first and where necessary decreasing the interval, first across the direction of flow and then along it until the valuation by the law of averages checks satisfactorily.

A further conclusion is that it is doubtful if all the suggested improvements will give consistently close approximation of actual value in the most common deposits without increasing the number of holes, which involves increasing the cost of the investigations.

CONTROLLING FACTORS

The best sampling methods which give the closest approximation to the recoverable value are those whereby as many as possible of the variable factors involved in the estimating are determined as accurately as nature and the resources of the investor will permit, thereby eliminating as much guesswork on the part of the engineer as is feasible. Both in ledge and placer deposits there is a wide variation in the character, occurrence, and quantity of the metal. In some occurrences it is uniform, in the majority it is uneven, but not excessively so, and in others it is extremely irregular. It seems clear to me that the nature of the occurrence of the metal in the deposit is by far the most important factor in determining the methods of sampling and of valuing the deposit. The discriminating engineer will recognize this feature and use it as a guide in his method of sampling. He will also recognize the limitations in the accuracy of sampling and estimate the hazards of proceeding on the valuations placed on a deposit as a result of the nature of occurrence of the metal and the methods of sampling used.

METHODS OF APPROACH TO PROBLEM

Assuming that valuable metal has been determined to exist in an appreciable quantity in placer gravel, the next step to take is to determine every possible feature respecting the genesis of the deposit which bears on the occurrence of the metal, and interpret the bearing of these features on the choice of a method of valuing the deposit by sampling. After such data and other general features which apply to the particular deposit under examination have been observed and interpreted, an attempt should be made to classify the probable character and occurrence of the metal in the deposit. It is likely that such data will assist the investigator to determine more or less approximately the quantity, size of particles, and occurrence of the valuable metal in the deposit. It is possible that some deposits can be classified on the basis of more or less uniform occurrence of the metal. The majority will probably be classified on the basis of irregular distribution of the metal, but not excessively irregular, and some deposits will be too irregular to permit of sampling by the ordinary methods of drilling.

The first type occurs most frequently in flat countries some distance from the foothills, where the bedrock is probably uniform and the gold and gravel are fine. The second type occurs between such flats and the mouths of the gulches down which the material had been transported or at extensive flat places along the course of streams. The third type is found in the steeper narrow streams.

Such a study will suggest a definite or tentative method of sampling. Other features which will be involved in deciding on the best method, such as the amount of money available for the investigation, the accessibility of the deposit to transportation, and other pertinent factors, must also be taken into consideration. These limiting conditions will commonly modify the methods which the natural conditions indicate to be the most desirable.

The tentative system, where the general conditions do not suggest a sufficiently definite character of the occurrence of the metal, would possibly be to lay out pilot drill holes across and along the direction of deposition of the gravel in the areas. The next step would be to increase the number of holes across the prevailing direction of flow of the material, and finally to increase the number of holes along the direction of flow of the material, and so on until the complete system of sampling has been established.

There are relatively few flood plain placer deposits where the gravel and metal occur in fine condition and uniformly deposited. Such deposits can be sampled with a reasonable degree of accuracy by the present number of holes, but the methods should be improved. The majority of placer deposits have an irregular occurrence of the valuable metal, but not excessively so. These cannot be evaluated satisfactorily by the present methods. The number of samples or drill holes should be either increased approximately to secure the same degree of accuracy as is obtained in vein sampling (at an increased cost) or a large factor of safety should be placed on the results.

Certain coarse-gold types of occurrence cannot be evaluated accurately by any method of sampling now in use. Such deposits lend themselves to simple tests by panning to determine the character and occurrence of the metal. This should be followed by guesses made by men experienced in the dredging of this type of deposit, with the definite understanding of the degree of the hazard to the investor. In other words, no method or variation of sampling methods can consistently furnish data from which accurate valuation of all types of placer deposits can be made. Some deposits can be evaluated accurately, most only approximately at a permissible cost, and some merely by guesses. The accuracy will increase as the ratio of the quantity of the sample to the amount of material in the deposit increases.

The investor should either increase the cost allowance for the investigations of placer deposits which contain irregular occurrence of valuable metal, or the engineer should increase his factor of safety when making his recommendations for the exploitation of the deposit. Those engaged in the business should collaborate more and devise methods whereby identical figures can be obtained by different engineers drilling under the same conditions, and, given the same data, they can arrive at a common constant and the same valuation.

Quicksilver Production Declined in 1921

Preliminary figures showing the production of quicksilver in the United States in 1921, compiled by F. L. Ransome, of the U. S. Geological Survey, give a total of 6,339 flasks, as compared with 13,392 flasks in 1920. Of this output 3,094 flasks is credited to California, 3,144 to Texas, 100 to Nevada, and 1 to Idaho. So far as could be learned, Oregon produced no quicksilver in 1921.

In California seven mines reported production, but the output from all but the El Senador mine, of the New Almaden group, was small. The New Idria mine, for many years the largest producer of quicksilver in the United States, was idle in 1921. In Texas, the Chisos was the only mine that remained continuously productive, but a small output was expected in December from the Mariscal mine, near McKinney Springs, and is included in the total. In Nevada about 100 flasks was obtained in the Pilot Mountains, east of Mina. The single flask reported from Idaho was retorted incidentally to development work in the Yellow Pine district, Valley County. During the year the United Mercury Mines Co. acquired over 100 claims that were formerly held by the Idaho Quicksilver Co., the Monumental Mercury Mines Co., and other companies in the Yellow Pine district.

In Oregon, the War Eagle Mining Co., operating what was formerly known as the Rainier mine, in Jackson County, completed a twenty-five-ton Scott furnace in 1920, but is not known to have produced any quicksilver in 1921.

The average price of quicksilver in 1921 per flask of 75 lb., as quoted by *Engineering and Mining Journal*, was $45.46.

Never before has the quicksilver-mining industry in the United States sunk to so low an output. The first recorded annual production was 7,723 flasks, in 1850, and from that year to 1920 inclusive the annual output has been 10,000 flasks or more. In fact, in only five years has it been less than 20,000 flasks. In 1859 it was 13,000 flasks; in 1860, 10,000; in 1908, 19,750; in 1914, 16,548; and in 1920, 13,392. The maximum output, that of 1877, was 79,395 flasks. The output in 1921 was thus the smallest on record. The average price in 1921, although of course much lower than for the years during and immediately after the war, nevertheless compares favorably with pre-war prices. The cost of production, however, has not declined so rapidly as the price, and no large bodies of ore are now known that are comparable in tenor to those that were exploited when quicksilver mining in the United States could be considered a flourishing industry.

Zinc-Lead-Silver in Upper Silesia

It is impossible to state exactly what part of the production of zinc and lead ore in Upper Silesia falls to Poland and Germany respectively, as the League of Nations decision provides for a final delimitation of the boundary on the ground and through the area where the mines are situated, according to *Commerce Reports*. A preliminary estimate states that the mines which will fall in Polish territory produced in 1913 almost exactly 500,000 tons of these ores, and those in the German part 61,000 tons. The production fell rapidly during the Great War, and the total for all Upper Silesia in 1920 was only 288,000 tons. These figures include calamine, zinc blende, and lead ore.

Practically the entire zinc-smelting and manufacturing industry will be in Polish territory. All of the thirteen roasting plants (about 250 furnaces), the sixteen zinc-smelting plants (316 furnaces), and the two lead smelters will be in Polish territory, together with five of the eight zinc-plate rolling mills. The production of raw zinc in Upper Silesia fell from 169,400 tons in 1913 to 81,400 tons in 1920. The production of lead in the two lead- and silver-smelting plants which are now in Poland was 41,800 tons in 1911 (the maximum year), but only 17,200 tons in 1920, and the silver production fell from 10,620 kilos to 3,110 kilos. The total output of zinc plate in 1913 was 49,200 tons, of which the mills now allocated to Poland produced 42,500 tons. The output of all these plants in 1920 was 34,170 tons.

Production of Bauxite in 1921

The production of bauxite in the United States in 1921 is estimated by the U. S. Geological Survey at approximately 130,000 long tons, as compared with 521,308 long tons in 1920, a decrease of 391,308 tons. This great decrease in the production of bauxite is largely the result of the curtailed demand for aluminum, particularly aluminum used in the automobile industry, though the curtailed consumption of chemicals containing alumina lessened the output of some of the mines, particularly those that are situated in the Georgia-Alabama field.

BY THE WAY

Schleichegrieben Outpointed

Just as there is more than one way of killing a cat, so there are various ways of getting the fat from a pig. From Prussia comes a tale that savors of Teutonic scientific achievement, but which in reality makes us almost suspect that the Prussians have forgotten the precept taught them when lisping babes, that they should be kind to the lower animals. It seems that in Schleichegrieben, that charming spot renowned among tourists for its beautiful, enchanting, Circe-like maidens, the farmers have adopted a practice of vivisecting their four-footed friends, not for the advancement of science, but because there is money in it. But they do not kill them. No longer are the pigs of Schleichegrieben led to the slaughter when their days are fulfilled. No longer are they cut down in their prime of life simply at the behest of the scale beam. Instead they are neatly and scientifically opened with precision at the critical point of attack, a layer of fat is removed, and then with equal precision they are neatly and scientifically closed up again, and turned out to grunt and root and whatever else that the pigs of Schleichegrieben do in order to grow a new layer of fat.

How essentially Teutonic, and how much better we do it here! Sad indeed would be the day when Yankee ingenuity would fail to triumph over all. Shall the bald-headed eagle yield to the two-headed eagle? Never! Not while there is any distinction left in a bald head. By the power of our home-made hooch, never! The scene changes.

Years ago, and not so very long ago at that, a little child was born in Osawatomie-by-the-Sea, Nebraska. Victor Carolus Pumpernickel did not look like much at the time, and few suspected that the germ of scientific greatness was in him, simply awaiting a suitable medium in which to develop. And so the years rolled by. In the course of time this promising youth found himself, in high top boots and corduroys, at a famous mining school. Here, studying under a world famous authority, he became interested in the problems of the domestic oil-shale industry, as yet almost nonexistent, but having simply tremendous, staggering possibilities. The equipment of the school included a fairly large retort of special design for testing oil shale on an almost commercial scale. This was built outdoors on the campus at the foot of a short declivity, so that the shale could be readily charged by passing it in barrows over a runway bridging the short gap between the charging door and the top of the slope. It so happened one day when a test was being run that a pet pig, the mascot of the Varsity eight, while rambling over the campus, ventured onto the charging floor, so to speak, in spite of the safety warnings, and fell in. Loud were the squeals probably, but help was far away, and considerable time elapsed before piggy was rescued, very hot and reeking at every pore with perspiration, but otherwise none the worse and still able to function as a source of inspiration for the students. Later when Pumpernickel came to measure the amount of oil recovered, he noticed something floating on the surface. On closed examination he found to his intense astonishment that it was rashers of bacon. Incredible though it seemed, there they were. He quickly sensed the importance of the occurrence. He had actually effected a fractional distillation of the pig, and the particular conditions under which the retort had been operating had been just sufficient to effect a partial synthesis subsequent to condensation. Pumpernickel had carefully preserved all the data of the run. Upon reproducing the conditions he found he obtained the same result. Eureka! he had found it. Croesus! he would be rich for life. He found that the pig showed a decrease in weight after each treatment, which was almost exactly equaled by the weight of bacon recovered.

To make a long story short, the Heat Treatment Pork Packers, Inc., has been organized, capital having been readily secured. Further research has proved that oil shale is not essential to the process. A retort has been developed which is really a chamber large enough to permit several hundred pigs to be driven into it at once. The bacon will be produced in rashers ready for boxing, and may soon be expected on the market. The pigs are turned loose to feed after each reduction. The process is beautifully simple and gives precise results. Science and industry have thus advanced another step hand in hand. Mr. Pumpernickel has been advised that his alma mater will bestow its valued LL.D. on him at its next commencement.

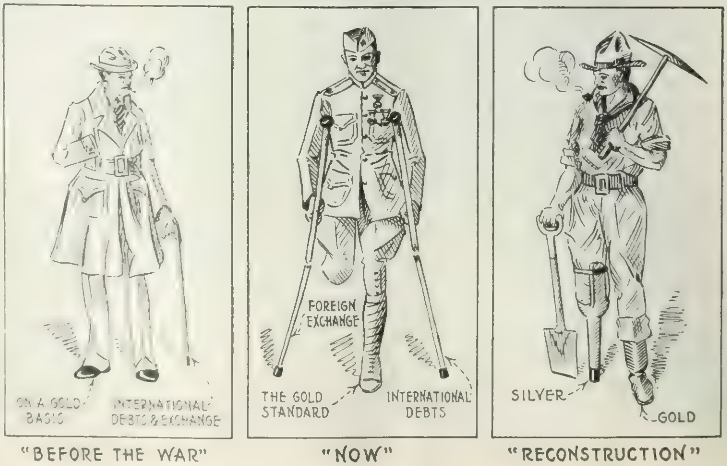
A Boring Tale

A wildcat oil well south of Porterville, Cal., now down 1,200 ft., is said to be producing fish from a subterranean stream.

The World's Business

By Hugo W. Miller

Drawn for *Engineering and Mining Journal*



"BEFORE THE WAR" "NOW" "RECONSTRUCTION"

HANDY KNOWLEDGE

Neighborly Chats With the Foreman

Condition of Tools

By Duncan MacGregor

Written for *Engineering and Mining Journal*

Not long ago, Jim, I went through a large lead-smelting plant. I was interested in observing the work and loitered by a gang rushing "muck." One of the men stopped his wheelbarrow opposite me and said "Look at that wheelbarrow, MacGregor. How can a man do an honest day's work with that thing?" One bearing was out of place, resulting in a crooked wheel. One leg and a handle were bent. It was obviously in bad condition. I agreed with him that it was a decided handicap. That company was paying $5 for eight hours' work and putting an Oregon boot on the man in the shape of a battered wheelbarrow at the same time. It seems to me that the mining industry has to pay for a certain amount of this stupidity all the time. In this instance both the foreman and the company were to blame, but the workman's aspersions were directed at the company.

It seems to me, Jim, that there's a lesson in this instance for both the foreman and the superintendent. How often are worn-out shovels kept on the job? It costs more to keep a worn-out shovel busy than a good one. How often is the steel supply allowed to run down so that a machine man is pounding a dull drill and breaking steel or even damaging his machine? There's a lot that can be done toward keeping small tools up. When you are paying a full day's pay to keep a tool busy, it pays to see that the tool is a good one.

Tramming a mine car is hard work, but if the car is in good mechanical condition and properly lubricated a man will not go off shift feeling as if he has put two days' work into one. Keep your repair men on their toes, Jim, and your cars, shovels, and drills in first-class shape. Poor tools and bad ladders increase your labor turnover, and if you want to keep your good men, one excellent method is to see that they can't kick over tools.

Increasing Rope Capacity of Hoist

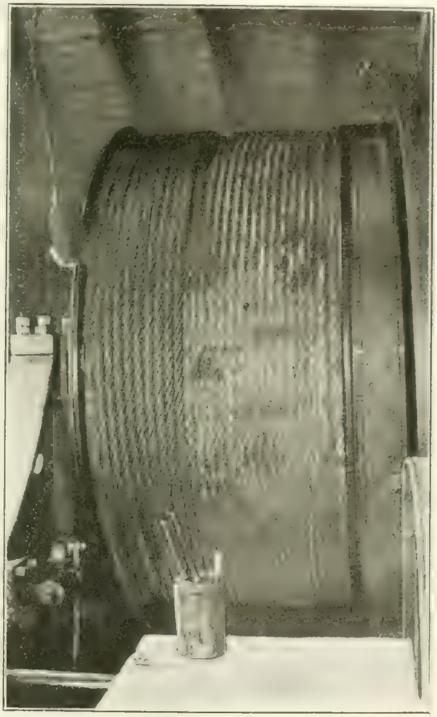
By H. H. Hunner

Written for *Engineering and Mining Journal*

A double-drum mine hoist with drums of 30-in. face and 6-ft. diameter was ground for 1½-in. rope. The drums would carry 1,000 ft. of 1½-in. rope in two layers. This hoist was put into service on a shaft-sinking job where each drum had to carry 1,700 ft. of 1½-in. rope. The new rope was put into service after the shaft had been sunk 650 ft.

The rope was first wrapped on the drum as it was, taking care to get a tight, snug wind, as each layer was put on. The 1,700 ft. occupied three and three-quarter layers on the drum. This method proved a failure in about three weeks. The rope had become so jumbled up in that time that it was necessary entirely to rewind.

Two ⅛-in. plates 29½-in. wide, each bent to cover one-half the drum with an inch or two for lap, were next hay-wired to the drum. This gave a smooth face for the bottom layer of rope, and it was thought would permit winding the center layers so tightly the rope could not squeeze through. This wrapping was done as carefully as possible, the rope being kept under a tension greater than it would have with a loaded skip. In two days' time it had crowded the two bottom layers over at one place so that the rope cut down to the plate.



HOISTING ROPE HELD IN PLACE WITH LEAD

The rope was again rewound, and the two inside layers were leaded up after winding each layer. This held the rope firmly in place and the two outer layers reeled up in perfect form.

In applying the hot lead no attempt was made to seal in the outer half of the rope coils. The lead was poured from a hand ladle, the man standing on the top of the drum and pouring straight across from flange to flange of drum at intervals about a foot apart on the circumference. Just enough lead was used to fill spaces between coils up to about half the thickness of the rope. In pouring, a thin coating of lead was given most of the upper half of the two inside layers of rope. This served as a bond between the two layers in pouring the second wrapping and also as a cushion for the rope between the active and reserve portions. As the shaft deepened and the leaded-in parts of the rope came into active service, the surplus lead was easily broken off.

THE PETROLEUM INDUSTRY

Drilling in White Point Gas Field

SPECIAL CORRESPONDENCE

The White Point Production Co. is drilling in the White Point gas field of San Patricio County, Tex. This well will be drilled below the gas-bearing strata in an endeavor to find oil. A second rig is being set up a quarter of a mile southeast of the producing gas well, and a well will be drilled to supplement the gas supply. This company is under contract to drill three more wells on the property of the White Point Development Co. and four on that of the White Point Oil & Gas Co. The White Point Development Co. has cleared a pipe-line right of way to the shore of Nueces Bay, and material is being received for its pipe line to Corpus Christi to supply that city with natural gas.

Production at Mexia, it is believed, has passed the peak, although some extensions to the field are being made. The highest production was a daily average of 190,000 bbl. one week in January. This has now fallen to about 145,000 bbl. daily, and few big gushers have been brought in recently to make up for the decline in the old wells. The field is being extended slightly to the north, and considerable drilling is under wav in the Wortham district. The recent completion of the Joe Kennedy No. 2 well of the Humphreys interests, with an initial production of 5,000 bbl., has extended the field one and one-half miles toward Groesbeck.

Oklahoma Oil Tax Bill Introduced

WASHINGTON CORRESPONDENCE

Chairman Snyder of the House Indian Committee has introduced a bill providing an oil tax in Oklahoma as follows:

> "That the State of Oklahoma is authorized, from and after the passage of this act, to levy and collect a gross production tax upon all oil and gas produced in Osage County, Oklahoma, and all taxes so collected shall be paid and distributed, and in lieu of all other state and county taxes levied upon the production of oil and gas as provided by the laws of Oklahoma, the Secretary of the Interior is hereby authorized and directed to pay through the proper officers of the Osage Agency, to the State of Oklahoma from the amount received by the Osage Tribe of Indians as royalties from production of oil and gas, the per centum levied as gross production tax, to be distributed as provided by the laws of Oklahoma."

Advantages of Diamond Drill in Oil Prospecting

The diamond core drill, common in mining, may become useful in testing out prospective oil fields, according to the U. S. Bureau of Mines. Recently the value of the diamond core drill was proved by the successful completion of a well in Mexico. It has certain advantages over the other drilling systems, and these have apparently been overlooked in oil drilling. The equipment is lighter and can be transported more easily, drilling should be cheaper with the improvement in equipment, and it furnishes a continuous core of the formation passed through.

Petroleum Investigations of the U. S. Bureau of Mines

D. B. Dow, of the Bartlesville Experiment Station of the U. S. Bureau of Mines, has begun an investigation of blended products containing natural-gas gasoline. At present the natural-gasoline manufacturers are having difficulty marketing their product, because of the overproduction of gasoline, and of the prejudice against natural-gas gasoline blends. By proper selection of blending material and use of the proper amounts of natural-gas gasoline, it may be possible to produce a mixture with characteristics similar to those of "straight run" products. A study is being made by the Bureau of the relation between vapor pressures and rates of evaporation for straight-run and blended products.

An experimental refinery consisting of three 1-bbl. stills and one 5-bbl. still, condensers, run-down tanks, and other fixtures has been constructed at the Bartlesville station, and is now being used in work on refining problems. Use was made of this refinery in investigating the recovery of gasoline from still vapors and in the production of special products for blending with natural-gas gasoline.

The investigation relating to the recovery of gasoline from uncondensed still vapors has been completed, and a report is being prepared. Practically all the refineries in the country that have installed equipment for obtaining gasoline from still vapor have furnished data on the type and process used, whether compression or absorption, the amount and nature of the vapors handled, the yield and quality of gasoline recovered, and other points.

New Pipe Lines for Natural Gas

SPECIAL CORRESPONDENCE

Announcement has been made that plans have been perfected for the construction of a pipe line from the Lost Soldier and Mahoney Dome oil fields in Wyoming, to convey natural gas to Denver and intervening northern Colorado towns. The pipe line will be 240 miles long and will first connect with the immense wells in the Mahoney district, where a single well is rated with a capacity of 40,000,000 cu.ft. of gas every twenty-four hours.

The line is to be built by the New York Gas Co., a corporation controlled by New York and Wyoming capitalists, and the gas is to be sold to existing gas companies operating in Denver, Boulder, Fort Collins, Greeley, and other northern towns.

Argentina Needs Well Equipment

Argentine purchases of oil-well equipment and supplies promise to be important during the present year, according to advices received from Edward F. Feely, commercial attaché at Buenos Aires. Large manufacturers are urged to keep on the ground qualified representatives thoroughly acquainted with the technical features of the business.

Technical Papers

Mine Power Plants—*Proceedings* of the Australasian Institute of Mining and Metallurgy (Melbourne, Australia), Sept. 30, 1921, contains a twenty-four page paper, illustrated with many plates and photographs, describing the new power plant at the South Mine, Broken Hill. Ten Babcock & Wilcox boilers, each of 2,690 sq.ft. heating surface, comprise the boiler equipment. The machinery includes two 3,000 kw. Fraser and Chalmers Vickers turbo-alternator sets and one 1,000-b.hp. Belliss turbine-driven air compressor to compress 5,000 cu.ft. free air per minute to 90-lb. pressure.

Mine Timber—The U. S. Bureau of Mines, Washington, D. C., has issued a bulletin on "The Growing Need for Preservation of Mine Timber," *Reports of Investigations*, No. 2310, obtainable on request. The amount of timber used in the American mining industries is estimated, and the kinds used for the various purposes are noted. Increased prices and scarcity make some method of preservation desirable, and it is pointed out that this practice has long been current in some foreign countries. The bulletin does not describe the manner in which the preservation should actually be done.

Mining in Burma—"The Mining Possibilities of Burma" are discussed in an eleven-page article in *The Mining Magazine* for December. (Salisbury House, London Wall, London, E. C. 2; price, 1s. 6d.) The author, H. D. Griffiths, thinks the possibilities are bright and that the region has been neglected. Gold dredging would seem particularly attractive.

Cyanide Process—In the series of articles on the new developments in ore treatment on the Rand, being published in *The Mining Journal* (15 George St., Mansion House, London, E. C. 4; price, 8d.), the Jan. 7 issue contains a three-page discussion of the treatment of slime and the recently introduced all-sliming process.

Gold Washing—The new hydraulic enterprise of the Idaho Gold & Ruby Mining Co. near Leonia, Idaho, is described in the Dec. 20 issue of the *Northwest Mining Truth* (Spokane, Wash.; price, 15c.). The plant for recovering and treating the gravel and black sand is described. Riffles and non-oscillating tables are to be used.

Mine Ventilation—A thirty-four-page paper in the *Transactions* of the Mining Institute of Scotland (Cleveland House, 225, City Road, London, E. C. 1) discusses a new method of measuring ventilating resistances, with special reference to the operation of mine fans in combination. A great deal of theoretical matter is included. There is also a shorter paper on the testing of anemometers, the results obtained in the tests described indicating the unreliability of the anemometer when measuring low air velocities.

Tungsten—The *Proceedings* of the Australasian Institute of Mining and Metallurgy (Melbourne, Australia) for Sept. 30, 1921, contains a fifty-two page paper entitled "Notes on Tungsten, With Particular Reference to King Island Scheelite Treatment and Assays of Low Grade Material." The introduction contains general information on the occurrence, method of milling and treatment of tungsten ores, and uses of the products. The next section describes the local treatment, which is, briefly, coarse crushing, tabling to remove such gangue minerals as quartz, and aplite, and the recovery of a garnet-scheelite concentrate. The garnet is removed by an electromagnet. The final section gives valuable information on assaying tungsten-bearing materials, of general application. The weakness of the purely acid methods, especially for low-grade ores, is brought out.

Metal Statistics—Another compilation of the Metallgesellschaft is out, under date of December, 1921. It covers aluminum, lead, copper, nickel, quicksilver, silver, zinc, and tin, giving figures for the world and individual country production, and prices for the years 1911 to 1920 inclusive. Copies of this seventy-six-page book may be obtained from the Metallgesellschaft, Frankfurt am Main, Germany. The price of the pamphlet is not stated.

Hydrometallurgy of Zinc—The *Journal* of the Society of Chemical Industry, (The Society of Chemical Industry House, Finsbury Square, London, E. C. 2; price, 3s. 6d.) in its Dec. 15 issue contains a six-page article on the "Hydrometallurgy of Low-Grade Zinc Ores." The paper is written by a Japanese and discusses the problem from a Japanese standpoint. The author describes a wet process which he has adapted, using sodium bisulphate as the solvent for the roasted zinc ore.

Canadian Mineral Production—The final report on Canadian mineral production during 1920 is now available on request from the Mines Branch, Department of Mines, Ottawa, Ont., Canada.

Economic Geology—Bulletin 715 of the U. S. Geological Survey, Washington, D. C., obtainable on request, has now been issued in complete form as "Contributions to Economic Geology, 1920." Practically all of the twelve papers which it contains have been issued separately and reviewed in these columns as they appeared.

Mining in India—The report of the Chief Inspector of Mines in India for 1920 is now available for 3 rupees from the Superintendent of Government Printing, No. 3 Hastings St., Calcutta. Most of the bulletin is devoted to the accident record.

U. S. Geological Survey—The forty-second annual report of the U. S. Geological Survey for the year ended June 30, 1921, is a 108-page book, obtainable from the Survey, at Washington, D. C., describing briefly the recent activities of the Bureau.

Book Reviews

Mineral Land Surveying. By James Underhill, Ph. D. Third edition, revised. Cloth; 4½ x 7¼; pp. 237, with three plates; figs. 13. John Wiley & Sons, Inc., New York, 1922. Price, $3.50.

The United States Mineral Surveyor who conscientiously follows the principles and practice laid down in this volume will not only reflect credit upon his own work, but by reducing the cost of governmental corrections will assure the return of a goodly share of the deposit which every claimant makes with the General Land Office before a patent survey is ordered. Naturally, in a specialized book of this nature the author assumes that his readers possess a knowledge of plane surveying principles, and in the first part of his work discusses only those methods particularly applicable to mineral land surveying.

Chapter 1 is devoted to the direct solar observation, a correct understanding of which is necessary to accurate surveying. The author dwells more upon practice, calculations, and formulæ than upon theory. A surveyor looking for enlightenment upon the theory of the solar observation will not find the subject discussed in much detail and may be confused by the solar diagram on page 5, in which the zenith appears tilted to the left of the observer instead of appearing directly overhead. Probably this is an error in printing, but it makes the diagram rather confusing, which it would not have been had the zenith been centered at the top.

Chapter 2 describes the use of the solar attachment, and the third chapter deals briefly with linear measurements. The next section begins the treatment of the special problems of mine claim surveying, goes into the location and patent surveys in great detail, and is the most valuable part of the book. Specimen surveys, field notes, plats and the required governmental forms, properly executed, give a good insight into the mineral surveyor's field and office work. A useful chapter is one upon examination questions to guide the prospective U. S. Mineral Surveyor in being adequately prepared for his examination for a commission. In some states these examinations are quite difficult.

Although this is a third edition, the omission of any reference to observations on polaris, which are frequently used to determine the meridian, detracts somewhat from its completeness. Also, a future edition might well consider the inclusion of the interesting and special problems of locating the points of intersection of conflicting claims. However, the book's compactness and the valuable practical information which it contains should place it within convenient reach on the mineral land surveyor's five-foot shelf.

F. E. W.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Spokane Convention Against Mine Law Revision

Government of Alaska from Washington Criticized—Bonus Legislation Scored—Strict Adherence to Pittman Act Advocated—Blue-Sky Bills Condemned

By Hilliard W. Power

Written for Engineering and Mining Journal

THE twenty-seventh annual convention of the Northwest Mining Association opened in Spokane, Wash., on Feb. 14, lasting four days. Delegates from Alaska, Oregon, Idaho, Washington and British Columbia were present. Much enthusiasm and optimism were shown by the visitors as regards the outlook for their respective sections. Technical discussion and papers were not on the program, the plan being, instead, to thresh out problems affecting the legislative and the requirements of the Northwest mining industry at large. Extensive use was made of motion pictures supplied by the U. S. Bureau of Mines. Arrangements were in the hands of Frank C. Bailey, secretary of the Northwest Mining Association.

RIVERSIDE AVENUE, ONE OF THE PRINCIPLE BUSINESS THOROUGHFARES OF SPOKANE, WASH., WHERE THE NORTHWEST MINING CONVENTION HAS JUST BEEN HELD

Resolutions passed at the convention numbered fifteen and included the following:

The Secretary of State of the United States was asked to enter into diplomatic negotiations with the Government of the Dominion of Canada, with a view to securing the removal of the Canadian tariff on Canadian lead smelted and refined at United States bonded smelters. Thanks were extended to Senator Miles Poindexter, of Spokane, and to Ravenel Macbeth, secretary of the Idaho Mining Association, for work already done at Washington in this connection.

Another resolution was passed condemning the system of bureaucratic government imposed upon Alaska as conflicting, interlocking and autocratic, with its lack of co-ordination and its abundance of red tape. The resolution alleged that the result is that the pioneer operator has been driven from the territory to more attractive fields and that the tendency towards monopoly has become more marked each year by large corporate interests. It pronounced as a failure the efforts directed to conserving Alaska's resources, and asserted that they tended to monopoly. It indorsed in principle the proposal made by the Secretary of the Interior and the Governor of Alaska and their several predecessors and embodied in bills already introduced in Congress, namely that all bureaus having to deal with the natural resources of Alaska be co-ordinated and united, in so far as their activities in Alaska are concerned, under one responsible head, preferably the Secretary of the Interior, with an authorized representative resident in Alaska. It was urged that early legislation be passed by Congress providing for a return in Alaska to that liberal public land policy which has been so successful in the western United States and in Canada.

Members of the Finance Committee of the United States Senate were urged in another resolution to take prompt action upon the Fordney tariff bill.

Completion of the South Fork road, which serves a rich mining district of southern Idaho, was favored in another motion which emphatically advocated the completion of local roads opening up mineral and other valuable producing areas. Equally emphatic protest was made against the provision of more national highways constructed unnecessarily for the sole benefit of automobile tourists.

Admiration of the patriotism of millions of ex-service men in the United States army and navy in the late war was expressed in a resolution, which, however, stated that any legislation involving huge cash expenditures at this time should be most carefully scrutinized to make sure that economical readjustment, so essential to the nation in the present crisis, be not obstructed.

It was insisted in another resolution that the provisions of the Pittman Act be carried out to the letter and that the silver sold to Great Britain be repurchased and restored to the Treasury to the full amount specified in the bill.

The Volstead and Dennison Blue-Sky bills now before Congress were condemned.

It was urged that the American magnesite industry, now stagnant because of competition with cheaply produced foreign magnesite, be given prompt and sufficient protection by Congress, and that at least the proposed specific duty of $15 per ton be levied on foreign magnesite imported into this country.

A resolution was passed condemning the Better Business Bureau, an adjunct of the Spokane Advertising Club, for methods used in attempting to pose as an adviser to the public in the matter of speculative investments, particularly mining, and pointing out that such an organization is less competent to advise investors intelligently than are reputable brokers and promoters who have made a close life study of the situation. The resolution also expressed the willingness of mining men of the Northwest to co-operate in any fair regulations designed to limit dishonest promotion and to protect the public against unsound investments.

The opposition expressed by the Northwest Mining Association to measures now before Congress providing for the revision of mining laws was indorsed. It was stated that mining men of the West are tired of regulations and restrictions, and prefer, for the present at least, to work their way back to prosperity through the aid of laws which are now well understood, even though imperfect, rather than to fly to evils of which they can as yet have no conception or adequate knowledge.

The work conducted by the U. S. Bureau of Mines at Moscow, Idaho, was indorsed, especially along lines of co-operative research in ore dressing and metallurgy at the University of Idaho. The desirability of increasing the scope of this work to that of a full station as soon as funds available will permit was urged.

The work of Ravenel Macbeth, secretary of the Idaho Mining Association, on behalf of tariff protection for metal and mineral industries was heartily commended.

An extensive display of minerals from the mining districts of the Northwest attracted much attention. A feature of this was an exhibit of the products of Washington magnesite plants, particularly of plastic magnesite manufactures. This indicated the possibilities of the industry along other lines of production than that of the well-known and common dead-burned material.

Mesabi Range Alumni Meet

The Mesabi Range Alumni Association of the Michigan College of Mines held a banquet on Washington's birthday, Feb. 22, at Hibbing, Minn. The principal speaker of the evening was Donald Gillies, vice-president and general manager of McKinney Steel Co. and president of the Alumni Association of the Michigan College of Mines.

Petroleum Geologists Meet in Denver

The tri-monthly meeting of the Rocky Mountain Association of Petroleum Geologists was held at the Albany Hotel, in Denver, on Feb. 9. Following a luncheon Charles T. Lupton submitted a paper on the "Pre-Cretaceous Stratigraphy of Western Kansas" and J. E. Redburn read a review of a recent paper published by John Rich on "Moving Underground Water as a Primary Cause of the Migration and Accumulation of Oil and Gas." A general discussion followed.

Canadian Engineers Meet at Vancouver

British Columbia Section of Institute of Mining and Metallurgy Holds Annual Convention—Taxation of Claims and Air Transportation Discussed

BY ROBERT DUNN

Written for Engineering and Mining Journal

THROUGHOUT the annual general meeting of the British Columbia Division of the Canadian Institute of Mining and Metallurgy, which was marked by many addresses on subjects ranging from a review of the past year's mining to the oil possibilities of the Mackenzie River, not a single note with a pessimistic ring was heard. The attendance was large, many being present even from the remote districts. When R. W. Brock, of the University of British Columbia, stated that mineral wealth was the basis upon which the province must build prosperity and that if the tragedy of isolation is not to overtake it, its mineral resources must be developed and railways built, he was applauded enthusiastically. Much the same point was made by William Sloan, Minister of Mines, in the concluding speech of the meeting. If the Hidden Creek mine and the Anyox smelter could produce practically all the copper of 1921 and keep the output within range of that of the previous year, and if the Sullivan mine and the plant of the Consolidated Mining & Smelting Co. could produce almost all the lead and zinc and establish new records in respect of these metals, it was hard to conceive of any limit to mineral possibilities of the province, he said.

Lieutenant Governor W. C. Nichol, who opened the convention, said: "If our mineral resources are to be of the greatest value to us, we must ourselves own and operate to a far greater extent than we do, and not leave it all to outside enterprise." A review of mining in the province in 1921 was given by William Fleet Robertson, provincial mineralogist, who placed the value of total production in 1921 at $28,504,903, a decrease of $7,038,181. The value of the metal output was $13,232,002 and that of coal was placed at $13,272,903.

Mayor Tisdall of Vancouver expressed the hope that local capital would be invested in the province's mining prospects. William M. Brewer, resident Government mining engineer, summed up a discussion of the prospector by charging that too much education was responsibile for his increasing scarcity. The youth of today, he said, are educated to the point where, after being graduated, they contrast unfavorably the lonely life of a prospector with life in a city, where money can be earned with no sacrifice of comfort or of social opportunities.

The question of the expediency of advocating the imposition of heavier taxation on Grown-granted mineral claims or of requiring a certain amount of development work to be done each year, in place of the present tax of 25c. an acre, was discussed with spirit. A faction headed by F. W. Guernsey, a mining engineer of Vancouver, was in favor of some course different from the policy now existent, to the end that Grown-granted mineral claims held without development and obviously for speculative purposes should be so dealt with that their mineral wealth would be exploited, if not by the present owners, then by others who are willing to do so.

On the other hand, though it was generally admitted that in the well-prospected areas there are many dormant Crown-granted claims and that this may be neither expedient nor desirable, strong opposition to a change developed. C. P. Hill, of the Hillcrest Collieries, argued against the principle of adding to the taxation on non-productive property, title to which had been fairly earned by prospectors who had roughed it and were responsible for the discovery and opening up of the great mining camps of the West. Others acknowledged the blight of unworked claims but felt that a radical change in the law might do an injustice to many deserving mining men. No conclusion appeared possible, and the issue was left in suspense.

TRANSPORTATION BY AIR AN AID TO PROSPECTING

"Aerial Photography as an Aid to Prospecting" was discussed by Major E. MacLaurin, who claimed that the airman with the present equipment can render valuable assistance to the prospector. Large tracts of territory, he said, could be photographed in strips, pieced together and the final mosiac would permit careful study and consideration before entering the country. From this the prospector could prepare his field map, showing the drainage of the country, the best route for entry, the relative locations of mountains, valleys, lakes and other important information as to cover, rock croppings and other features. Major MacLaurin said that conditions in British Columbia were favorable to this kind of preliminary exploration.

"In my experience," he declared, "an efficient seaplane or flying boat may move almost anywhere in comparative safety, as the province abounds in lakes and rivers suitable for emergency landing places. As far as I know, little use has been made of aircraft by mining men. Except for one or two photographic surveys of oil properties in the south, the Imperial Oil Co's experiment in the Peace River country, and a flight made by Professor Bruce, of Queens University, last summer in northern Ontario, not much has been done. British Columbia is especially well suited to the operation of aircraft. Its physical features are exceptionally rough, offering difficulties to the ordinary means of locomotion, but its innumerable lakes and rivers provide splendid natural landing places. Straightforward flying with a reliable pilot and a properly cared for machine offers a perfectly safe and sane means of travel."

The general mining and milling practice at the Britannia mine, on Howe Sound, was discussed by C. P. Browning. He said that, power being produced entirely on the property, the whole operation of mining, transporting and concentrating 2,300 tons of ore daily was accomplished by a plant that was more or less self-contained, with the exception of the smelting and refining of the copper concentrates.

Oil possibilites of the Mackenzie River were described by Prof. M. Y. Williams who recounted the results of the prospecting of the Imperial Oil Co. A gusher has been struck and capped, he said, and later the flow had declined. It was not likely that, however the field might develop, it would produce what were commonly referred to as gushers. He stated, that the company did not have to sink far before obtaining the oil.

Standardization Bulletin of A.M.C. Ready for Distribution

Every mine operator and engineer interested in standardization of mining equipment, or in improving the methods and practices in mining, will find much useful information in the Second Standardization Bulletin just published by the Standardization Division of the American Mining Congress, Washington, D. C. It contains the recommendations of the committees from the coal and metal branches, and as the committee had the views of both operators and manufacturers, the recommendations are the result of thorough consideration. The bulletin also contains the discussions of the reports which were presented at the Second National Standardization Conference in Chicago in October, 1921.

The following committees of the metal-mining branch have presented progress reports with discussions and suggestions for the consideration of the industry: drilling machines and drill steel, N. B. Braly, chairman; underground transportation, William B. Daly, chairman; fire-fighting equipment, William Conibear, chairman; mine ventilation, Charles A. Mitke, chairman, (temporary); mechanical loading underground, Lucien Eaton, chairman; mine timbers, Gerald Sherman, chairman; mine accounting, T. O. McGrath, chairman.

It is the desire of the Standardization Division of the congress and of all those who have been carrying on the work of standardization to obtain the widest possible distribution of this bulletin to the mining industry. The bulletin will be furnished on request to the American Mining Congress, Munsey Building, Washington, D. C.

The After-Effect of Igneous Intrusion*

Presidential Address of James F. Kemp, Before the Geological Society of America, Made at Amherst
December, 1921

The general use of the polarizing microscope was brought into this country in the 70's but had its greatest stimulus in the next decade, through American students Cross, Iddings, Diller, Adams, Williams and others returning from the laboratories of Zinkel or Rosenbusch. Subsequent detailed study has made it possible to say that we have about completed our knowledge as to components and structures of rocks. Petrography has become petrology, and we are now looking forward to a greater understanding of processes.

Another important subject gaining in attention in the last three decades relates to the after-effects of igneous intrusion.

No matter how undisturbed are sedimentary strata, it is never safe to assume that igneous rocks may not be associated. The basic dikes of western New York, Kentucky, and Arkansas are examples. The flat beds around the Gulf of Mexico are penetrated by basaltic plugs near Tampico, and even the salt domes of Texas and Louisiana persistently suggest underlying intrusive masses.

We now know more about the chemical components of the igneous rocks than of the igneous magma. Magmas contain dissolved gases, most of which escape on crystallization. Experience assures us that, in general, high silica magmas are richest in these gases, and basic ones less so. These gases are almost universally held to be as much a part of the deep-seated magmas as are the silica and the common bases. On cooling, most of these gases escape, although small amounts remain in the composition of certain minerals; and they doubtless separate as the rock crystallizes.

The effect of these gases is observed in the intrusive rock itself in minerals developed after the main crystallization. Orbicular or spheroidal granites or diorites may be due to this stage and class of igneous phenomena, and inclusions in ingneous rocks may be perfectly altered by the same agencies.

What do we know as to the actual composition of these emitted gases? At Kilauea, Day and Shepard caught from the basaltic magma, water, carbon dioxide, nitrogen, carbon monoxide, and sulphur trioxide—also soda, potash, lime, ferric oxide, and alumina, but no silica. At Katmai, Allen and Zeiss have found, in the emanations, water, carbon dioxide, nitrogen, hydrogen, sulphide and hydrogen, methane and oxygen. Indicated compounds are hydrochloric acid, hydrofluoric acid and hydrogen sulphide. A computation of fifty analyses of volcanic emissions by F. C. Lincoln has indicated that after water-gas, carbon dioxide is the most abundant. Then comes nitrogen; then hydrofien sulphide; then sulphur dioxide; then hydrochloric acid, hydrogen, and methane. Among the condensible components come sulphur, salt, salammoniac, and ferric chloride; in small quantities, tellurium, arsenical compounds, boric acid, and all the common economic metals except gold and silver. Silica is missing, although it occurs in hot spring waters and is most characteristic of contact zones and mineral veins.

Volcanic emissions are only a partial indication of what takes place around a deep-seated intrusion under high pressure and temperature, and under the precipitative influences of the wall rocks. One of the most indicative things is the impregnated ancient strata in the Pre-Cambrian ancient gneisses of sedimentary origin which have been soaked with the juices of igneous rocks. Around igneous intrusions the alteration has in many cases been so profound that it is difficult to determine where original sedimentary matter ends and contribution from the intrusions begins; and near the intrusion, the alteration may be so intense as to cause the altered rock to be mistaken for igneous. The partial bed-by-bed (lit-par-lit) alteration of sedimentaries is closely allied to the phenomena of contact zones; where shales are crystallized into new minerals; and with limestones where characteristic lime silicates are developed. The early view of these lime silicates was that they represented the crystallization of material already in a limestone, but in 1905 Kemp and Lindgren announced that the garnet of these contact zones, instead of being of the lime-alumina variety, was the lime-iron variety (andradite), demonstrating the introduction of some iron into the limestone at the time of crystallization. There are also, besides the iron silicates and oxides (magnetite and specular hematite) great bodies of iron sulphides, sometimes with copper and other ores associated. Clearly, also, silica has been introduced. The general order of introduction seems to be: first, lime silicates; second, iron oxides, magnetite, and specularite; third, sulphides of iron, copper, and other metals.

As to the mineral veins, the significance of the mineral-bearing pegmatites has been realized more and more, as they have been found to be sources of tungsten, molybdenum, and other ores. This realization of their significance to the study of ore deposits began in the early 90's; and the study was led by Vogt in Norway, and the distinctive American school, presented by the writings of Lindgren, Spurr, and Kemp, emphasizing more and more the growing faith in the explanation of ore deposition as an after-effect of igneous intrusion. In 1901 Kemp pointed out the absence of meteoric waters in deep mines, and the estimate of Delesse in 1861 that the total amount of the ground waters would yield a layer 7,500 ft. deep uniformly over the earth has been gradually reduced to that of Fuller in 1906 of only 96 ft.

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*An abstract.

In 1906 Lindgren gave his noteworthy address on "The Relation of Ore Deposits to Physical Conditions," and in 1907 Spurr published his valuable contribution, "A Theory of Ore Deposition," in which he outlines the zonal theory of ore deposition in successive zones or stages, away from a central magmatic source, the different zones being marked by characteristic metals. This sequence has been corroborated in whole or in part by many observers.

My conclusion is that, in spite of my early training, I have been irresistibly drawn by study and logic to a confidence in the great part played by igneous forces in nature. We have now learned many facts concerning them, and we are now in process of interpreting them. The intrusive rocks and their emissions constitute an explanation of recrystallization of ancient strata of contact zones, pegmatites, and quartz veins and of the zonal distribution of ores.

In the future, we hope to find out the causes of upward intrusion; why igneous magmas differentiate; and why the differentiated products resume their upward journey.

MEN YOU SHOULD KNOW ABOUT

Morgan H. Wright was recently in New York.

W. A. Funk has gone to Los Angeles on professional business.

Eugene Dawson will go to Panama on mining business, to be gone about thirty days.

Richard A. Parker, of Denver, and **Mrs. Parker** left New York this week for Italy.

R. V. Whetsel is in New York, and will return to Tampico, Mexico, in a few days.

Walter Douglas, president of the Phelps Dodge Corporation, is on an inspection trip in Arizona.

William B. McKinlay is now at Quiruvilca, Peru, with the Northern Peru Mining & Smelting Co.

Gerald H. Hutton, of the Gold Canyon Dredging Co., has recently returned from Dayton to San Francisco.

R. H. Elliot, vice-president of the United Comstock Mines Co., is in Gold Hill on professional business.

A. J. Clark, metallurgist of the Homestake Mining Co., is in New York, his father having recently died there.

Bernard MacDonald has returned to Parral from an examination of mines at Indé, in the State of Durango, Mexico.

Nathaniel L. Amster, Boston mining man, with his family, is spending the last of the colder months in Phoenix, Ariz.

J. A. Cullen has been assigned to cement experiment work at the Columbus station of the U. S. Bureau of Mines.

Charles Dunphy and **H. R. Bostick**, of San Francisco, were recent visitors to the San Dimas mine, in Durango, Mexico.

N. M. Getchell, manager of the Betty O'Neal mine near Battle Mountain, has returned to Battle Mountain from Salt Lake City.

W. Haseltyne has been placed in charge of the concentrating and cyanide plants at the Premier mine, Portland Canal.

P. G. Beckett, general manager of the western operations of the Phelps Dodge Corporation, has reopened his offices at Douglas, Ariz.

Samuel H. Bolbear will spend most of the next two or three months in Canada. He was a recent visitor at the Vimy Ridge mine, Coleraine, P. Q.

Colonel C. H. Machin, of Kenora, Ontario, is in New York completing financial arrangements for the opening of the Mikado mine, in the Lake of the Woods district.

Charles F. Mason sailed on the "Huron," Feb. 18 for Argentina, where he will supervise the installation of Holbeck powdered-coal equipment at the Famatina smelter.

M. M. Blazquez and **J. W. Barry**, directors of the Cia. Minera la Constancia, have returned to Saltillo from inspection of the properties of the company in Sierra Mojada.

H. G. Thiele, formerly with the Oliver Continuous Filter Co., is now connected with the Engineering Structures Co., Call Building, San Francisco, specializing on structural erection.

Patrick Daly, veteran prospector and mine operator of Stewart, B. C., has left for New York to interest capital in mining properties of the Salmon Arm section of Portland Canal district.

Bulkeley Wells, president of the Metals Exploration Co., en route to San Francisco from New York, stopped off at Virginia City, Nev., on Feb. 7 to inspect operations at Gold Hill and Gold Canyon.

Norman Carmichael, former general manager for the Arizona Copper Co., Ltd., is in Phoenix, Ariz., with **Mrs. Carmichael**, for a period of rest and recreation before starting for New York, where they will make their home.

Senator Samuel D. Nicholson, member of the Senate Committee on Mines and Mining, was in Denver during the week of Feb. 13, conferring with Colorado mining men concerning measures pending in Congress affecting the mining industry.

Dr. F. V. Meriweather, of the U. S. Bureau of Mines, has been assigned to the Houghton station for temporary duty. Dr. Meriweather was chief physician for the Public Health Service at the Muscle Shoals plant and also saw service overseas.

D. M. Drumheller, Jr., formerly manager of the Tidewater Copper Co., has returned to Sidney Inlet, where he will supervise the reopening of the company's Indian Chief mine and plant. Mr. Drumheller has been in private practice in Spokane for a year.

H. A. Doerner has been assigned to rare-metal work at the Reno experiment station of the U. S. Bureau of Mines. Mr. Doerner was formerly connected with the Denver office of the Bureau of Mines. For the past several years he has been engaged in commercial work.

John C. Greenway, general manager of the Calumet & Arizona, has been commissioned a brigadier general in the United States Reserve Corps, assigned to command of the 409th and 410th infantry regiments, within the 103d Reserve Division, which embraces Colorado, Oklahoma, New Mexico, and Arizona.

SOCIETY MEETINGS ANNOUNCED

Engineers' Club of Northern Minnesota will hold its annual banquet at Hibbing, Minn., on the evening of Feb. 25. The principal speaker of the evening will be John Stone Pardee, who will address the club on the subject of the Great Lakes-St. Lawrence deep-waterway canal.

OBITUARY

John Adams Smith died in Montreal on Feb. 11 after a long illness. Mr. Smith was one of the pioneers of the Rossland, B. C., and Porcupine mining districts.

John F. Shafroth, former United States Senator from Colorado and twice Governor of the state, died at Denver on Feb. 20 after a week's illness. He was sixty-seven years old. Senator Shafroth was one of the original commissioners appointed by President Wilson on the War Minerals Relief Commission.

Lucien H. Norton, of the firm of Root & Norton, Durango, Col., died on Feb. 10 of heart failure. Mr. Norton was a graduate of the Columbia School of Mines, class of 1886. After his graduation he was employed by an English mining company in San Domingo. Later he became identified with the Pennsylvania Lead Co. at the smelter at Sandy, outside of Salt Lake City, and then removed to Park City, where he was employed at the Mercur mine, at the time of one of the first trials of the cyanide process in this country. In 1895 he removed to Monterey, Mexico, where he was chief assayer, for the Guggenheim smelter there, for five years. From 1900 to 1902 he was superintendent of the Humphreys M. & M. Co. at Creede, Col. In 1908 the partnership of Root & Norton was formed.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

A strike in the Tintic district, Utah, caused by the recent reduction in wages there, has resulted in the old wage scale being restored in that camp.

Reduction of freight rates has virtually been asked of the Interstate Commerce Commission by the directors of the Colorado Metal Mining Fund and the Colorado Metal Mining Association.

The Lone Pine-Surprise Consolidated Mining Co. has won the decision in the apex suit brought against it by the Day interests. The finding of the lower court has been affirmed.

Inspiration Consolidated has put four units of its mill in operation. False reports of a labor shortage have caused many to go to the Globe-Miami district seeking employment. United Verde Extension has started one reverberatory.

The Daly West Mining Co., at Park City, Utah, is to be taken over by a new company headed by George W. Lambourne. The Judge holdings may be transferred to the same company, it is said.

War mineral relief claimants to the number of 837 have asked rehearing of their cases.

Inspiration Starts Four Units of Concentrator

False Reports of Labor Shortage Cause Flood of Men Seeking Employment in District

Inspiration has resumed production of concentrates with four of the twenty units of its mill, after nine months' idleness. Half of the mill is ready for operation at any time. The company is reported to have struck a large body of 2 per cent mixed carbonate and sulphide ore in the new Porphyry shaft, which has gone through about 60 ft. of mineralized material without striking bottom. The shaft is now about 420 ft. deep, and is being pushed at the rate of 7 or 8 ft. a day. The same orebody was cut several years ago in the old Barney shaft, 200 yd. distant and at about the same depth. The shaft is to have modern and expensive equipment.

The International smelter is operating two reverberatories at capacity. No. 1 furnace is not expected to be ready for operation before March 15, when Old Dominion concentrates are expected. Inspiration concentrates are to be handled at Miami and a corresponding cut made in the amount of Miami concentrates. The two furnaces will continue their normal output of about 15,000,000 lb. of blister copper per month. When the smelter closed last May, there was on hand 65,000,000 lb. of copper bullion, now reduced to 10,000,000.

Old Dominion is expected to start operation about March 1 and to be operating its mill within a few days thereafter. H. C. Plummer, general manager of the Arizona Commercial, states that his company will resume shipments of ore as soon as the Old Dominion mill is ready, about March 1. He has added to his underground force and has started operation of the power house.

Iron Cap is operating its mill two shifts at about two-thirds capacity and is sending concentrates to the International smelter.

Both Globe and Miami are flooded with new arrivals of men seeking employment, brought here by erroneous reports of a labor shortage. Skilled labor will be recruited from former employees. Of unskilled labor there is a surplus already.

A material reduction has been made on ore shipments from the district to El Paso, with a base of $2.60 a ton in car-load lots on ores valued at $15 a ton, ranging up to $7.37½ on $150 ore. The old rate started at $3.38 for $15 ore. Almost all the ores shipped are valued between $15 and $30 a ton.

Strike at Mount Morgan Settled

By Cable From Reuters to "Engineering and Mining Journal"

Brisbane, Feb. 16—The strike which, owing to a reduction in wages, has been in effect at the Mount Morgan Gold Mining Co.'s property has been settled. It is expected that work will be resumed in about three weeks.

Lone Pine-Surprise Wins Apex Decision

The Circuit Court of Appeals has confirmed Judge Rudkin's decision in favor of the Lone Pine-Surprise Consolidated Mining Co., owner of the Last Chance Gold Mine, at Republic, Wash. This company several years ago was made defendent in apex litigation brought by Republic mines branch of the Northport Smelting & Refining Co., owners of an adjacent mine. The plaintiff sought about half the ore above the 500 level of the Last Chance mine and nearly all below it; also damages totaling about $100,000 for ore removed by the Last Chance. Judgment for the Lone Pine company was entered in the Federal Court at Spokane during 1920. The decision was appealed, only to be confirmed as stated.

Colorado Operators Seek Freight Reduction

Interstate Commerce Commission Petitioned by Directors of Two Organizations

Reduction of freight rates has been asked by the board of directors of the Colorado Metal Mining Fund and the Colorado Metal Mining Association, on behalf of the ore producers of the state. A statement has been filed with the Interstate Commerce Commission, asking that, in the proceedings now pending before the commission, special notice be taken of the deplorable condition of the metal-mining industry in Colorado, so that such remedies as are possible may be applied.

The statement recites conditions in Colorado in support of the following recommendations:

A uniform reduction of freight rates on ores and concentrates throughout Colorado to the basis of the rates in force prior to May, 1918.

A revision of freight rates on coal and coke from the producing points to metal mines and smelters.

A modification of the rates on lead bullion and copper matte from Colorado common points to the Atlantic seaboard to a parity with those in force prior to 1918.

Spain Revises Export Duties

By Cable From Reuters to "Engineering and Mining Journal"

Madrid, Feb. 16—The new tariff which became effective today fixes the following export duties: Pyrites, .15 pesetas per ton; other iron ores, .20 pesetas per ton; copper ores, .15 to 10 pesetas per ton, according to richness; copper precipitate, 35 pesetas per ton; wolfram, 25 pesetas per ton; manganese, .20 to 1.50 pesetas per ton; and lead ores, a rate of 20 pesetas per ton export duty.

CROSSING ELBOW LAKE,
NORTHERN MANITOBA

CAMP ALONG TRAIL TO
ELBOW LAKE

IN THE PAS, THE "JUMPING OFF PLACE" FOR NORTHERN MANITOBA

The Elbow Lake Strike—Another Porcupine?

Three Big Companies Already Interested in Manitoba's Newest Gold District—Spring Rush Expected—Mineralization Suggests Possibilities of Opening Large Mine

By Walter A. Rukeyser

Written for *Engineering and Mining Journal*

LATE LAST SUMMER two brothers, Gordon and Kenneth Murray, made a spectacular gold discovery at Elbow Lake, about 125 miles by trail north of The Pas, Manitoba. An option on this group of five claims was taken by S. W. Cohen, of Montreal, who immediately made a thorough examination of the property. In October this option was taken up by the Hollinger interests through the agency of Mr. Cohen. Since that time there has been an ever-increasing impetus to a healthy development of the new district and a veritable rush of prospectors, brokers and engineers into the country.

Elbow Lake lies in the east-central part of an intensively mineralized zone extending from the already famous Flin Flon and Mandy copper properties on the west to Herb Lake, with its small but consistent veins of high gold content, on the east. This zone, approximately 100 miles in an easterly and westerly direction by 30 miles north and south, consists of a series of basic volcanic flows now altered to greenstones and chlorite schists. These have been intruded by large batholiths of granite and a series of related acidic dikes, quartz porphyries, syenites, and the like. All these formations are of pre-Cambrian age.

The spectacular showing uncovered by the Murrays lies in the greenstone at or near the contact with the granite mass. The work done to date consists of a series of deep trenches crosscutting the formation for well over 100 ft. and at intervals along the strike for 500 ft. or more. The greenstone apparently was sheared before or at the same time that the intrusion of the granite and acid rocks took place. It is replaced in varying degree by the action of highly siliceous solutions and has been mineralized with quartz, free gold, pyrite, and other iron sulphides. It is a peculiar characteristic that practically all of the pyrite is in the residual greenstone, whereas all the free gold that I observed, at least, is included by the quartz. This occurs in the form of veinlets, flat seams, and irregular masses throughout the mineralized zone.

It has been said by authorities on the district that the mineralization is genetically related to the granite. However, my own impressions (they cannot be called more than that) are that sufficient emphasis has not been placed on the porphyritic and associated dikes as a factor in the mineralization of the greenstone.

The gold occurs as nuggets and large spatterings of a most spectacular nature, and it has furthermore been proved that, disregarding these visible showings, the intermediate rock assays high across the widths developed by the trenches. Furthermore, these remarkable showings extend over a wide area, and shots which have been placed in rock under the muskeg nearly 3,000 ft. north of the original discovery have brought to light similar extraordinary results. One more fact that leads to the belief that this is in reality a mineralized zone, and not a vein or shoot in any sense of the word, is that one can blow out a spectacular showing, go down a few inches without encountering visible gold, and then suddenly again encounter a large display.

The Hollinger representatives have just completed cutting a forty-five-mile winter road from Mile 55 of the Hudson Bay Railway. This, it may be remembered, was put through from The Pas to Fort Norman, on Hudson Bay, for the purpose of supplying a short haul to the sea as an outlet for western Canada's grain. The project, started in Premier Laurier's administration, has never been completed, although steel has been laid for 211 miles. A mixed train is operated fortnightly over the line.

At the instigation of Philip L. Foster, representing English interests, I have just made the trip to Elbow Lake. George Bancroft, who was with J. E. Spurr's party when the Mandy was located, accompanied me from The Pas and also acquired property for his interests. Travel was by dog team and the longer trail (about 125 miles), following the waterways, was taken, as we could not be dependent upon the bi-weekly train service to Mile 55. By easy stages it took three and one-half days each way to make the trip.

Hundreds of claims had been staked; in fact, as far south as Island Lake, north to the head of Elbow and east to Claw, the country had been blanketed, most of the locations having been made over the snow. A large number of

CAMP OF HOLLINGER CONSOLIDATED GOLD MINES, LTD., AT ELBOW LAKE

claims have already changed hands; syndicates have been formed to acquire property, and even some small companies organized in anticipation of the boom which is bound to result this spring. Already there is an influx of prospectors from the more beaten trails of Ontario. The usual amount of wildcatting is prevalent.

On the whole, however, the prospects for an intelligent development by responsible interests are bright for this new district, hitherto neglected even by prospectors, probably a natural sequence to war and post-war conditions and a general lack of available capital. The Hollinger, I am told, will have a force of nearly sixty men on surface development this spring. At present its group of thirty-five men are completing camps, bunkhouse, grubhouse, stable, office, assay hut, and powder house. The work will be pushed energetically by their engineer in charge, Mr. Rutherford, and his foreman, Mr. Dowley.

WALTER A. RUKEYSER

The Tonopah interests will undoubtedly be represented by George Bancroft, and I am at present preparing to return to the district to take charge of a quite extensive development program. Work will be done on not only the gold properties at Elbow Lake, but also on some promising copper options which have been acquired on the zone west of this immediate locality.

It is an interesting fact in connection with the foregoing that the Mining Corporation of Canada, which now controls the Flin Flon, has had substantial assurance from the Manitoba provincial government that a railroad will be built into the district as soon as large-scale development begins. This would run about thirty-five miles south of Elbow Lake, and if the present interviews of Mr. Brigham, general manager of the Hollinger company, with the representatives of the government are successful, one can rest assured that should later conditions warrant, Elbow Lake will not lack adequate rail transportation. The same applies to the power situation, for large water power is available for development within easy transmission radius of the entire mineralized belt.

Preliminary geological reports have been prepared by Professor Wallace, of the University of Manitoba, and E. L. Bruce, of the Canadian Geological Survey. These, with accompanying maps, can be obtained from J. O. Campbell, the Commissioner for Northern Manitoba at The Pas.

Copper Radiator Being Tested By New Cornelia

Tests are being conducted with an automobile radiator of copper by the New Cornelia Copper Co., at Ajo, Ariz. The work began more than a year ago, and improvements have been made from time to time. The cooling ability of the copper radiator has already been proved.

Wages Raised Following Strike in Tintic District, Utah

The Walkout on Feb. 15 Results in a Restoration of Scale Effective Before Reduction Was Made

Because of the reduction in wages of 50c. a shift on Jan. 16 in the Bingham Canyon and Tintic districts, Utah, with no reduction at Park City, the miners at the Eagle & Blue Bell and the Victoria mines, in the Tintic district, walked out on Feb. 11 for a 50c. increase in wages—that is, for the former wage scale in effect prior to Jan. 16. The Tintic Standard company was affected to a lesser extent, in that about 20 per cent of its men walked out, the others deferring action until their petition for a 50c. increase in wages with a reduction of 30 per cent in board charges was considered by the Tintic Standard management.

On Feb. 15 the Tintic Standard announced an increase in wages of 50c. a shift, as did also the Eagle & Blue Bell and the Victoria. The men at these properties returned to work. This increase made by the Tintic Standard and Eagle & Blue Bell necessitated a 50c. increase in wages by other Tintic mines, so that machine men now receive $4.25 per shift, instead of $3.75, which was in effect for about a month.

Properties whose operations are carried on largely by lessees—for example, the Chief Consolidated, Gemini, Ridge & Valley, Grand Central, and others—were affected to a lesser extent than some of the others, as there are a relatively smaller number of company employees. Whether Bingham will make a 50c. increase or not has not been determined to date.

Lambourne Heads New Company at Park City, Utah

Announcement has been made of the formation and financing of the Park City Mining & Smelting Co., of Park City, Utah, incorporated under the laws of Colorado, with an authorized capital of $7,500,000, divided into 1,500,000 shares of $5 each. Officers are G. W. Lambourne, president and managing director; Moylan C. Fox, vice-president; O. N. Friendly, manager; George S. Kruger, superintendent of mines; and D. C. Murphy, secretary. The Daly-West Mining Co., of Park City, Utah, will be taken over in exchange for treasury stock as soon as details can be arranged. This was authorized unanimously by Daly-West stockholders at a special meeting held in Denver recently. The stock in the Daly-West will be exchanged for 250,000 shares of Park City Mining & Smelting Co.'s stock on the basis of share for share in the Daly-West. The Judge Mining & Smelting Co. will be invited in the near future to transfer the property of that company to the Park City Mining & Smelting Co. upon an equitable basis. Other properties may be acquired.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

5,000 Companies Show Income of 10 to 16 Per Cent in 1919

Net Return on Invested Capital of 1,091 Gas and Oil Operators, 12.45 Per Cent

Companies engaged in mining and quarrying to the number of 4,708 that reported invested capital to the Bureau of Internal Revenue for 1919 had an income amounting to 10.15 per cent of that capital; 373 metal-mining companies show a net income of 16.26 per cent on invested capital; 1,091 gas and oil companies show a net income of 12.45 per cent on their invested capital. The Bureau of Internal Revenue of the Treasury Department on Feb. 20 released for publication a statistical compilation, just completed by the Bureau, of the income taxes paid by industries in 1919.

Altogether, 18,469 companies engaged in mining and quarrying made returns. Of this number, 13,197 reported no net income whatever. The detail of the compilation covering mining and quarrying is shown in the table.

CORPORATION RETURNS: DISTRIBUTION BY INDUSTRIES FOR THE UNITED STATES

Income Returned for the Calendar Year Ended Dec. 31, 1919

Industries	Total Number of Corporations	Corporations Reporting Net Income: Number	Net Income	Income Tax	War Profits and Excess Profits Tax	Total Tax	Corporations Reporting No Net Income: Number	Deficit
I Mining								
Coal mining	3,288	1,581	$99,142,382	$8,402,818	$9,298,252	$17,701,070	1,647	$23,748,867
Metal mining —								
Iron	119	47	3,829,527	325,442	292,362	617,804	72	1,444,507
Copper	241	29	10,490,792	916,619	7,226	923,845	212	10,051,758
Lead and zinc	192	35	9,502,566	833,879	162,962	1,046,841	157	2,695,184
Gold, silver and precious metals	516	122	5,195,635	478,786	101,278	580,064	394	10,829,485
All other mining	2,489	263	44,053,032	3,931,764	2,146,457	6,078,221	2,226	23,489,858
Non-metal mining:								
Oil	2,820	1,098	194,028,005	17,032,714	20,868,157	37,900,871	1,722	41,004,128
Gas	179	117	4,359,090	386,095	348,708	734,803	62	265,050
Salt, mines and other sources	40	23	3,968,041	354,105	361,204	715,309	17	266,962
All other non-metal mining	3,499	779	36,605,129	3,217,282	2,192,678	5,409,960	2,720	19,217,863
All other mining concerns, combinations and tributary industries	3,969	576	10,687,024	946,820	460,836	1,407,656	3,393	43,761,516
Total mining	17,292	4,670	$421,861,223	$36,876,324	$36,240,120	$73,116,444	12,622	$176,775,352
II. Quarrying.								
Stone	290	166	3,478,089	284,967	323,110	608,077	124	785,966
Clay, sand and gravel	538	295	3,466,992	268,406	298,146	566,552	243	1,410,730
Precious and semi-precious	17	13	1,499,263	116,339	307,079	423,418	4	6,689
All other quarrying	235	93	2,008,190	167,289	172,432	339,721	142	1,415,727
Total quarrying	1,080	567	$10,452,534	$837,001	$1,100,767	$1,937,768	513	$3,619,112
Mining and quarrying combinations, but main business not given	97	35	309,944	24,691	2,609	27,300	62	559,205
Grand total mining and quarrying	18,469	5,272	$432,623,701	$37,738,016	$37,343,496	$75,081,512	13,197	$180,953,669

Appropriations Bill Passed

The House has passed the Interior Department Appropriation bill with appropriations for the U. S. Bureau of Mines and the U. S. Geological Survey as recommended by the committee. A motion of Representative Carter, of Oklahoma, to abolish the offices of Surveyor General of Colorado, Oregon, Washington and Wyoming was defeated.

Appropriations for the mint and assay service for the year beginning July 1 are authorized in the Treasury Department appropriation bill, which has been approved by the President.

Product of Ore Treatment Not an Ore

A product resulting from a number of processes applied to an ore is not to be classed as an ore, according to a decision that has been handed down by the United States Court of Customs Appeals in the case of Tower & Sons *vs.* the United States. The question arose over an importation which was assessed by the collector of customs as oxide of cobalt. The importer contended that it should be admitted free as "cobalt and cobalt ore." The importation was in the form of a heavy grayish black powder. It was admitted that the product was a residuum remaining after the natural ore had been subjected to various treatments. The ore had been roasted, it was testified, to eliminate the arsenic. It then had been treated with an acid to concentrate its soluble components. A part of the residuum was precipitated, filtered, dried, and ground. The court held that, after these treatments, the product could not be classed as an ore. Incidentally, the testimony developed that it could not be classed as oxide of cobalt, as the analysis disclosed that it contained 28 per cent of oxide of nickel.

Blue-Sky Bill Hearings Over

Hearings on the Denison blue-sky bill closed before the House Interstate Commerce Committee recently, those appearing in favor of the legislation including Franklin Leonard, representing the New York curb market; G. S. Canright, of Madison, Wis., representing the association of securities commissioners; Roy C. Osgood, a Chicago banker, and George W. Hodges, of New York, representing investment bankers.

837 War Mineral Claimants Ask Rehearing

Quarter Million Award Recommended for Whitmarsh Mining Co. Crosby Claim Considered

Formal application has been made under the amended War Minerals Relief Act for a rehearing of 837 claims. In numerous cases efforts to locate claimants failed, and for that reason they received no official notification of the change in their status. It was possible to locate only thirty-five of the fifty one claimants whose cases had not been considered, on account of the fact that their original applications for relief were received too late.

The commission has recommended an award of $226,348.66 in the manganese claim of the Whitmarsh Mining Co. The company claimed net losses of $325,268.77. A recommendation for the payment of $22,517.77 was made in the companion claim of George H. Crosby. The original amount claimed in this latter case was $60,549.51.

Finance Committee Silent on Tariff Bill

Zinc, manganese, graphite, and mica are to be on the free list when the tariff bill emerges from the Finance Committee, it is stated on good authority. The members of the Finance Committee are making no announcements. They decline to confirm or deny the various rumors as to decisions the committee is said to have made. As any decision made in committee is subject to revision, it is difficult to ascertain with certainty what any schedule may be when the bill is finally reported to the Senate.

NEWS BY MINING DISTRICTS

London Letter

Globe & Phoenix Company's Ore Reserves—Gaika Gold's Policy Reversed—Esperanza Again Active

BY W. A. DOMAN

London, Feb. 7—Certain persons interested in the Globe & Phoenix Gold Mining Co. are becoming uneasy at the condition of the ore reserves. At the end of December the grade showed its first big drop for many years, being about 5 dwt. less than previously reported. As I have mentioned on a previous occasion, the ore reserves are now divided into "available" and "pillars," and the latest estimate of the "available" is that the grade is down nearly 8 dwt. Its tonnage is equal to about ten months' mill supply at the current rate. The ore in pillars cannot well be used until the mine is finished, and as it has to be removed slowly, say at the rate of about 2,500 tons monthly, it is probable that costs will be high and profits small. The loss in recovery may be regarded as about 5 per cent., and with gold at its present price—and the "premium" is running off—there will not be much surplus for dividends after the working costs, depreciation, and taxes have been met. Since the reserves were separated into "available" and "pillars," the figures have been as follows:—

	Tons	Contents, Ounces	Value, Dwt.
December, 1919			
Available ..	62,941	97,475	30.97
Pillars	45,241	78,216	34.58
December, 1920			
Available ..	47,380	62,753	26.49
Pillars	46,472	82,568	35.53
December, 1921			
Available ..	62,000	58,300	18.81
Pillars	48,000	81,800	34.08

The Gaika Gold Mining Co., another Rhodesian, is also in an interesting condition. The new directors are endeavoring to make their influence felt both financially and in a technical sense, and to a certain extent are reversing the policy of their predecessors. The latter had retained a large sum from profits and had invested it mainly in government securities upon which depreciation had left its mark. The financial resources amount to about £70,000, or about 50 per cent of the market price of Gaika shares. The new board is investing a portion of this in Rand mining and other shares such as New Modderfontein, Geduld, Springs Mines, Brakpan, and Union Corporation. The idea seems to be to earn a larger income. Several big shareholders are protesting, saying they would prefer to do their own speculation. The new chairman is of the opinion that the shares mentioned are not speculations but mining investments. The ore reserves at the end of the past three quarters compare thus:

June 30, 73,000 tons, valued at 13.2 dwt.

Sept. 30, 68,000 tons, valued at 13.0 dwt.

Dec. 31, 64,000 tons valued at 13.0 dwt.

The Gaika mine is an erratic property, and an extensive development program is to be undertaken.

After a period of quietness, the Esperanza is coming into the limelight again. For two consecutive weeks encouraging development cable dispatches have come to hand concerning the Descubridora vein, on the 5th level, north drift. For the week ended Feb. 2, the advance was 12 ft., the average width of the vein being 16 in. and the assay values 2.78 oz. gold and 52.53 oz. silver. This follows upon an advance of 24 ft. showing an average width of vein of 20.48 in., with assays of 2.68 oz. gold and 58.31 oz. silver. Winze No. 12 is fairly encouraging. The first 10 ft. of sinking disclosed the vein 15 in. wide assaying 0.91 oz. gold and 26.23 oz. silver; the next 30 ft. gave an average width of 26 in., and the gold content had improved to 2.16 oz. gold, and 27.70 oz. silver.

Freight Rate Cut Because of Water Competition

During a discussion of ore rates before the House Appropriations Committee, Representative Newton, of Minnesota, said, in advocating a $40,000,000 appropriation for improvement of the Mississippi and Ohio rivers: "The rate on iron ore from Minneapolis to St. Louis is 25½c. per 100 lb., carload lots. There is a shorter haul and better railroad facilities from Minneapolis to Kansas City than from Minneapolis to St. Louis, but there is no water route. The rate is 34c. from Minneapolis to Kansas City. That is done in order to cut under the Goltra Line. There is the difference between 25c. and 34c., the lower rate being on a railroad that winds along with the river for a long distance as against a higher rate for a shorter haul across the prairie to Kansas City."

Would Give Unreserved Lands to States

A bill ceding to the states the unreserved public lands remaining in them, and providing that the revenue from disposition of the land shall be divided into four parts, has been introduced in the Senate by Senator Bursum, of New Mexico. One fourth of the revenue is to be allotted to educational purposes, including schools of mines; a fourth to public roads; and a fourth each to public schools and to irrigation.

Johannesburg Letter

December Gold Output of Transvaal Drops—Decimal Coinage Proposed

BY JOHN WATSON

Johannesburg, Jan. 17—The gold output of the Transvaal mines for December was announced on Jan. 10 as 681,847 oz. of fine gold, which is a decrease of 22,389 oz. compared with the previous month. The greatest decrease, taking individual mines, was that of the Crown Mines, where a decline of 11,450 oz. was recorded, this being due of course to the strike which prevailed at that mine up to Dec. 5. The Ferreira Deep had a drop of 3,254 oz. compared with November, due to the underground fire and fall of rock, already reported. The price of gold for December has been calculated at £4 15s. 6d. per fine ounce, as against £5 10s. for September. Owing to the fall in the price of gold and the above noted causes, the decrease in value of the December output was equal to £335,784. For the year 1921, the total gold output of the Transvaal was 8,114,586 fine ounces, having a value of £42,017,350. This is a decrease in weight of 39,586 oz., and in value of £1,090,734, compared with the year 1920.

The decimal system of coinage may soon be adopted in the Union of South Africa. At a joint meeting of the scientific and technical societies held in Johannesburg some years ago, the majority of members were in favor of this system. We now learn that it is understood that during the ensuing parliamentary session, the government will introduce a bill to establish the decimal coinage system. A sovereign now represents 240 pennies, or 960 farthings. In the new system the sovereign will represent 1,000 farthings (or cents). The florin or 2s. piece will be continued; but the half-crown will disappear. A florin will be worth 100 cents and will be divided into a half-florin (50 cents) and a quarter-florin (25 cents), roughly representing our present shilling and sixpence. This secures the decimal system, with little deviation from the present. Instead of silver "tickeys" (threepennies) there will be nickel coins worth 10 and 5 cents. These will, of course, differ slightly from our pennies and halfpennies, as 1,000 cents will equal in value 960 farthings.

The unfortunate strike still continues, both at the collieries of the Transvaal and at the gold mines of the Witwatersrand. A conference is being held daily, to discuss the possibilities of a settlement. It is estimated that the direct and indirect loss daily sustained by workers and the community during the first week of the strike will be as follows: Employees' loss of wages, £35,000 per day; employers' direct loss, standing charges and natives' expenses for first week, £35,000 per day; community's direct loss, amount expended by mines in wages, stores, and fixed charges, £9,000 per day. If the strike continues after the first week the direct loss to the employers will be reduced by reason of the repatriation of many of the time-expired natives.

CANADA

British Columbia

Premier Acquires Control of B. C. Silver Mines, Ltd.—Cork Province Mine To Improve Power Plant

Stewart—Particulars have been published of negotiations under the terms of which the Premier Mining Co. acquires control of the holdings of the B. C. Silver Mines, Ltd. These consist of seventeen Crown-granted claims and fractions adjoining the Premier company's property. The Premier has obtained over half a million shares of the B. C. Silver Mines, paying more than $100,000 for them. The British Canadian Silver Corporation, Ltd., a British company, controls the issued stock of the B. C. Silver Mines, Ltd., and has an option on all the treasury stock, for which the consideration was 800,000 fully paid-up shares in the British Canadian Silver Corporation. The latter corporation is capitalized at £400,000 sterling in 5s. shares, of which 1,000,007 shares are issued and fully paid up. The company's head office is at 19 St. Swithin's Lane, London, England. The British Columbia offices of the company are in the Pacific Building, Victoria.

The aërial tramway to the Silverado group, on Portland Canal, is ready for operation. A snow trail has been constructed from the lower terminal to tidewater. With these facilities considerable high-grade ore, now ready, will be shipped. Plans are being made fore next season's development work.

A permanent bridge is to be constructed by the Provincial Department of Mines across the Bear River, replacing that which was washed out by recent floods. This will assure ready access to the mineral properties of the upper Bear River and its tributaries.

Alice Arm—The Lion Group of claims, situated near the town of Alice Arm, has been found to carry several small veins of high-grade ore, which were uncovered in crosscutting at a distance of 100 ft. from the surface. One hundred tons of high-grade ore taken from the Esperanza mine is ready for shipment.

Kaslo—Improvements are to be made to the power plant of the Cork-Province mine, to permit the mine and mill to be operated throughout the year. No work was done last year.

On the Bell group, Wallace Mountain, a promising vein of ore has been uncovered. A shipment is being prepared for the Trail Smelter.

Quesnel—Placer ground on Cedar Creek, which was found to contain good values last summer, has been bonded to outside interests, the intention being, it is stated, to undertake development during this year's open season. The Del Ecuador Mining Co., Ltd., has also acquired holdings in the same locality, and is reported to be arranging to put a dredge to work as soon as weather permits. Hydraulicking is to be undertaken soon by the Cariboo Goldfields, Ltd., on Roses Gulch.

Rossland—Operation of Le Roi No. 2 (Josie) mill has been suspended because of cold weather. Word has been received from Ottawa that the Railway Commission has no jurisdiction over the Great Northern branch line extending from Rossland to Northport, Wash., nor any part of it. A successful conclusion of the efforts now being made by local interests to prevent abandonment of the branch line, at one time noted for its heavy ore traffic, appears to be remote. The railway company has announced that it is willing to turn all right of way, bridges, and grade over to the provincial and Washington state governments for highway purposes.

Sandon — The output of the Silversmith mill in January amounted to 350 tons, or a total of ten cars, which were shipped to the Bunker Hill smelter, at Kellogg, Idaho. Concentrates run 67 per cent lead and 106 oz. silver. The February output will, it is estimated, total about 400 tons of concentrates and crude ore.

Three Forks—It is expected that a tramway will be put in by McAllister Mines, Ltd., from the north fork of Carpenter Creek to the company property this season.

Ainsworth — Advices from Spokane are to the effect that the Lakeshore Mining Co., owning property adjoining the Florence mine, has completed arrangements in the East for financing, and that a resumption of extensive development operations may be expected in the near future.

Poplar—A Ross gold mill and crusher have been installed at the Bullock Gold Mines property.

Trout Lake — Plans are being made for a resumption of operations on Silver Crown Mining Co.'s property near here.

Kaslo — The first shipment made by the new lessees of Utica mine ran 157.7 oz. silver, 14.6 per cent lead, and 24.6 per cent zinc.

Tax on Asbestos Reduced

The asbestos companies of Quebec province have been urging the remission of the 5 per cent royalty on asbestos on the ground that the industry is now much depressed. On Feb. 7, the Hon. J. E. Perrault, Minister of Mines, made the announcement that the government had reduced the tax on asbestos mined for export from 5 to 3 per cent for a term of four months, and to 2 per cent on asbestos manufactured within the province.

CALIFORNIA

The Engels Controversy—Power Rates Being Investigated—Water Abundant for Next Season

San Francisco Correspondence

San Francisco—Henry Engels, president of the Engels Copper Mining Co., in an endeavor to influence proxies, has issued various circular letters in which it is alleged that the management of E. E. Paxton was responsible for a cave-in of the upper workings of the Engels mine and that the present policy of marketing copper concentrates at Garfield, Utah, could be improved. Various criticisms of existing methods are also made. During the slump in the copper market, the Engels property was operated at a nominal loss and is now in excellent condition, both in development of ore reserves and in amount of broken ore and stopes ready to produce. From a diffused policy, there has been a definite compacting of facilities, a successful campaign to increase ore reserves, and a broad policy of exploitation that has placed the property in excellent condition.

The recent storms have materially added to the snowfall in California, and on Feb. 10 there was 122 in. of snow at Summit. This indicates an abundance of water for the ensuing season.

The California Metal and Mineral Producers' Association is making an investigation of the power rates in force in California in relation to the mines and dredges served by hydro-electric companies. H. G. Butler has been retained by the association to represent the interests of those engaged in the mining industry in the general rate cases now pending before the state Railroad Commission. The hearing has for its purpose the fixing of just and reasonable rates for electric service.

According to local reports, the Tonopah Mining Co. will take over the Alabama group of mines, on the Mother Lode west of Jamestown, in Tuolumne County, for exploration purposes. The Nevada Wonder, another Nevada mining company, is reported to hold an option on the Chileno, on Jackass Hill, in the Tuttletown district. The Belmont Mining Co. has operated for some time the Shawmut mine, near Chinese Camp. The entry of three successful mining companies into the Mother Lode region is significant.

Plymouth—Raymond Rodriguez was killed recently in a shaft accident at the Plymouth Consolidated. Henry Lee, a skip tender at the Plymouth, was seriously injured by a falling rock.

Angels Camp—Local reports indicate that an important strike has been made at the Victor gravel mine. The gravel is cemented, and milling will be necessary. Preparations are being made to install the necessary equipment.

Sutter Creek—Reports from the Central Eureka mine by A. S. Howe are to the effect that most of the steel for the new headframe has been received and the heavy work of erecting the hoisting equipment has been completed.

NEVADA

Tonopah Extension Recovers Anchor Vein—Ben Hur Leases Divide Junior

From Our Special Correspondent

Tonopah—Tonopah Extension reports the recovery of the Anchor vein on the 1880 level from the Victor shaft. The vein was cut off going west by a rhyolite dike and where picked up in the crosscut is about 6 ft. wide and carries good ore. Development work on the orebody recently found on the 900 level of the Halifax mine has been temporarily checked while making an air connection with a raise from the 1,000 level.

Divide—The Ben Hur company has secured a three-year lease on the property of the Divide Junior Mining Co. and on a portion of the Verdi Divide ground, and development work will be prosecuted through the Keystone shaft by agreement with this company. The shaft is now 435 ft. deep and will be sunk to the 500 level. Work will also be done from the 200 level. The 1,300 station of the Tonopah Divide mine is practically completed, and shaft sinking will soon be resumed. For the week ending Feb. 8 development totaled 97 ft., the principal work being done on the 2d and 10th levels.

Goldfield—The shaft of the Goldfield Deep Mines Co. is down 1,135 ft. No change has been anounced in the original plan to sink to the 2,400 level before any lateral development work is done.

Rochester—The January production of the Rochester Silver Corporation was below normal, the gross production being $43,483 from 3,972 tons of ore. The reduced output was due in part to adverse weather conditions. A recent discovery in an east crosscut on the 900 level may prove of importance. The vein met, which is in virgin territory, is said to be 5 ft. wide and to assay $12 per ton.

Virginia City—Construction work on the plant of the United Comstock Mines Co. is making satisfactory progress. In the main drainage tunnel there is still about 400 ft. to drive between the Knickerbocker and Belcher shafts. The ground is heavy and wet and progress is slow. Lateral tunnels and raises for mining purposes are being driven and all preparations made for mining by the caving system. The orebody on the 200 level of the Imperial is said to be over 200 ft. wide. At the Middlemines all preparatory work has been completed and drifting started from the Hale and Norcross tunnel.

Pioche—The reduced freight rates became effective on Feb. 7, and are expected to increase materially the volume of ore shipped from the district. At present the Pioche district is the only shipping point granted more favorable freight rates as a result of the conference held at Carson City last November. During the week ended Feb. 10, the Bristol Silver Mines Co. shipped 75 tons and the Black Metals mine, at Jackrabbit, 150 tons.

COLORADO

Randolph Company, at Georgetown, To Build 250-Ton Mill

Idaho Springs—The Silver Cycle Mining Co. is advancing the Wyoming Valley tunnel under contract, to cut the veins of the Gold Medal group. The installation of a new compressor plant is under consideration.

The Brazil property has been sold to B. J. Jeffry and associates, of Long Beach, Cal. The main adit level, which has been advanced about 800 ft., will be continued, and other development work will be undertaken during the month of April.

The Gem Mines Co. has completed a raise from its 1,600 level to the upper workings of the Silver Age and Freighter's Friend mines, and mining operations in this territory will be resumed in the near future.

Georgetown—The Randolph Mining Co. has arranged to erect a 250-ton mill, to be constructed of steel and concrete. The equipment will be supplied by the Denver Engineering Works Co.

Telluride—Shipments of concentrates during January were as follows: From Smuggler-Union, 85 cars to Durango, and 3 cars to Leadville; Tomboy, 55 cars; total 143 cars.

UTAH

Weekly Shipments From Park City Increase; Those From Eureka Drop

Park City—Ore shipments for the week ended Feb. 10 amounted to 2,354 tons, compared with 2,158 tons the week before. The shippers were: Judge allied companies, 1,328 tons; Silver King Coalition, 602; and Ontario, 324 tons.

Eureka—Shipments for the week ended Feb. 10 amounted to 136 cars, compared with 156 cars the week preceding. The shippers were: Tintic Standard, 46 cars; Chief Consolidated, 41; Grand Central, 17; Eagle and Blue Bell, 9; Victoria, 6; Iron Blossom, 7; Centennial Eureka, 3; Alaska, 2; Swanson, 2; Gemini, 1; Bullion-Beck, 1; and Colorado, 1.

The annual report of the Chief Consolidated for the year 1921 showed that the average value of the ores mined was $41.89 gross and the average net value $23.24. The average ore carried 0.0467 oz. gold, 34.97 oz. silver, 16.47 per cent lead; and 1.32 per cent copper. The total tonnage produced was approximately 94,000, or 10,837 tons more than the largest previous production. Development totaling 7.8 miles was done. During the year the company obtained an option on the Grand Central mine, at Mammoth, and exercised this option on Jan. 7 of this year. It also acquired control of the Apex Standard Mining Co., Eureka Lilly, and East Tintic Consolidated near the Tintic Standard, in the eastern part of the camp. Net profits for the year were $336,998.

WASHINGTON

Iron Creek Mine Now Producing—Pyrargyrite Mill To Be Started

From Our Special Correspondent

Keller—The Iron Creek Mining Co. is now on a producing basis. It is mining ore averaging 10 to 20 oz. silver, which goes to a twenty-ton stamp mill equipped with tables and cyanide tanks. A recovery of 80 per cent is reported. Of this 15 to 20 per cent is made on the tables and the remainder by cyanidation. The ore occurs as replacements in limestone and is badly oxidized. J. E. Angle is manager.

Nighthawk—The Pyrargyrite Mining & Milling Co. expects to resume operation soon at its seventy-five ton concentrator. Development work has been under way at the mine, and a carload of crude ore recently shipped to the Bunker Hill smelter yielded 100 oz. of silver to the ton.

Tacoma—The Tacoma smelter is receiving an increasing tonnage of ore from the north, now that the tramway connecting the Premier mine, in the Portland Canal district, with Stewart, B. C., is in operation.

Oroville — A shipment of crude ore from the Ruby mine to the Bunker Hill smelter, made this winter, returned over 100 oz. silver to the ton. The mill on this property is not now in operation, but it is expected that milling will be resumed this spring.

OREGON

Blue Mountain Company Sells North Pole Property

Baker—The Eastern Oregon Mining Co. has sold its North Pole property to the Blue Mountain Mining Co., and it is officially announced by Dr. Sowder, manager of the last-named company, that his company has taken possession and will operate the North Pole in conjunction with the E. & E. mine. The North Pole is on Cracker Creek, near Bourne, and about eight miles from Sumpter. Alexander Baring, of London, was the principal owner.

Homestead—It is reported the Iron Dike mine, which produced heavily for a number of years, and which has large reserves of milling ore, will resume operations this year.

SOUTH DAKOTA

Work Resumed at Anaconda Gold Mining Co.'s Prospect

Deadwood—Work has been resumed at the property of the Anaconda Gold Mining Co. near Roubaix. The shaft, which was started a few years ago and which had reached a depth on a trifle over 100 ft., is being continued, and it is planned to sink to 500 ft. When this depth is reached connections will be made with the Shaft No. 1. Buildings have been erected for the accommodation of employees, and the work will be continued until the lower depth is reached. (This property is not to be confused with the important Anaconda Copper Mining Co.)

ARIZONA

Calumet & Arizona Reported Entering Jerome District on Larger Scale—U. V. Extension Starts Operations

By JAMES H. McCLINTOCK

Jerome—Rumors are afloat to the effect that the Calumet & Arizona is entering the local field to a greater extent and is seeking to add the Calumet & Jerome and the Shea properties to the Verde Central and the Gadsden, both of which it now controls. It is pointed out that the Calumet & Jerome is so situated as to give Verde Central an outlet at depth. Verde Central is installing a new surface plant. Pending installation, a winze hoist is being used on the 600 level, so that sinking of the main shaft will not be delayed. Crosscutting on the 600 is to be started as soon as a new pumping plant can be put in operation.

It is also rumored that in Jerome Verde ground an important orebody has been cut by diamond drilling and that drifting will be started to it soon. This development is being prosecuted at depth in United Verde Extension, which is now in control of Jerome Verde holdings.

United Verde Extension has started one reverberatory at Clemenceau after heating for a week. About 30,000 tons of ore and 10,000 tons of flue dust and other waste are on hand for treatment, and it is expected that there will be no material increase of mining operations before April 1. The company's stock of blister in the smelter yard has been reduced to about 175,000 lb.

United Verde has been churn drilling six holes for blasting operations ahead of the steam shovels that will open up the old upper levels of the mine. The old office building, outside the former smelter site, has been demolished, as the ground it stood upon will be removed by the shovels.

Tucson—In the Superior Court, default judgment for $44,572 has been given J. H. Huntsman in his suit against the Dos Cabezas Gold Ridge Mining Corporation. In evidence were six promissory notes, signed for the corporation by J. H. Huntsman, as president, and W. A. Julian, as secretary.

In the Federal Court, on demurrer, a $20,000 damage suit against the New Cornelia company has been dismissed. The action was based on the death of José María Ochoa, in November, 1918, due to injuries from a powder explosion on the ground of the defendant company at Ajo.

TEXAS

Shipments of Sulphur Heavy

Sulphur exports from Texas City during January were 63,774 tons, according to the Texas City Terminal Railway Co. This includes shipments to Australia, British Columbia, Germany, North Atlantic ports, Pacific ports, Spain, and the United Kingdom. In addition, a large tonnage was also exported from Galveston.

JOPLIN-MIAMI DISTRICT

Missouri-Kansas-Oklahoma

Applications Made for Leases on Indian Lands—Missouri Section More Active

By P. R. COLDREN

Joplin—Much interest is being manifested in this field by the applications for leases that have been filed with the Indian agency at Miami and which now must go to the Department of the Interior at Washington. A number of such leases have been applied for, these in most instances being applications for renewals of leases that applicants have had for some years.

George W. Beck, Jr., S. C. Fullerton, ad W. W. Dobson have applied for a lease on the Mary Whitebird tract of 236 acres, offering $16,000 bonus. They also have applied for the Harry Crawfish 160-acre tract, offering $10,000 bonus. In each proposition 25 per cent of the amount offered accompanies the application.

George W. Beck, Jr., has applied for a lease on the Joseph Whitebird tract of 200 acres and the Eudora Whitebird tract of 160 acres, offering $14,000 and $10,000 bonus, respectively.

J. W. Roberts, Homer Seals, and W. H. Walker have applied for a lease on twenty acres of land on the Federal Lead & Zinc Co.'s tract, and this same copartnership is planning to take over the Big Chief mine, which includes a forty-acre tract just north of the town of Picher.

Mining activity on the Missouri side of the field has been considerably increased in the recent weeks, notably by the starting up of the Connecticut Zinc Co.'s Circle mine, at Oronogo, with the intention of making a big tonnage. In addition to this, the Center Creek properties, at Webb City, are producing in a small way, and the Barnsdall company, at Waco, continues to be a heavy producer. During 1921 this company, with its three mines at Waco, was the heaviest producer in the field. Two of the mines are on the Kansas side of the line and the other mine, though only a few hundred yards distant, is on the Missouri side.

Records of operations show that more mines are now producing in the field than at any time in the last ten months. On June 10, 1921, only 41 mills were operating. By June 14 there were 50, but the number fell back to 39 by June 23, and on June 25 there were only 37 in operation. This was the low point. By Sept. 3 the number has increased to 45, and by Nov. 16 to 53. On Dec. 20 it was 66, on Jan. 11 this year 73, and on Feb. 11, 75.

The increase in activity does not imply a corresponding increase in production, however, as some of the larger mines have started cutting some of their thinner dirt and are not making so much ore. At one mine the dirt a month ago showed 50 per cent lead ore, but it is now showing only 4 per cent lead, and it is possible that it may be closed down.

MICHIGAN

The Copper Country

Copper Range Output Near Normal Quincy on 75 Per Cent Basis

By M. W. YOUNGS

Houghton—The coming of spring will witness the usual exodus of many underground workers to the farm. They may be largely replaced by miners from other districts or former residents who will return with the general resumption of mining in the district on April 1, but the labor turnover will be considerable, and all producing properties will do well to maintain an even force.

Copper Range Consolidated is now close to normal in refined-copper production. Present output is at the rate of 36,000,000 lb. per year, which is not far short of the average yearly production in the years prior to the war. Forty million pounds may be fairly taken as the normal output, refined. Production in 1915 and 1916 was unusually high, owing to the demand for copper in those years for war purposes. The output in each year was approximately 53,000,000 lb., but this was capacity production and not representative of output in years of normal market conditions.

Quincy, which normally produces about 20,000,000 lb. per year, is on a 75 per cent basis, and probably will not increase this rate of output for some time. This company, however, is in a position to bring about a sharp reduction in costs when there is a return to normal production, which course will be governed by improvement in the demand for copper. Notable improvements have been made at mine, mills, and smelter. The powerful new hoist installed a year ago at No. 2 shaft has not been pressed to capacity because of curtailed production, and as a result has not yet demonstrated its actual worth. This also applies to the new furnace at the smelter.

Mohawk and Wolverine are practically at capacity production. Mohawk is shipping about 2,300 tons of rock daily and Wolverine is averaging 900. The average yield is close to 23 lb. to the ton. An extensive program of opening work is under way in all shafts. Pillar mining and stope extensions in Wolverine are yielding rock running approximately 15 lb. to the ton in metal content.

The annual meeting of Arcadian Consolidated was held at Houghton on Feb. 14. One change was made in the board of directors, B. F. Bartholomew succeeding S. T. Everett, deceased. Both drifts, north and south, on the 1,100 level, recently reached, are in good mineralized ground. The south drift from the 942 level also continues in good copper rock.

The recent reduction of freight rates on refined copper to New York, amounting to 33⅓ per cent, effects the saving of one-fifth of a cent a pound. The reduction in rates was made effective Feb. 13.

THE MARKET REPORT

Daily Prices of Metals

Feb.	Copper, N. Y., net refinery* Electrolytic	Tin		Lead		Zinc
		99 Per Cent	Straits	N. Y.	St. L.	St. L.
16	12.75@12.875	29.50	30.50	4.70	4.40	4.475@4.50
17	12.75	29.375	30.375	4.70	4.40	4.475@4.50
18	12.75	29.375	30.375	4.70	4.40	4.475@4.50
20	12.625@12.75	28.625	29.625	4.70	4.40	4.475@4.50
21	12.625	28.25	29.25	4.70	4.40	4.475@4.50
22	....	....	.....	.....	.....	....

*These prices correspond to the following quotations for copper delivered: Feb. 16th, 13@13.125c.; 17th and 18th, 13c.; 20th, 12.875@13c.; and 21st, 12.875c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Feb.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
16	60½	61½	66	149	151	20½	20½	24	24⅝
17	60	61	66	148¼	150¼	20⅛	20¼	24	24½
18							..	...	.
20	58	59	64½	144	146	19⅞	19⅞	24	24½
21	58	59	63½	140	141¾	19½	19½	24	24⅜
22	57½	58½	63½	140⅛	142¼	19⅝	19⅝	24	24⅜

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Feb.	Sterling Exchange "Checks"	Silver			Feb.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
16	434½	99⅝	65½	33⅞	20	438½	99⅝	64⅞	33⅜
17	434½	99⅝	[illegible]	34⅛	21	[illegible]	99⅝	65⅛	33⅝
18	436½	99⅝	64⅝	33¼	22	...	...	..	33⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Metal Markets

New York, Feb. 21, 1922

The inactivity in the local metal market has continued during the last week, although sales of lead have been somewhat larger than usual. Prices of copper and tin are lower, but zinc and lead have held steady. Producers are generally inclined to be optimistic and feel that the spring demand cannot be postponed much further.

Copper

Those who are interested in copper mining are wondering how much farther the present decline is going to run. Many thought that increased buying at the 13c. level would arrest the movement at that point, but they have been disappointed. With present conditions—that is, several producers attempting to market current production regardless of prices—the only thing that will make conditions better is a resumption of buying. It is generally felt that the spring demand for metal for second-quarter use should manifest itself certainly by the first of March, as there has been little buying of copper since December.

Sales for the last week have been of exceedingly small proportions. Consumers showed no inclination to avail themselves of copper in any quantity at the 13c. delivered level, which was generally quoted on Friday and Saturday of last week. It was therefore necessary to shade this price, and copper could be obtained from several sources today at 12.875c. delivered, with a possibility of shading even this price for attractive orders where the delivery charge was not high. A feature of the market during the last few days has been the induction of the Anaconda interests into the buying field. This, of course, results from the fact that the American Brass Company requires more copper than Anaconda produces.

Export business has been small, although a moderate amount of inquiry from the Far East has been encouraging.

Copper for forward delivery can be obtained at approximately the same prices as for prompt and near by.

Lead

The official contract price of the American Smelting & Refining Co. remains at 4.70c. Lead can also be obtained from several other interests at this figure for New York delivery. Lead has been sold in considerably larger tonnage during the last week than for some time, although not all producers have shared in the business. Consumers seem to be enjoying a satisfactory demand for their products. Corroders evidently expect an excellent demand for paint during the spring and summer, judging by the amount of lead which they are taking. The battery manufacturers are also taking a great deal more lead than at this time last year. In fact, demand for lead from battery makers promises to be larger in the current quarter than for any quarter last year. The lead-covered cable business is also fair, the telephone companies taking increased amounts. There is also a fair demand from cartridge makers. Just at present, production and consumption seem to be almost evenly balanced. However, during the last week a new factor has projected itself into the situation. With the continued decline in London, which has now carried the price well below £20, the importation into the United States of Mexican lead becomes a factor which must be considered. The advantage of selling foreign lead in this country is not yet marked, but should the London price decline further, all of the Mexican lead at least would be marketed here. Should the demand continue to improve, this lead could easily be taken care of, and no price decline would be likely to ensue. It is probable that this condition will obtain.

Most of the sales during the last week have taken place in the New York market, and there has been a disposition to shade the usual premium for corroding grades. The St. Louis market is quiet, with most producers quoting

4.40c. There seems no disposition to unload lead on the Middle Western market in excess of the requirements.

Zinc

Zinc has been exceedingly quiet, with many producers refraining from quoting at the present price. The general quotation is 4.50c., but 4.475c. has been done on a limited number of sales. The market seems steady at current levels.

Tin

The London price of tin is the lowest since October, 1914, but when judged by the gold equivalent the situation is not quite so bad as that would indicate. The local tin market has also declined, but the higher sterling rates have helped the situation somewhat. Buying has been fair in volume, with a somewhat unusual activity among both consumers and dealers today, which forced the price up about ½c. from the morning quotations.

Tin for May delivery was quoted as follows:

Feb. 16th, 30.25c; 17th, 30c.; 18th, 30c.; 20th, 29.25c.; 21st, 29c.

Arrivals of tin, in long tons: Feb. 14th, Hongkong, 5; 15th, Straits, 10; China, 10; 16th, London, 100.

Gold

Gold in London: Feb. 16th, 95s. 7d.; 17th, 95s. 7d.; 20th, 95s. 4d.; 21st, 94s. 9d.; 22d, 93s. 10d.

Foreign Exchange

European exchanges have been generally strong and higher. On Tuesday. Feb. 21, francs were 9.125c.; lire. 5.02c.; and marks, 0.455c. New York funds in Montreal, 2¾ per cent premium.

Silver

The market has continued quiet, with all the support coming from Indian bazaar buying. China's position is still that of a seller, and America has also sold in London. San Francisco reports no business, and the volume in New York is small. The market closes uncertain.

Mexican Dollars—Feb. 16th, 49¾, 17th, 49¾; 18th, 48¾, 20th, 49¾, 21st, 50.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 4 40c.; market dull. W.C.C. brand, 5⅜@5½c. per lb. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6¼@7c.

Arsenic—7½c. per lb. Strong.

Bismuth—$2@$2.10 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Iridium—Nominal, $170@$190 per oz.

Nickel—Standard market, ingot and shot, 41c.; electrolytic, 44c. Small tonnages, spot, nominal at 32c.

Palladium—Nominal, $55@$60.

Platinum—$85@$90 per oz.

Quicksilver—$48 per 75-lb. flask. San Francisco wires $47.30. Firm.

The prices of **Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of Feb. 4.

Metallic Ores

Bauxite — American, crushed and dried, $6@$8 per gross ton; pulverized and dried, $12@$14 per gross ton; calcined, $20@$22 per gross ton, all f.o.b. shipping points. Foreign bauxite offered at $6@$8 per metric ton, c.i.f. Atlantic ports, depending upon grade.

The prices of **Chrome, Manganese, Tungsten, Molybdenum, Tantalum, Uranium, Vanadium, and Iron Ore, Zircon and Zirkite** are unchanged from the prices in the issue of Feb. 4.

Zinc and Lead Ore Markets

Joplin, Mo., Feb. 18—Zinc blende, per ton, high, $30.45; basis 60 per cent zinc, premium, $27@$26; Prime Western, $25@$24; fines and slimes, $23; average settling basis, all blende ores, $27.16.

Lead, high, $64.55; basis 80 per cent lead, $60; average settling price, all grades, $62.49 per ton.

Shipments for the week: Blende, 5,723; lead, 1,834 tons. Value, all ores the week, $270,070.

All efforts on the part of buyers to break the holding price for blende continue to fail, but week after week purchases grow less, with only 5,880 tons sold this week.

Federal Lead continues to take the bulk of the lead output by maintaining the basis at $60, at which prices others are not caring to fill large orders.

Platteville, Wis., Feb. 18—Blende, no sales. Lead ore, basis 80 per cent lead, $60 per ton. Shipments for the week: Blende, none; lead ore, 32 tons. Shipments for the year: Blende, 1,703, lead ore, 489 tons. Shipped during the week to separating plants, 487 tons blende.

Non-Metallic Minerals

There are no price changes from those indicated in the market report of the issue of Feb. 4 covering **Asbestos, Barytes, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur** and **Talc.**

Mineral Products

The prices of **Copper Sulphate, Potassium Sulphate, Sodium Nitrate** and **Sodium Sulphate** are unchanged from the issue of Feb. 4.

Ferro-Alloys

Ferromanganese—Domestic, 78 to 82 per cent, $59@$60, f.o.b. furnace; English and German, $62.50, c.i.f. Atlantic seaport. Spiegeleisen, 16 to 19 per cent, $30 per gross ton, f.o.b. furnace; 19 to 21 per cent, $35, stronger.

Ferrovanadium—$4 per lb. of V contained, according to analyses and quantity.

The prices of **Ferrotitanium, Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotungsten** and **Ferro-uranium** are unchanged from the issue of Feb. 4.

Metal Products

Nickel Silver—26.75c. per lb. for 18 per cent quality Grade "A" sheets.

Yellow Metal — Dimension sheets, 17.25c.; sheathing, 16.75c.; rolls, ⅝ to 3 in., 14.75c.

Copper Sheets—Current New York list price, 20.25c. per lb.; wire, 14.50@14.75c.

The prices of **Lead Sheets and Zinc Sheets** are unchanged from the issue of Feb. 4.

Refractories

The prices of **Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick,** and **Silica Brick** are unchanged from the issue of Feb. 4.

The Iron Trade

Pittsburgh, Feb. 21, 1922

Demand for steel has continued to broaden in a satisfactory way, viewing the tonnage in the aggregate, as ingot production is now at between 26,000,000 and 28,000,000 tons a year, the rate at the end of December having been under 18,000,000 tons. Last autumn's rate, the best since early in the year, was 23,000,000 tons. Production in 1921 aggregated about 19,500,000 tons, so that the industry is now doing about 40 per cent better in tonnage.

Steel prices are uneven, with the exception of sheet prices, and further assurance of the steadiness of this market is the opening of order books yesterday by the American Sheet & Tin Plate Co. for second quarter at unchanged prices, 2.25c. for blue annealed, 3c. for black, and 4c. for galvanized. Bars, shapes, and plates are now more commonly done at 1.40c. than at 1.50c., and nails go more at $2.40 than at $2.50

Pig Iron—Furnaces are now firm on basis at $18, Valley, and indeed are nominally quoting $18.25. The $18 price was paid by the Allegheny Steel Co. on 1,000 tons. The Standard Sanitary Manufacturing Co. has bought upward of 1,000 tons of foundry iron for each of its three plants, getting the southern iron, for Louisville, at $15, Birmingham, a new low price, and paying $18.75 to $19, Valley basis, for the northern for the other two plants. Bessemer remains at $19.50, Valley.

Coke

Connellsville — Furnace, $2.85@$3; foundry, $3.75@$4.25.

The Porphyry Coppers' Past and Future

By F. E. Calkins

Written for Engineering and Mining Journal

TECHNICAL and financial results of operations of the so-called porphyry copper mines of the United States from the beginning of operations to Dec. 31, 1920, are summarized in the accompanying table. Following are the names of companies covered by this record, the situation of the mines, and general method of mining employed:

Utah Copper Co., Bingham, Utah; steam shovel. Nevada Consolidated Copper Co., Ely, Nev.; steam shovel and underground. Chino Copper Co., Santa Rita, N. M.; steam shovel. Ray Consolidated Copper Co., Ray, Ariz.; underground. Miami Copper Co., Miami, Ariz.; underground. Inspiration Consolidated Copper Co., Miami Ariz.; underground. New Cornelia Copper Co., Ajo, Ariz.; steam shovel.

This group of mines has become an increasingly important factor in the world's copper production, and, before the general shut-down early in 1921, was contributing about one-third of the annual production of the United States and 20 per cent of the world production. In the future, including the operation by the Detroit branch of Phelps Dodge Corporation and the Arizona Copper mine at Morenci, which are now really porphyry mines; the recently developed Sacramento Hill at Bisbee, Ariz.; the further exploitation of the Braden, Chile, and Andes mines, in Chile, and the probable discovery of new deposits, this class of large, low-grade copper deposits will eventually occupy the dominant position in the copper production of the world.

The ore from the first six mines mentioned is concentrated by combined gravity and flotation methods, the concentrate smelted, and resulting blister cópper electrolytically refined. Ajo has thus far operated only on oxidized ore, which is treated by leaching and electrolytic precipitation, producing electrolytic copper direct and some cement copper, which is smelted. In the following discussion only the first six mines are referred to unless Ajo is specifically mentioned.

Under "Ore Reserves," the figure for Inspiration is obtained by subtracting tonnage mined from originally estimated tonnage, as no figure has been published recently. It is probable that none of the mines has completely exhausted its possibilities for developing new ore.

The next column gives the estimated percentage of copper in ore reserves at the time of beginning operations, since which time much additional ore has been developed and lower-grade material has been included in the calculations. The discrepancy between these figures and those representing percentage of copper in ore milled has been due to the combined effect of three factors: unavoidable sampling error, dilution by waste rock in mining, and deliberate mining of lower-grade ore that was not included in the original estimates, but which it was later found could be mined at a profit.

Averaging results at all the mines, it is seen that the mill recovery has been 69.1 per cent and the mill and smelter recovery—that is, the net recovery in fine copper—has been 66.8 per cent, or almost exactly two-thirds, the other third being represented by mill and smelter losses. The average recoveries for the future will greatly exceed these figures. A considerable part of the total tonnage was treated before the advent of the flotation method, with its higher recoveries. Furthermore, although the ores thus far mined have been classed as sulphide ores, they have all contained a considerable proportion of copper in the form of oxidized copper minerals, of which it has been possible to recover only a small percentage, perhaps 30 per cent, by either gravity or flotation methods. Although some of the mills have been able to save 90 per cent or more of the sulphide copper, the low recovery of the oxide copper has reduced the total recovery to a much lower figure.

Recoveries are even now considerably in excess of past averages. For the year 1920 the mill recoveries at Utah, Ray, and Miami were all over 81 per cent, the recovery at Miami being 82.5 per cent, and the average for all six mines was 76.7 per cent, as compared with the past average of 69.1 per cent. Some of the mines will probably eventually attain a net recovery in fine copper of over 85 per cent and the future average for all the mines over the remainder of their life may exceed 80 per cent, as compared with the past average of 66.8 per cent.

The figures under "Total Profits" are the actual profits, that either went into dividends or to building up working capital, and are obtained by adding total dividends to net quick assets as of Dec. 31, 1920. Subtracting the resulting profit per pound of fine copper from the price received gives the cost per pound. This cost is credited with gold and silver proceeds and miscellaneous income and includes all construction and extraordinary development expense that was paid out of earnings. All the mines but Inspiration have increased their capacity from earnings, that company having built its plant to the desired capacity from original capital. Construction expense that increases capacity is considered as an addition to capital upon which a profit must be earned, but from the shareholder's viewpoint it is a cost, as he will never get his hands on any money that has been spent for plant that will be junk when the mine is exhausted.

It seems likely that, due to a change in general industrial and financial conditions, certain factors in cost will be higher than the pre-war average for some time to come, but, because of the interrelation of cost and price, any change in average cost should be reflected in a similar change in average price. If the average cost over a future long period is going to exceed the pre-war average, it is reasonably certain that the average price will exceed the pre-war average of 15c. in similar ratio, with little change in the ratio of profit to price.

Perhaps the most important figure and the only one that can be directly applied in estimating future results is "Ratio of Profit to Price," that is, the ratio of profit per pound to price received per pound. J. R. Finlay, in his "Cost of Mining," has pointed out an interrelation of cost and price, and hence of profit and price, that varies from year to year but tends to average nearly constant over long periods, and the following paragraphs attempt to show the reason.

A study of price and cost curves for individual mines over a fairly long period shows that variations in price are followed by corresponding similar variations in cost, but although price responds rapidly to variations in demand, the cost moves slowly and ponderously like a heavy body, slow to start and hard to stop, and its movements lag behind those of price, so that there are alternating periods of divergence and convergence of the curves, with consequent alternating periods of high and low ratio of profit to price, but the average ratios over equal fairly long periods tend to be about the same. In unprofitable periods the dropping price curve approaches the rising cost curve. In 1920 the curves actually met, with extinction of profit. We are now in a period of rising price and decreasing cost.

A fairly constant element in cost is inexorably imposed by Nature—namely, the quantity of capital, labor, and material necessary to discover and produce a pound of copper. A certain natural limitation is placed upon cost, and hence on price, independently of variations due to changes in the ratio of supply to demand. The reason that the price of copper has consistently averaged over three times that of lead is because it takes over three times as much capital, labor, and material to discover and produce a pound of copper as it does to win a pound of lead. This quantity is different for different mines and different classes of mines, but, for the industry as a whole and for individual mines, it tends to a fairly constant average over long periods, and will gradually increase with the decline of the industry and with the approaching mine exhaustion.

The tendency is continually toward higher recovery, increased tonnage capacity, and greater general efficiency, the immediate effect of which is to lower the cost per pound, but the average combined effect over a long period is to lower the grade of ore mined and the yield in pounds of fine copper per ton; increase the total available tonnage, copper, and profits; and increase the average annual profit per share by an amount at least equal to a fair return on the additional capital per share that was invested to get the increased recovery and capacity without much change in the average cost per pound. Thus the present value per share is increased by both the additional annual profit per share and the increase in total available profits. Always, of course, the objective is not cost per pound, not only annual profit per share, but the creation of the greatest possible present value with the least capital expenditure that natural limitations will permit, and these natural limitations prescribe the minimum combined quantity of capital, labor, and material that is necessary to discover and produce a pound of copper.

One influence that tends to maintain a constant relation between average price and average cost for the industry as a whole is the necessity that average price must be composed of average cost plus an average profit on invested capital commensurate with the risk involved, for the industry to exist and grow. When profit declines, new capital investment is halted and the ratio of production to demand declines until price and profit begin to rise again, so that over long periods there tends to be a fairly constant relation between cost, profit, and price.

It seems likely that for some mines the future average grade of mill feed may be less than 1 per cent copper and the yield in fine copper as low as 15 or 16 lb. per ton and still return the present invested capital, with a good rate of interest. This means that, under favorable conditions and with sufficiently large tonnage, a body of copper-bearing rock whose sampling by churn drills indicates a copper content of about 1¼ per cent, and hence about 1 per cent mill feed, can now be classed as ore and be made the basis of a profitable operation, and it is safe to say that the time will come, and may not be far distant, when the same remarks will apply to material whose indicated content is only 1 per cent.

As long as grade of ore is controllable, it will be maintained at a point that will give a yield in fine copper that will create the greatest present value. In the last years of life, grade will be the controlling factor.

From the foregoing considerations it is reasonable to conclude that, for most of the mines that have operated over the longer periods, the past ratios can be safely applied over a future long period and will be exceeded at some of the mines, owing principally to the effect of increased capacity; and that in estimates covering a future long period, say fifteen years, a ratio of 37 per cent can be safely used as the average for the group. This means that for every dollar received from sale of copper, 37c. should be applicable to dividends or working capital, and, after working capital has been replenished, to dividends alone.

Computing present values is a dangerous pastime if done without a more detailed knowledge of the entering factors than is ordinarily available. Estimates of future dividends based on this table of past results alone would be seriously in error. Following are the essential factors except interest and most of them are difficult to estimate closely:

(1)—Future average annual tons milled.
(2)—Future average per cent copper in mill feed.
(3)—Future average mill and smelter recovery.
(4)—Future average ratio of profit to price.
(5)—Future average price.
(6)—Life of the mines.

(1) and (3)—Will be considerably higher than the past average and should result in an important increase in the future average annual profits per share for most of the mines.

(2)—Will be much lower than the past average and the future average yield, for the group will be lower.

(4)—Can be estimated closely from records, and it is safe to use the figure of 37 per cent as the average for the group over a long future period. In the last years of life this ratio will steadily decrease, as the mines will continue to operate on lower and lower grade ore as long as there is any operating profit at all, and the average ratio for the whole future life may be less than this.

Estimates of (5) will vary with the optimism of the estimator, but it is logical to assume that it will bear about the same relation to the pre-war average of 15c. that the future general price level will have to the pre-war general level, at least until that time when the shortage of copper will force an increase in both price and cost independently of general conditions.

(6)—Is difficult to estimate closely, as additional ore will probably be developed at most of the mines. It will also depend on (1), which is uncertain, but which almost certainly will be considerably higher in the future than in the past. The effect of any further increase in tonnage capacity will be to shorten the life, but its effect, and the effect of increased recovery, will also be to lengthen life by making lower-grade ore available. However, considerably longer life than is indicated by the figures on ore reserves and tonnage capacity may be expected.

It can be stated that the intrinsic value of most of these properties, computed on a conservative basis, is considerably higher than the recent market value, though the market prices closely reflect the relative values, with a few exceptions.

It is impossible to study this record of operations without being impressed by the tremendous achievement of the American engineers who extracted these profits from rock that yielded only 20 lb. of copper to the ton.

PORPHYRY COPPERS' RECORD FROM BEGINNING OF OPERATIONS TO DEC. 31, 1920

Name of Mine	Ore Reserves Dec. 31, 1920 Tons	Ore Reserves Per Cent Cu	Orig. Est., Per Cent Cu	Total Ore Milled Tons	Total Ore Milled Per Cent Cu	Total Fine Cu Produced, Lb.	Fine Cu In. lb. Per Ton	Mill Recov., Per Cent	Mill and Smelter Recov., Per Cent	Year of Inc.	First Full Yr. of Oper.	Yrs. of Oper.	No. Shares Issued
Utah	364,130,000	1.35	2.00	89,340,223	1.57	1,546,153,606	17.3	66.0	63.2	1903	1908	13	1,624,470
Nevada	63,845,000	1.58	1.97	35,180,801	1.60	759,680,986	21.6	70.0	67.2	1904	1909	12	1,999,457
Chino	105,689,000	1.53	2.24	21,532,415	1.85	510,313,779	23.7	66.6	64.2	1909	1912	9	869,980
Ray	83,004,000	2.07	2.17	23,522,127	1.68	559,532,318	23.8	71.4	70.8	1907	1912	9	1,577,179
Miami	10,723,000(a) 36,000,000(a) 6,000,000(c)	2.26 1.06 2.00	2.48	14,104,887	2.12	421,806,746	29.9	74.2	70.5	1907	1912	9	747,114
Inspiration	72,000,000	1.63	1.63	24,462,809	1.36	477,439,016	19.5	74.2	72.0	1911	1916	5	1,181,467
Total	739,400,000	1.51		208,143,000	1.54	4,274,926,000	20.5	69.1	66.8				
Ajo	8,234,000(b) 42,000,000(a)	1.49 1.50	1.57 1.59	6,032,097	1.54	146,046,284	24.2	79.0		1909	1918	3	1,890,000

Name of Mine	Par Value, Share	Total Dividends	Div. Per Share	Total Profits	Profit Per Ton	Profit Per Lb., Cents	Price Recd Lb., Cents	Cost Per Lb., Cents	Cost Per Ton	Ratio Profit to Price, Per Cent	Div. Per Lb., Cents	Ratio Div. to Price, Per Cent	Average Annual Dividend, Per Share	Approximate Annual Capacity, Tons
Utah	$10	$111,509,662(d) 88,264,000(e)	$70.75	$132,617,808(f) 109,372,000(e)	$1.23	7.08	18.64	11.5	$2.00	38.0	5.70	30.6	$5.45	14,000,000
Nevada	5	46,768,616	23.40	55,471,665	1.58	7.30	17.90	10.6	2.29	40.7	6.17	34.4	1.95	5,000,000
Chino	5	29,991,709	34.52	33,452,546	1.58	6.66	19.85	13.2	3.13	33.5	5.88	29.6	3.83	3,800,000
Ray	10	25,412,620	16.32	33,578,890	1.43	6.00	19.70	13.7	3.26	30.4	4.54	23.0	1.81	3,500,000
Miami	5	22,950,660	30.75	30,200,787	2.14	7.16	20.1	13.0	3.87	35.6	5.44	27.0	3.42	2,100,000
Inspiration	20	38,678,671	33.00	47,957,201	1.95	10.00	22.0	12.0	2.34	45.4	8.10	36.8	6.60	5,000,000
Total		$252,066,276		$310,533,000	$1.49	7.3	19.3	12.0	$2.46	37.8	5.9	30.5		33,000,000
Ajo	$5	$1,350,000	$0.75											

(a) Sulphide ore. (b) Oxide ore. (c) Mixed ore. (d) Total. (e) From operations. Balance of total is from dividends on 1,000,500 shares of Nevada. (f) Total profits equal total dividends plus net quick assets as of Dec. 31, 1920.

MINING STOCKS

Week Ended February 18, 1922

Stock	Exch.	High	Low	Last	Last Div.	
COPPER						
Ahmeek	Boston	62	61	61	Sept. '20, Q	$0.50
Alaska-Br. Col. new	N. Y. Curb	2¼	2⅛	2⅛		
Allouez	Boston	28	27	27	Mar. '19	1.00
Anaconda	New York	49	47½	48½	Nov. '20, Q	1.00
Arcadian Consol.	Boston	2½	2½	2½		
Ariz. Com'l.	Boston	9	8½	8½	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*25	*23	*24		
Bingham Mines	Boston	14	13½	14	Sept. '19, Q	0.25
Calumet & Arizona	Boston	59	58	59	Dec. '21, Q	0.50
Calumet & Hecla	Boston	285	275	275	June '20, Q	5.00
Canada Copper	N. Y. Curb	*27	*25	*26		
Centennial	Boston	12	12	12	Dec. '18, SA	1.00
Cerro de Pasco	New York	34½	33¼	33½	Mar. '21, Q	0.50
Chile Copper	New York	17⅛	15⅞	16⅜		
Chino	New York	26½	26	26	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*27	*26	*27		
Con. Arizona	N. Y. Curb	*3	*2	*2	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	1 5/16	1¼	1 5/16		
Copper Range	Boston	43	41	41½	Sept. '20, Q	0.50
Crystal Copper	Boston Curb	*59	*54	*58		
Davis-Daly	Boston	8¼	7½	7½	Mar. '20, Q	0.25
East Butte	Boston	10⅞	10½	10¾	Dec. '19, A	0.50
First National	Boston Curb	*70	*60	*70	Feb. '19, SA	0.15
Franklin	Boston	1½	1¼	1¼	......	....
Gadsden Copper	Boston Curb	*55	*45	*45		
Granby Consol.	New York	†29½	†27	28½	May '19, Q	1.25
Greene-Cananea	New York	26¼	25⅛	26¼	Nov. '20, Q	0.50
Hancock	Boston	2¾	2½	2¾		
Howe Sound	N. Y. Curb	2¾	2½	2⅝	Jan. '21, Q	0.05
Inspiration Consol.	New York	39	37¾	38½	Oct. '20, Q	1.00
Iron Cap	Boston Curb	†*7½	†*7	*7	Sept. '20, K	0.25
Isle Royale	Boston	23¼	23	23	Sept. '19, SA	0.50
Kennecott	New York	27¾	26⅞	27½	Dec. '20, Q	0.50
Keweenaw	Boston	†1½	†1¼	1¼	......	....
Lake Copper	Boston	2⅝	2½	2½	....	..
La Salle	Boston	2	1⅞	2	....	..
Magma Copper	N. Y. Curb	31½	30	30¼	Jan. '19, Q	0.50
Majestic	Boston Curb	†*6	†*5	*3	...	...
Mason Valley	Boston	1 7/16	1 7/16	1 7/16		
Mass Consolidated	Boston	2¾	2¼	2¾	Nov. '17, Q	1.00
Miami Copper	New York	26¾	25¾	26½	Feb. '22 Q	0.50
Michigan	Boston	1¾	1½	1¾	....	
Mohawk	Boston	56¾	55⅞	56	Nov. '20, Q	1.00
Mother Lode Coa.	N. Y. Curb	8⅛	7⅝	7⅝		
Nevada Consol.	New York	14	13¾	13¾	Sept. '20, Q	0.25
New Cornelia	Boston	18	17½	17⅞	Aug. '20, K	0.25
North Butte	Boston	12	11	11¼	Oct. '18, Q	0.25
North Lake	Boston			*25		
Ohio Copper	N. Y. Curb	*10	*10	*10		
Old Dominion	Boston	24½	23¾	23¾	Dec. '18, Q	1.00
Osceola	Boston	33	32¼	32¼	June '20, Q	0.50
Phelps Dodge	Open Mar.	†190	†175		Jan. '22, Q	1.00
Quincy	Boston	43¼	42¾	43½	Mar. '20, Q	1.00
Ray Consolidated	New York	14	13⅝	13⅞	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*3	*2	*2		
St. Mary's Min. Ld.	Boston	45	44	45	Dec. '21, K	1.00
Seneca Copper	Boston	13¼	12½	12½		
Shannon	Boston	1	1	1	Nov. '17, Q	0.25
Shattuck Arizona	New York	8	7¾	8	Jan. '20, Q	0.25
South Lake	Boston	†1	†*65	*65		
Superior & Boston	Boston	1¼	1	1		
Tenn. C. & C. ctfs.	New York	10½	10¼	10⅜	May '18, I	1.00
Tuolumne	Boston	*60	*60	*60	May '13,	0.10
United Verde Ex.	Boston Curb	29	28	28¼	Feb. '22, Q	0.25
Utah Consol.	Boston	2¼	2	2	Sept. '18,	0.25
Utah Copper	New York	63⅛	61	61¾	Dec. '21, Q	0.50
Utah Metal & T.	Boston	1⅛	1	1	Dec. '17,	0.30
Victoria	Boston	2¼	2	2¼	...	...
Winona	Boston	*45	*45	*45	...	...
Wolverine	Boston	11	10½	11	..	...
NICKEL-COPPER						
International Nickel	New York	12½	12	12¼	Mar. '19,	0.50
International Nickel, pfd	New York	65	62	62	Nov. '21, Q	1.50
LEAD						
National Lead	New York	90½	88	90½	Dec. '21, Q	1.50
National Lead, pfd.	New York	†113	†111	112	Dec. '21, Q	1.75
St. Joseph Lead	New York	13½	13¼	13¾	Dec. '21, Q	0.25
QUICKSILVER						
New Idria	Boston	†1¼	†*75	1	.	....
ZINC						
Am. Z. L. & S.	New York	13½	13¼	13½	May '20,	1.00
Am. Z. L. & S. pfd	New York	36½	36	36½	Nov. '20, Q	1.50
Butte C. & Z.	New York	5½	5	5	June '18,	0.50
Butte & Superior	New York	27¼	25½	26	Sept. '20,	1.25
Callahan Zn-Ld	New York	5½	5¼	5¼	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	137	136	136	Feb. '22, Q	2.00
Yellow Pine	Los Angeles			*50	Sept. '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

These quotations courtesy Hamilton B. Wills, Spokane; Pohlman Investment Co., Salt Lake; Stock and Mining Exchange, Los Angeles; Chamber of Commerce and Oil; Colorado Springs; The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.	
GOLD						
Alaska Gold	New York	½	⅜	⅜	....	....
Alaska Juneau	New York	†⅞	⅝	⅝	.	
Carson Hill	New York	15¼	15	15		
Cresson Consol. G.	N. Y. Curb	2 15/16	2 13/16	2⅞	Jan. '22, Q	$0.10
Dome Extension	Toronto	1.00	*83	1.00	..	
Dome Mines	New York	23½	22¾	23½	Jan. '22, Q	0.25
Florence Goldfield	N. Y. Curb	*25	*21	*25	.	
Golden Cycle	Colo. Springs	*81	†*78	*51	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb			*4	Dec. '19,	0.05
Hollinger Consol.	Toronto	8.54	8.50	8.53	Jan. '22,	0.05
Homestake Mining	New York	61½	61	61	Jan. '22, M	0.25
Kirkland Lake	Toronto	*35½	*30	*33		
Lake Shore	Toronto	1.50	1.43	1.49	Nov. '21, K	0.02
McIntyre-Porcupine.	Toronto	2.58	2.50	2.55	Jan. '22, K	0.05
Porcupine Crown	Toronto	*19	*17	*18¾	July '17,	0.03
Porcupine V. N. T.	Toronto	*25½	*23	*24	..	.
Portland	Colo. Springs	*39	*39	*39	Oct. '20, Q	0.01
Schumacher	Toronto	*36	*35	*36	.. ..	..
Silver Pick	N. Y. Curb			*2	....	..
Teck Hughes	Toronto	*31	*29¼	*30	...	
Tom Reed	Los Angeles	*79	*70	*77	Dec. '19,	0.02
United Eastern	N. Y. Curb	2 1/16	1 15/16	1 15/16	Jan. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*22	*22	*22	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*3	*3	*3	...	.
Yukon Gold	N. Y. Curb	1¼	1⅛	1¼	June '18,	0.02½
SILVER						
Batopilas Mining	New York	⅝	½	½	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*24	*20½	*23½	May '20, K	0.03
Coniagas	Totonto	1.25	1.25	1.25	May '21, Q	0.12½
Crown Reserve	Toronto	*16	*14½	*15½	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3¼	3¼	3¼	Jan. '22, Q	0.12½
La Rose	Toronto	*38	*36½	*37	Apr. '18,	0.02
McKinley-Dar.-Sav.	Toronto	*19½	*18¾	*19½	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.15	1.01	1.10	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6	5⅞	5⅞	Jan. '22, Q	0.15
Ontario Silver	New York	5⅝	5⅛	5½	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	.	.	*12	Jan. '12,	0.10
Temiskaming	Toronto	*34	*31	*32½	Jan. '20, K	0.04
Trethewey	Toronto	*4½	*2½	*3½	Jan. '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*47	*42	*46	....	....
Cash Boy	N. Y. Curb	*5	*5	*5	....	....
Dolores Esperanza	N. Y. Curb	1⅛	*85	85	. ....	...
El Salvador	N. Y. Curb	*5	*3	*3		
Jim Butler	N. Y. Curb	...	..	*6	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	.	..	*4	June '16,	0.05
MacNamara M. & M.	N. Y. Curb	*8	*6	*8	May '10,	0.02½
Tonopah-Belmont	N. Y. Curb	1 9/16	1½	1 9/16	Jan. '22, Q	0.05
Tonopah-Divide	N. Y. Curb	*63	*60	*63		
Tonopah-Extension	N. Y. Curb	1⅜	1 5/16	1⅜	Jan. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1 11/16	1⅝	1 11/16	Oct. '21, SA	0.05
West End Consol.	N. Y. Curb	*76	*73	*75	Dec. '19, SA	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*5	*5	*5	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	1.02½	1.00	1.02½	Dec. '20,	0.15
Chief Consol.	Boston Curb	3⅝	3 7/16	3 7/16	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	19	18½	18½	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†3.00	†1.25	.	July '20, Q	0.10
Daly-West	Boston	2¼	2¼	2¼	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	2½	2½	2½	Apr. '21, K	0.05
Electric Point	Spokane	*5	*4¾	*5	May '20, SA	0.03
Federal M. & S.	New York	†12	†8	.	Jan. '09,	1.50
Federal M. & S., pfd	New York	39¼	38	38¼	Dec. '21, Q	1.00
Florence Silver	Spokane	*19	*19	*19	Apr. '19,	0.01½
Grand Central	Salt Lake	*42	*42	*42	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	5⅝	5⅛	5⅝	Dec. '21, Q	0.17
Iron Blossom Con.	N. Y. Curb	*20	*19	*19	Dec. '21, Q	0.02½
Judge M. & S.	Salt Lake	†3.25	†2.80	3.00	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*4	*4	*4	June '21, I	0.02
Prince Consol.	Salt Lake	*8	*6½	*8	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*6	*5¾	*6	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*8	*6	*7	..	
South Hecla	Salt Lake	†*60	†*35		Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*18	*18	*18	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*4	*3	*3	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.10	1.90	2.10	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.15	2.02½	2.15	Dec. '21, Q	0.05
Utah Apex	Boston	3¼	3	3	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	*2	*2	*2	Nov. '17,	0.01
VANADIUM						
Vanadium Corp.	New York	35⅝	34	34¼	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	47	46	46	Jan. '22, Q	1.50
Asbestos Corp., pfd.	Montreal	75	74	75	Jan. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	13⅜	13⅛	13¼	Nov. '19, Q	1.00
Texas Gulf	New York	44	42½	44	Dec. '21, Q	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	46¼	45⅛	46	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	91	90⅜	90⅝	Dec. '21, Q	1.75½
Am. Sm. Sec. pf. A.	New York	87¼	87	87¼	Jan. '22, Q	1.50
U. S. Sm. R. & M.	New York	34½	34	34	Jan. '21, Q	0.50
U.S. Sm. R. & M. pf.	New York	43½	43½	43½	Jan. '22, Q	0.87

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Engineering and Mining Journal

A Weekly Journal of the Mining and Mineral Industries
METALS NON-METALS PETROLEUM

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[illegible]
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Special
Consulting Editors

Volume 113 New York, March 4, 1922 Number 9

Union of the Two Great Weeklies of the Mining and Mineral Industries

THIS IS AN ERA of growth, development, and organization, and the mining industries of the country and of the world are not exceptions to the general evolution, but indeed are typical examples. The all-'round mining engineers of a few decades ago have resolved themselves into a group of specialists, each devoting himself to the science of one of the many branches of mining or of treating ores, or to some one of the increasingly precise economic phases of mining. Each mining industry is progressively developing its own technique, its own economic requirements, its own particular place in the complex of present-day life. A mining journal, therefore, to keep ahead of the times must also be constantly progressive and must grow.

IT IS with the desire to serve more effectively these growing complex industries that there has been agreed upon a union of forces between the two great mining weeklies of the country and of the world, *Engineering and Mining Journal* and the *Mining and Scientific Press.* Both have international influence; neither represents a section. The strength of *Engineering and Mining Journal* is great in the Western States; *Mining and Scientific Press* is well known and influential in the East. Each is long established and successful, the former having been founded in 1866, the latter six years before, in 1860. But at those dates the West Coast was remote from the East, and independent centers of scientific and technical thought naturally arose. These conditions have progressively altered to the vanishing point.

Development and increase of population have blended the East and West; and the building up of the mining activities in the vast intervening territory has joined them in one great whole.

UNDER recent conditions neither journal can go confidently forward in a progressive expansion. The development of mining more and more clearly indicates the conclusion that there is room and need for only one really great mining journal, not only for the country, but for the world, which also is daily being knit more closely together.

THE combined journals will be published under the name of *Engineering and Mining Journal-Press,* with Mr. J. E. Spurr as Editor. Mr. T. A. Rickard becomes Contributing Editor. Mr. Rickard will remain on the Coast and will especially present the problems and the voice of the West. It is intended that increased attention shall be given in the new journal to all the features which have been carefully worked out editorially for the two weeklies, and, in addition, it is intended to devote increased attention to the important and growing field of non-metallic mining. With a large and additional force, a campaign of increased field work on the part of the editors will also be made possible by the consolidation. Better correspondence, including better European representation, has been arranged for. *Engineering and Mining Journal-Press* will serve the entire mining industry, including the Far West, as never before, with this consolidation of resources and editorial staff.

THE subscription price of *Engineering and Mining Journal* has been five dollars; that of the *Mining and Scientific Press,* four dollars. The price of the *Engineering and Mining Journal-Press* will be four dollars.

THE consolidated weekly will have far greater circulation than any other mining journal in the world. Both the journals which are now combined have had an international circulation—in the case of *Engineering and Mining Journal* one out of every four subscribers is outside of the United States.

WE KNOW that the consolidation will be a most popular one, and that it will be hailed by readers and advertisers alike as a practical example of the "elimination of waste" in mining industries. The consolidated journal will afford the editors and publishers an opportunity never before approached for service to the mining industries.

McGraw-Hill Company, Inc., JAMES H. McGRAW, *President.*

WHAT OTHERS THINK

Graduates of California, Stand Up!

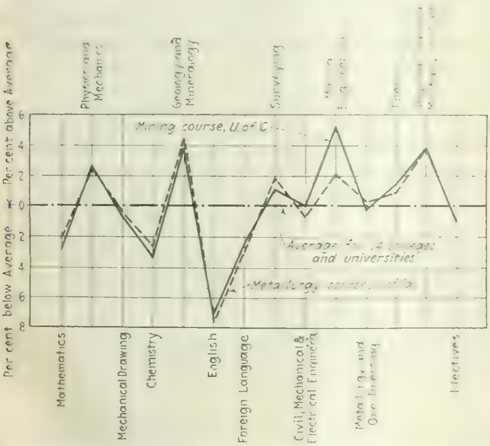
On Jan. 7, 1922, the *Engineering and Mining Journal* contained a write-up of the College of Mining, University of California, by your Western editor, Mr. George J. Young: an interesting article in some ways because three columns of the text is devoted to inconsequential gossip suggested by the author's "scrap-book of allusions" or illusions, irrelevant in regard to the College of Mining; incompetent and misleading in other ways, because of inaccuracy and omission of essential facts. I have a high regard for your Western associate; his sketch is breezy and tends to revive that "slow decadence of American humor" which President Barrows is said to deplore; he does his job as a magazine reporter, and having once been on the teaching staff of three mining colleges, Nevada, Minnesota, and Colorado, and an alumnus of the University of California, his evaluation of the merits of a curriculum should carry weight.

In August, 1921, Mr. Young called at my office and consumed all of fifteen minutes in asking a few questions. I had just completed a statistical summary of the enrollment for the semester and gave him a copy. He told me he intended writing "something" about the College of Mining, and in this respect he has kept his word. I plead for accuracy of statement and the good name of California. Such faulty effusions are harmful in many ways, they are unjust to the University, they cause bewilderment in the minds of students, and make the older men of the profession who take pride in the *Journal* and who look to its pages for information and inspiration hesitate and question the reliance that can be placed in other articles published in its pages.

How puny and puerile is the Young statement as compared with the competent analysis and constructive report of the Committee on Technical Education of the Mining and Metallurgical Society of America, which calls attention to the diversity of opinion on what constitutes an acceptable course of studies for students of mining engineering. The education of an engineer is never completed, and no school or college, whether it prescribes a four-, five-, or six-year course, can turn out a finished product. It teaches an alphabet that the student may learn to spell; it supplies tools with which to work; it develops an inquiring mind, quickens observational and inferential powers, and stimulates the desire for knowledge, for truth, and accomplishment. No college can graduate a man capable of immediately assuming the direction of a mining enterprise: men are not born; they grow and develop, and all children creep before they walk. An engineering college lays only a foundation on which the superstructure shall be built in the great laboratories of the world.

I desire to correct some of the false statements and implications made in your issue of Jan. 7. A prospective student to the University of California must either pass rigid entrance examinations or be fully matriculated from an accredited high school. He enters an engineering college with a comprehensive understanding of mathematics above that required by many other universities. A searching test in English is prescribed for all intrants, and failure means a protracted course without credit, in English composition, until the student can satisfy this requirement. Throughout the undergraduate days, all examination papers and other tests are blue pencilled for irregular orthography, calligraphy, and composition. Repeated offences may lead to further corrective courses. In all upper division work, so far as time will permit, the historical background of the subject is presented, the business and humanistic side of mining is particularly emphasized, its influence in the march of civilization, and its relationship to other industries. Throughout the course, and more than ever in the senior year, the economic side overshadows the merely technical or mechanical. A blacksmith is best trained in a smithy, a "mucker" in the stope, a rodman in the field. It is apparent to me that what was "not apparent" and "also not apparent" to Mr. Young might have been apparent to the gentleman had he the "vision, capacity, and personal power" that comes from the "quiz method" which he preached but apparently does not practice.

Figures will or will not lie, as we interpret them. The arithmetical gymnastics presented by Mr. Young are fittingly framed in the empty three rings of his Fig. 2. Again I say that enlightenment would have followed inquiry. An engineer should not jump at conclusions. In addition to the actual lectures and laboratory work in college halls, problem sets, assigned reading, Saturday field trips, and a month's geology excursion, at least one summer in mine, mill, smelter, or oil field is required of all students; record is kept, reports are criticised, and credit is given accordingly. Every candidate for the B. S. degree must present a thesis based either on field studies or laboratory experimentation. As this is the culminating feature of the rigidly prescribed course, work of a high order is expected. These are not "theoretical requirements." My deep concern for the students is in the limitation of "play time" rather than its excess. About 50 per cent of the student body is wholly or in part "working its way" in order to pay for the much-desired education.



COMPARISON OF SUBJECT REQUIREMENTS IN MINING AND METALLURGY CURRICULA

In *"Bulletin 150,"* Mining and Metallurgical Society of America, tables 1 and 2 show the distribution of students' time in a four-year course of mining and metallurgy respectively at twenty-four universities of the United States. Using the average of all colleges as a datum line, I have prepared a chart showing wherein the courses as given at California depart from this established average. It should be noted that in the tabulations given a unit of laboratory work is taken as meaning two hours, whereas at California all laboratory courses are of three hours' duration.

In conclusion, a word about the fitness of our graduates for life work: In 1917 and 1918 practically the whole graduating class passed immediately from the campus to the United States Army or Navy as commissioned officers to serve in the Great War. Yes, I think they could "qualify as an assistant to a draftsman," but there are bigger things for them to do. At California it is seldom that an engineering student is considered for Phi Beta Kappa: during the last three years two mining students have been elected. Twenty-two men have made Tau Beta Pi in five years; ten men were honored by Sigma Xi. Last year eight miners made the Big "C"; in 1920 and 1921 the captain of the crew was a mining student. In 1920, when the University medallist was chosen, it was found that of the best twenty scholars in a student body of 11,000, four were registered in an engineering college. Such a record demands more than "passive receptivity."

In August, 1921, there were transfers to the College of Mining, University of California, from twenty different universities for upper division work, from Yale westward. Three men are working for a higher degree in the graduate school.

California is rightly proud of its alumni. Gardner F. Williams, Alpheus Williams, W. W. Mein, C. W. Merrill, E. L. Oliver, F. L. Ransome, C. B. Lakenan, S. A. Easton, F. W. Bradley, P. R. Bradley, B. H. Dunshee, F. W. Laist, C. W. Butters, F. G. Cottrell, Norman Stines, D. McLoughlin, Fred Searles, Erle Daveler, B. L. Thane are names to conjure with. These, and many others, are they who, possibly in spite of the fact that "many subjects are lacking in this engineering course," have eventually landed "in the higher consulting and operating positions." No, "the students of marked ability are not going to be miners"; they are diligently preparing themselves to take their place in the development and direction of the mineral industry, as men and as citizens of this great state and country.

Berkeley, Cal. **FRANK H. PROBERT,**
Dean, College of Mining, University of California.

African Golf in India

White people in the East are all classed as "Europeans," for it is only recently that Americans in any numbers have begun to appear in the Far East. In Jamshedpur, India, where the big steel works of the Tata Iron & Steel Co., Ltd., are situated, many Americans are employed, and some years ago Sam Washington, a southern darky, blew in, who claimed Birmingham, Ala., as his home town. Sam was a distinct curiosity in every way to the country, and on appealing to some "white folks" was given a job firing on a switch engine, where he did good work in the hot climate. On pay day, with his silver rupees jingling in his pockets, Sam viewed the hundreds of his unsuspecting, brown-skinned fellow employees with anticipated joy. He soon managed to corral several of them in a secluded corner, and producing two little cubes of ivory proceeded to institute an orgy of Dixie's national game. Three times Sam "shook 'em, talked to 'em and rolled 'em," but not the faintest gleam of intelligence appeared in the cow-like eyes of his audience, who merely gazed at him questioningly. Sam, disgusted, tried a new bunch, and then another, only to achieve the same result.

At dusk Sam stood leaning against a tree, a picture of despondency, trying to puzzle out the strange phenomenon, when one of his white foremen strolled along, and Sam gave vent to his solution of the mystery as follows: "Captain! Dese heah niggers hain't got any brains and sense like us Europeans, has dey?"

The Westly Electric Furnace for Copper Smelting

Experiments Made at Sulitjelma, in Norway, Show Electric Smelting Practicable Where the Necessary Power Is Available at Low Cost—Metallurgical Advantages Include Sulphur Conservation, Reduced Metal Loss, and Smaller Flux Requirements

By C. S. Witherell and H. E. Skougor
[illegible] Engineering and Mining Journal

As in the metallurgy of iron, a great deal of thought and experimentation have been given to the electric smelting of non-ferrous ores, with the hope of obtaining lower costs and better metallurgical efficiency. It is natural that the most practical developments in electric smelting should have taken place in Norway, where electric power is cheap, fuel expensive, and ore available. During the war period there was also the added incentive of high prices and great demand for all metals.

During the summer of 1912, Jens Westly, metallurgical engineer of the Sulitjelma Copper Co., of Norway, conducted the first practical experiments with his new electric smelting process. Ore from the Vaer Valley containing copper and nickel was treated, together with Elmore concentrate from Sulitjelma. Since then the Westly electric smelting process has been gradually developed until it has been applied to regular large-scale operation at Sulitjelma.

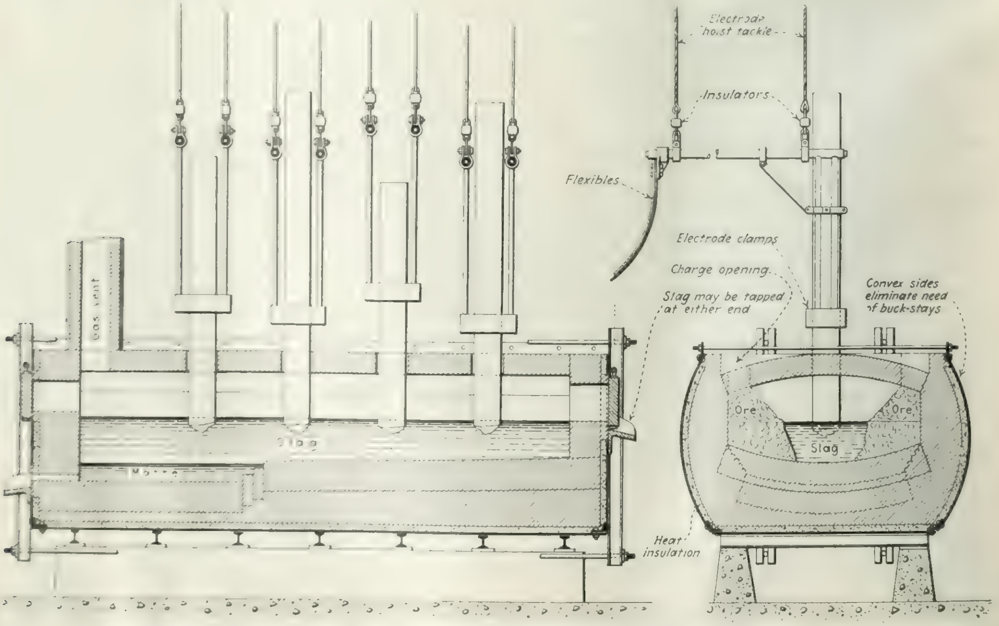
The Westly electric furnace developed for the process is of simple design and construction. It consists of a boiler-iron shell, lined with standard refractories, an open arched roof with regular electrode openings, and holes along the skewbacks for charging. The electrodes are fed vertically through the top. At first, single-phase alternating current and two electrodes were used in the furnace. Later, three-phase alternating current, with three, and up to six, electrodes, according to the size of the furnace, were also used. Preferably, the electrodes are placed in a straight line, although the delta arrangement has been used.

As can be seen in the illustrations, the furnaces at Sulitjelma were non-tilting. Ordinarily, there would be no reason for tilting in straight smelting, but the furnace can be made tilting if desired.

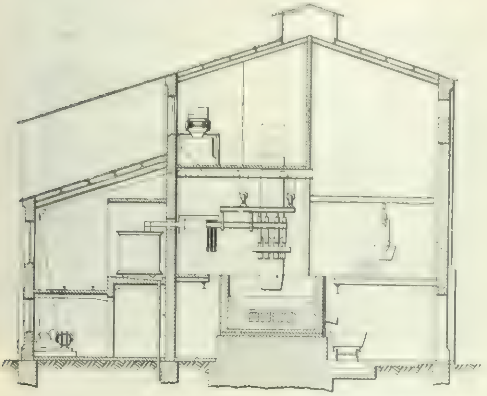
The design and construction do not differ much from the Heroult smelting furnace, but some important operating details are peculiar to the Westly furnace.

A transverse section of a Westly furnace is similar to that of a modern smelting reverberatory. The ore, charged through roof openings along the skewbacks, banks against the sides and forms, as it melts, a molten pool in the center composed of slag and settling matte. A sump is incorporated in the hearth of the furnace, preferably at one end, for the purpose of diverting the settled matte away from the electrode tips and also to provide a larger bulk for tapping.

The electrode tips dip into the slag layer, but are



DIAGRAMMATIC SKETCH OF WESTLY ELECTRIC SMELTING FURNACE IN OPERATION kept a considerable distance above the matte layer; hence the heating is done entirely by the current passing through the slag between electrode tips, it being intended that the matte layer should carry practically no current. This takes advantage of the fact that all mineral substances that are electric insulators when cold become high-resistance conductors when above a red heat. There is no arc action when the furnace is running normally, and as a result the power factor is almost unity.


A CROSS SECTION OF A SMELTER BUILDING WITH OPERATING PLATFORM FOR THE MAKING IN PLACE OF CARBON ELECTRODES

The experimental and developmental work done at Sulitjelma was thorough, covering several sizes of furnaces, from 200 kw. to 900 kw., and furnaces of various shapes. Also, the method of operating was varied to obtain complete operating data. Because of the success of the initiatory tests, the Sulitjelma company undertook to build a 3,000-kw. furnace, which was almost completed before plant operation was stopped at the end of the war. This furnace should be able when efficiently operated to smelt at least 100 metric tons of charge per day.

The principal ore treated at Sulitjelma consisted of mixed sulphides; namely, copper pyrite, iron pyrite, and pyrrhotite, in a gangue of gabbro and phyllitic slate. The mined ore was partly concentrated, which gave a product for smelting, analyzing on the average 6 per cent Cu, 28 to 30 per cent S, and 28 per cent SiO_2. Usually, part of this concentrate was roasted and mixed with the raw portion before charging into the electric furnace, thereby producing 30 to 40 per cent copper matte direct. The slag usually ran 0.3 to 0.4 per cent Cu. No fuel was added with the charge nor used extraneously. The slag loss was cut from 10 to 20 per cent in previous methods to 5 to 6 per cent in the electric method. Also, the slag could be varied considerably in composition; successful slags analyzing up to 62 per cent SiO_2 were run.

POWER CONSUMPTION MODERATE

Electric-power consumption in regular operation was less than 700 kw.-hr. per metric ton of ore smelted. The furnace voltage varied from 112 to 230 volts, depending on the space between electrodes and resistivity of the molten slag; the more siliceous the slag, the higher the resistivity. The electric current used was three-phase, fifty-cycle.

The consumption of electrodes for regular smelting amounted to 3 to 4 kg. of carbon electrode material per metric ton of ore smelted.

Two long and several short campaigns were made. One furnace ran continuously at 600 kw. for 378 days and was finally shut down on account of labor trouble; another furnace ran 186 days at 300 kw., with one stop to make changes in the transformer station, and finally shut down to transfer its transformer to the first furnace, thus bringing the power of the first furnace up to 900 kw. This 900-kw. furnace ran for about four

RECORDS OF EXPERIMENTAL AND ROUTINE OPERATION OF WESTLY ELECTRIC FURNACES AT SULITJELMA, NORWAY, FOR 1917, 1918, 1919

	Elmore Raw	Conc. Roast	Silica Flux	Crushed Slag	Total Solids	Liquid		Total Liquids and Solids	Kw.-Hr.	Kg. Per Kw.-Hr.		Smelting Days		Per Cent Cu			
						Knudsen Furnace	Conv'r			Solid	Total	Furnace No. 1	Furnace No. 2	Furnace No. 1 Matte	Furnace No. 1 Slag	Furnace No. 2 Matte	Furnace No. 2 Slag
1917																	
January	5	70	.		75	33	9	117	86,200	0.87	1.36	7		22.8	0.60		..
February	93	291			384	272	85	741	354,900	1.16	2.09	28		28.4	0.53		
March	170	257	18	20	465	469	146	1,080	396,400	1.17	2.72	31		24.4	0.40		
April	30	17	5		52	55	17	124	47,650	1.09	2.60	4		25.5	0.38		
May	143	202	25		370	268	73	711	287,900	1.29	2.47	16	13	24.3	0.31	19.6	0.32
June	153	488	27		668	390	182	1,240	592,800	1.13	2.09	30	30	26.2	0.55	23.3	0.56
July	317	324	31		672	545	217	1,434	623,700	1.08	2.30	31	31	26.3	0.46	20.6	0.53
August	423	209	3		635	420	208	1,263	588,800	1.08	2.15	31	31	23.4	0.45	19.4	0.57
September	226	235			461	302	230	993	428,000	1.08	2.32	30	10	23.8	0.45	19.4	0.55
October	171	356			527	365	254	1,146	539,500	0.98	2.12	31	31	19.9	0.56	19.6	0.53
November	217	104			321	600	229	1,150	450,100	0.71	2.55	30	20	31.0	0.73	25.3	0.74
December	191	194		251	636	433	203	1,272	491,250	1.29	2.59	31 (a)		33.0	0.52		
Total for 1917	2,139	2,747	109	271	5,266	4,152	1,853	11,271	4,887,200	1.08	2.31	300	166	26.04	0.50	21.1	0.57
1918																	
January	157	166		586	909	246	192	1,347	536,650	1.69	2.51	31		34.4	0.75		
February	193	241		346	780	432	219	1,431	506,700	1.54	2.82	28		30.2	0.70		
March	246	383			629	516	217	1,362	536,700	1.17	2.54	28		29.5	0.62		
April	163	287	87		537	461	207	1,205	498,600	1.08	2.42	25		31.44	0.56		
May	181	351	38		570	237	190	997	520,800	1.09	1.91	25		30.25	0.60		
June	96	458	50		604	75	185	864	491,700	1.23	1.76	30		24.50	0.51		
July	220	439	1		660	232	126	1,018	575,700	1.15	1.77	31		27.0	0.64		
August	316	514	20		850	42	143	1,035	599,500	1.42	1.73	31		22.70	0.64		
September	123	177	64		564	150	201	715	266,430	1.37	2.68	8	21	27.80	0.56	13.35	0.43
October	122	18			140		165	305	132,880	1.05	2.30		24			14.40	0.41
November																	
December		153			153	6	211	370	151,930	1.01	2.44		29			18.7	0.48
Total for 1918	1,817	3,187	260	932	6,136	2,397	2,056	10,649	4,817,590	1.29	2.21	237	74	28.60	0.62	15.79	0.44
1919																	
January	126	65			[illegible]	12	223	426	188,020	1.02	2.27	2	30	[illegible]	0.56	15.60	0.52
February	90	481	42		[illegible]		161	774	404,100	1.52	1.91	21		20.70	0.53		
Total for 1919	216	546	42		[illegible]	12	384	1,200	592,120	1.36	2.03	23	30	20.62	0.53	15.60	0.52

Note. This record is not entirely conclusive, as it includes poor results together with good ones, and experimental as well as routine operations.

(a) Of this twenty-one days with about 1,000 kva.

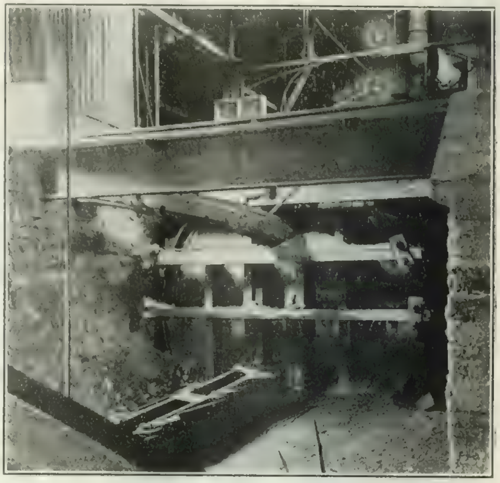
months. The whole plant was finally shut down on account of the poor copper market following the war. Thus it can be seen that long campaigns can be expected, and because of the simplicity of construction and relatively small size of an electric furnace compared with other smelting furnaces, lost time for repairs will be small and the repairs will be cheap and easy to make.

ELECTRIC METHOD SUITABLE FOR LOW-SULPHUR ORES

The electric method of smelting is particularly applicable where it is desired to conserve sulphur. The little sulphur loss that does occur is either by distillation of part of the "first atom" or by reaction with oxides in the ore. As the electric-furnace atmosphere is either neutral or reducing, the principal cause of sulphur loss, namely oxidation, that obtains in other kinds of smelting furnaces is eliminated. Furthermore, when smelting a raw sulphide ore, the electrode consumption will be less than with roasted ore, and therefore, under such condition, a saving can be expected on the 3 to 4 kg. per metric ton experienced at Sulitjelma. However, the main conditions that govern the choice of the electric method in preference to a fuel method of smelting are low power cost and high fuel cost.

OPERATING COST COMPARISONS

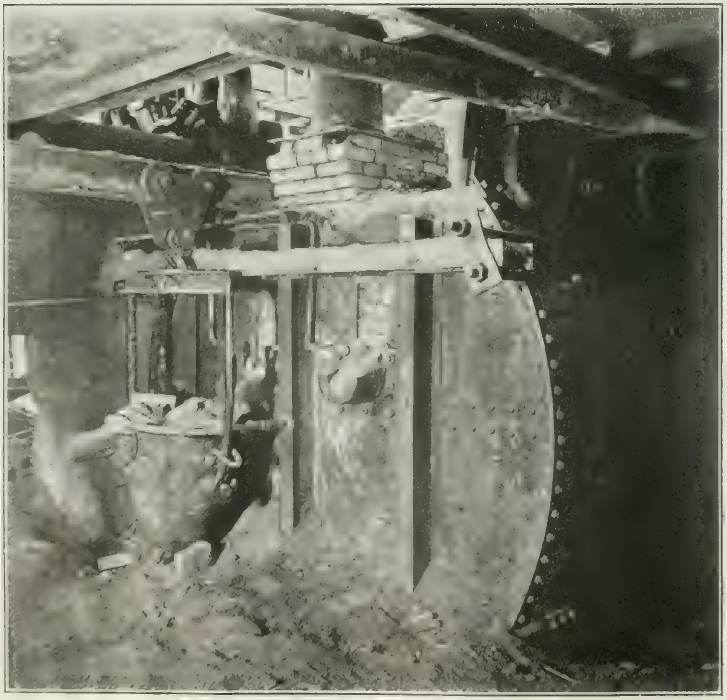
In comparing the operating cost of the electric method with that of fuel methods, it is only necessary to consider the items affected, to arrive at a conclusion as to probable economy. The following is a tabulation of such items, comparing the electric method with blast-furnace smelting and also with reverberatory smelting:



MATTE END OF 1,000-KW. FURNACE
(d) Stack. (e) Matte launder

BASIS OF COMPARISON OF VARIOUS METHODS OF SMELTING

Item	Electric Method	Blast-Furnace Smelting	Reverberatory Smelting
A...	Electric power	Coke	Fuel
	Electrode consumption	Agglomeration of fines	
B...	Slag loss	Slag loss	Slag loss
	Dust loss	Dust loss	Dust loss
C...	Operating labor	Operating labor	Operating labor
	Upkeep	Upkeep	Upkeep
D...	Interest on investment	Interest on investment	Interest on investment
	Obsolescence	Obsolescence	Obsolesence

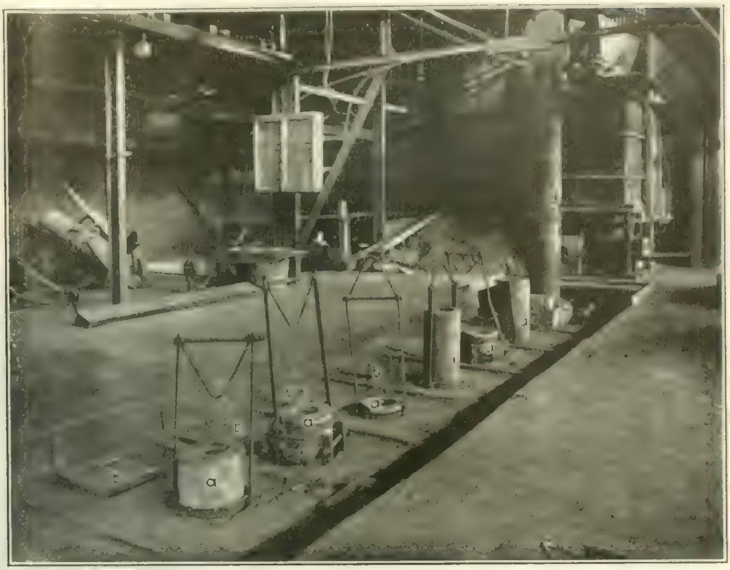


SLAG END OF 1,000-KW. FURNACE
(f) Slag pot. (g) Slag launder

Item "A" is the most important and the first that should be considered, as it contains the controlling conditions for the choice of the electric method—namely, cheap power and expensive fuel. Such conditions are found in mineralized localities, remotely situated, causing high freight rates, and where either hydroelectric power is available or cheap to install, or power can be obtained over a high-tension line from a cheap source, either steam or hydro-electric. By cheap power is meant, say, not over $60 per kw.-yr., delivered to the high-tension side of furnace transformers. Blast-furnace coke that would cost only $6 or $7 per ton at any of the great metallurgical centers of the United States costs over $20 in many remote places. This applies also to coal or fuel oil for reverberatory smelting. Carbon electrodes 12 to 20 in. in diameter, tapped for splicing nipples, now cost 6 to 7c. per lb. in the eastern centers of the United States, but would probably cost 9c.

per lb. in places where the electric method would be used. As no form of agglomeration of fines (such as sintering or nodulizing) is needed for electric smelting, this would constitute a gain over the usual blast-furnace operation or practice.

Item "B" is of next importance. Metallurgical loss in smelting is mainly made up of slag and dust losses. Undoubtedly, as borne out by Sulitjelma experience, the electric method will produce slags running much lower in metal content than the slags produced by fuel methods operating on a charge of like composition. This is due to the thorough, quiet settling at a perfectly controlled temperature. As ordinarily there are no combustion gases to be considered in the operation of the Westly electric furnace, or at the most only a little gas produced by occluded air in the charge and from sulphur reactions, practically no dust is thrown off from the furnace, thus eliminating the second main cause of metallurgical loss even with most up-to-date dust-catching devices.



CHARGE FLOOR OF 1,000-KW. FURNACE

(a) Electrodes (suspension omitted). (b) Charge openings (on both sides of electrodes). (c) Charge bin (one at each end of the furnace), one containing raw, and the other roasted, ore. (d) Stack.

It is difficult to forecast just how much the metallurgical loss will be lessened, but for most smelting plants a fair figure for the reduction of total loss would be, say, from 12 lb. copper per short ton of charge in fuel smelting down to 6 lb. per short ton in the electric method, or, probably, a saving of 6.6 lb. of copper per metric ton smelted. Assuming a value of copper at this stage of the process at 10c. per lb., a saving of $0.66 per metric ton of charge is effected. If precious metals are present, the saving will be still greater.

SLAG RANGE WIDE IN ELECTRIC SMELTING

In fuel smelting (blast-furnace or reverberatory), the slag must be kept within certain limits of composition to produce good metallurgical results. This frequently requires an addition of a flux or a low-margin ore whose metal value would hardly cover its smelting cost. As before stated, the electric method can handle a much greater range of charge composition, owing to the unlimited but perfectly controllable temperature, and therefore few ores would require flux in the electric furnace. A highly siliceous or aluminous slag that would be considered impossible for fuel smelting can be successfully run from the Westly electric furnace, and although it may analyze a little higher in copper, because of the lesser amount of slag produced, the slag loss per ton of ore charged would be less than when using fluxes.

Considering item "C," smaller units, ordinarily (100 to 300 tons per day), would be used with the electric furnace than with fuel furnaces (over 500 tons per day), and hence the operating labor cost would be slightly higher in electric smelting, but this would be offset by cheaper upkeep.

The amount of furnace repairs at Sulitjelma was found to be very low, the reason for which is apparent when the method of heating is considered. In a fuel-heated furnace, the heat is generated away from the ore or slag and must be transmitted to the ore or slag by conduction or reverberation. The inside surfaces of the furnace are subjected to higher temperatures than those existing in the material treated. In the electric furnace the heat is generated in the slag layer, and as the inside surfaces of the furnaces are heated only by contact or radiation from the molten bath, they must be at a considerably lower temperature than the bath. Furthermore, the quiet atmosphere of the electric furnace is not conducive to the excessive erosion that exists in fuel furnaces.

As to item "D," it is not expected that the capitalization costs of the Westly electric furnace plant would be any greater than those of fuel smelting plants. The furnace proper, on account of the simple design and lack of massive parts, would cost less per ton of capacity than either a blast furnace or a reverberatory. The electric equipment would be somewhat expensive, but this is at least partly offset by auxiliaries for fuel furnaces, such as blowers, fuel pulverizers or fuel-oil storage and atomizers, dust-catching devices, and other necessities. As the investment is about the same, interest charges will be approximately equal.

In considering obsolescence, it is usual to assume a shorter period in which a new style of device will become obsolete than for an old-style standard device, say five to seven years against seven to fifteen years. But under the metallurgical conditions that an electric furnace would be used, the furnace would be superseded by another electric furnace of better or larger design and a blast furnace or reverberatory would have to be scrapped before the termination of its natural life. In that event obsolescence charges would be about the same.

From the data it is apparent that the last two items, "C" and "D," are considered to be the same for electric and fuel methods, leaving the real comparison between the totals of items "A" and "B." A fair figure for item "B" is $0.66 per metric ton in favor of the electric furnace, as has already been shown. This leaves the final comparison to item "A."

As the Westly electric-smelting method is practically a modification of the standard reverberatory-smelting method, the principal difference being the substitution of electric heating for extraneous firing, a comparison between the electric smelting and the standard reverberatory smelting is germane. For this purpose the following tabulation is given, showing what must be the cost of fuel delivered to reverberatory burners to be on a parity with electric energy delivered to the high-tension side of the furnace transformers:

COMPARATIVE COSTS OF ELECTRIC ENERGY AND FUEL FOR SMELTING

Cost of Electric Power in United States, Cents per Kw.-Hr.	Cost of Electric Power in United States, Dollars per Kw.-Yr.	Electric Power Cost per Metric Ton of Charge Smelted at 700 Kw.-Hr. per M. T.	Add $0.81 for Electrode Consumption Taken at 9 Lb. (4.1 Kg.) per M. T. and 9c. per lb.	Deduct $0.66 for Less Metallurgical Loss	Parity Cost in United States Dollars per M.T. of Pulverized Coal Delivered to Burners, Assuming 6.5 Tons Smelted per Ton Coal Burned	Corresponding Cost in United States Dollars per Barrel of Fuel Oil, Assuming 4.4 Bbl. Oil Will Do the Work of 1 M. T. of Coal
0.2	17.52	1.40	2.21	1.55	10.08	2.29
0.3	26.28	2.10	2.91	2.25	14.63	3.32
0.4	35.04	2.80	3.61	2.95	19.18	4.36
0.5	43.80	3.50	4.31	3.65	23.73	5.39
0.6	52.56	4.20	5.01	4.35	28.28	6.43
0.7	61.32	4.90	5.71	5.05	32.83	7.46

To determine whether or not the electric method is applicable to a given smelting problem it is evidently necessary first to ascertain if the cost of fuel is almost as great or greater than that given in columns "F" or "G" corresponding to the prevailing power cost (interpolate for intermediate amounts). If found so, then of course the figuring must be again done in detail, using exact costs and quantities and considering all pertinent features of situation and plant.

Electrode Costs Can Be Reduced

The Westly furnace is particularly adaptable for the use of the Söderberg continuous, make-in-place, self-baking electrode. Assuming that this electrode will save 4c. per lb. of electrode material and with no greater electrode consumption, there will be an additional gain of $0.36 per metric ton of charge on the basis of a consumption of 9 lb. per metric ton.

Even under conditions in which the electric method cannot be applied to the whole treatment, troublesome material, such as argillaceous concentrates (flotation or table), flue dust, or extremely fine matter, must be handled, the removal of which from the regular smelting operation will hasten that stage and save fuel. It is likely that the troublesome material can be treated in the electric furnace to advantage.

Another plausible use for the Westly furnace is for slag setting. Frequently a blast furnace or reverberatory delivers a highly viscous slag that gives poor settling results and it may be undesirable to run the furnace at a high heat. In such an operation it would only be necessary to boost the temperature of the slag to a certain degree to obtain the desired fluidity. This can be easily accomplished in a small container electrically heated.

Experiments were made in slag settling in the Westly furnace at Sulitjelma, and the results indicated that the power consumption was less than 233 kw.-hr. per metric ton. Taking cost of power at 0.5c. per kw.-hr. and the value of the copper in the slag at 10c. per lb., the amount of copper thus saved would have to be 12 lb. per metric ton to show a profit; or, if precious metals are present, a total metal value of $1.20 per metric ton of slag. As can be said of most of the recent advances in the art of metallurgy, there is no great novelty, either in the process or furnace, but practically all of the many "snags" have been overcome by the technical talent at Sulitjelma.

AN 850-MM. (34-IN.) DIAMETER, CONTINUOUS (MADE AS USED IN PLACE), SELF-BAKING ELECTRODE
Used in a 1,400-kw. monophase carbide furnace of Gullspaangs Electrokemiska a/b, Gullspaang, Sweden. Equally applicable in the Westly furnace

There is really no definite limit to the size of the furnace. The inside width would be 2 to 3 m., dependent upon the size of electrode selected. The spacing of electrodes would be 1 to 1½ m., depending on the size of electrode and bath resistance required. The number of electrodes would be selected to fit the phase number and power input. For example, a dozen 14-in. (35-cm.) electrodes placed in a straight line along the middle axis of the roof would not be abnormal. A furnace thus fitted would be about 15 m. long inside, would take 9,000 to 12,000 kw., and would easily smelt from 300 to 400 metric tons of charge per day. In a high-power furnace containing many electrodes the electrodes may be divided into, say, three groups, each group connected independently to its own transformer, thus permitting adjustment of the heat of either end or middle of the furnace independently.

Summary of Advantages

The advantages of the Westly electrical method therefore are:

1. Conservation of sulphur.
2. Low metal loss, both in slag and by dust.

3. No thermal fuel requirement has to be observed.

4. Great range of slag composition (SiO_2 up to 62 per cent).

5. The method is particularly applicable in localities where power is cheap and fuel expensive.

6. Consumption of power is less than 700 kw.-hr. per metric ton; therefore, the size of the furnace should be 3,000 kw. to smelt 100 metric tons per day.

7. The electrode consumption is less than 4 kg. per metric ton.

WESTLY ELECTRIC METHOD WITH ZINC ORE

Small-scale experiments of smelting zinc ore by the Westly method were conducted, with satisfactory results. The ore used for experiment analyzed in per cent: Cu, 1.35; Pb, 3.92; Zn, 25.52; Fe, 21.52; S, 19.15; Al_2O_3, 8.28; CaO, 5.32; SiO_2, 9.57. Total, 94.63.

The experiments were conducted for the purpose of first finding a charge capable of forming a fluid and an easily melted slag low in Cu, Pb, and Zn, and, second, to develop a method for carrying out the smelting in such a way that lead together with lead-copper matte would be separated out; and to prevent metallic iron from separating out.

A 3-PHASE, 1,800-KW. FURNACE OF THE SOUTHERN MANGANESE CORPORATION, ANNISTON, ALA., USING THE CONTINUOUS SELF-BAKING ELECTRODE

The zinc and lead fumes formed during the smelting were burned to zinc oxide and lead sulphate and were caught in flannel filters.

A charge consisting of 1,000 gm. of roasted ore (containing 2 per cent S), 200 gm. limestone, 150 gm. silica and 120 gm. pulverized coke (for reduction) gave satisfactory results. The smelting of this charge, which was carried out continuously, gave the following products:

1. Zinc oxide and lead sulphate, containing: 66.9 per cent Zn, equal to 83 per cent ZnO; and 10.6 per cent Pb, equal to 15 per cent $PbSO_4$.

2. Matte containing: 9.7 per cent Cu; and 3.2 per cent Pb. A small amount of metallic lead also separated out.

3. Slag containing: 0.08 per cent Cu; 0.03 per cent Pb; and 1.78 per cent Zn.

Testing Platinum-Palladium Separation

At the Reno, Nev., station of the U. S. Bureau of Mines a study is being made of the conditions affecting the separation of platinum and palladium by precipitation of the latter, using the dimethylglyoxime method. Samples from the Ordnance Department of the U. S. Army are being tested.

The Mica Industry of Argentina

Mica has been mined on a small scale in Argentina for many years, but it is only recently that the industry has received serious attention, according to *Commerce Reports*. In the five years preceding the war, 46 tons of mica was exported, of which the largest share went to Great Britain, the remainder being taken by Germany and Austria. In 1919 the exportation had increased to 145 tons, of which the United States took more than half.

The mica exported is muscovite, from the pegmatites of the sierras of Cordoba and San Luis, occurring throughout the extent of the Cordoba hills and northward through the provinces of Catamarca, La Rioja, Tucuman, and the territory of Los Andes. All of the mining is done on a small scale by individuals with little or no capital, and the mica is sold to factories or dealers in Buenos Aires. The chief local use is in the manufacture of electrical heaters, although one small factory in Buenos Aires selects and cuts mica for phonograph disks and other uses. There are, however, no figures available on the production of mica for domestic consumption. According to one mine owner, a metric ton (1 metric ton equals 2,204.6 lb.) of mica from the Cordoba mines will yield sizes as follows: Special, 15 kilos (1 kilo equals 2.2046 lb.); No. 1A, 35 kilos; No. 1, 50 kilos; and in increasing proportion through the following five grades to 300 kilos of No. 6.

According to the Argentine mining code, it is not necessary to own land to exploit the mica, mining rights being taken out by anyone locating the mineral, and therefore any American companies interested will not find it necessary to own mines. The numerous known deposits of the Cordoba hills, 200 miles west of the port of Rosario, are capable of being put on a producing basis if payment for the mineral can be made at the mine or railroad station. Lack of capital is holding back the workings. An American company well represented in the field could collect almost any desired quantity of Argentine mica for export.

Exports of Vanadium From Peru

During the calendar year 1920 a total of 198,760 sacks of vanadium ore, aggregating in weight 10,534 metric tons, was exported from Peru, and shipped to New York, according to *Commerce Reports*. The value in Peruvian money was fixed by the exporters at 12 sols per sack, with shipping expenses averaging 45 centavos per sack, giving a total valuation at the port of 2,474,562 sols. In American money the values fixed by the shippers amounted to $1,237,281, computed by giving an arbitrary value of 50c. United States currency to the Peruvian sol.

In the first six months of 1921 there have been only four shipments of vanadium ore, aggregating 44,562 sacks, with a total weight of 2,362 metric tons, valued by the shippers at 12.45 sols per sack at the port. In shipments covering the 1921 exports, the value has been reduced to American money at two for one as in 1920, giving a total of $277,400, despite the fact that Peruvian exchange has been more than 20 per cent below par during the year.

The local office of the corporation that has been the principal exporter of this ore advises that the maximum vanadio-acid content of the Peruvian product has during the last two years been 26 per cent, the average being 20 per cent.

The Tiu-Tiu-He Zinc-Lead-Silver Deposit, On the Siberian Coast

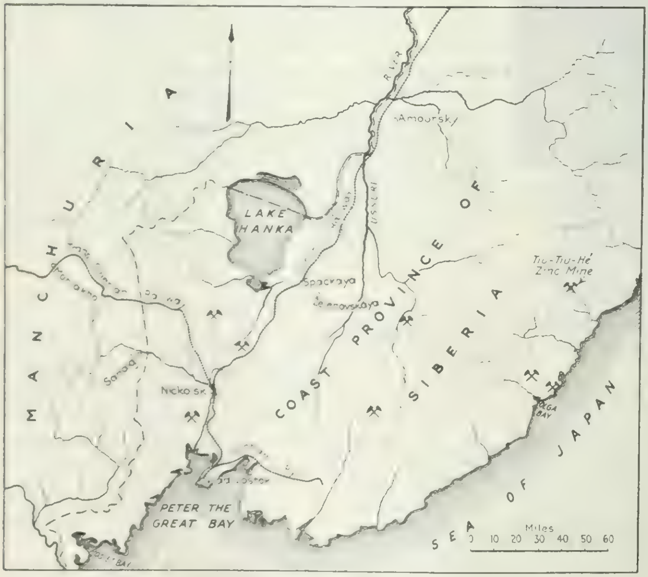
Calamine Ore Mined by Open-Cut Methods From Deposits in Southern Sikota-Aline — Hand Sorting Practiced and Aërial Tram Used To Convey Shipments From Mine to Tidewater — Coking Coal on Saghalin Island 400 Miles Distant

BY CHESTER WELLS PURINGTON

Written for Engineering and Mining Journal

MINING OPERATIONS on a considerable scale were carried on from 1909 to the outbreak of the Great War at a point twenty-four miles inland from the mouth of the Tiu-Tiu-He or Te-Tu-He Creek, in latitude 44 deg. 15 min. north on the east coast of Siberia, about 250 miles slightly north of west of the town of Otaru, Japan. The Tiu-Tiu-He mine is connected with the coast of the Sea of Japan, into which the creek empties, by a 2-ft. gage railway. The small harbor is indifferently protected. From this harbor to Vladivostok is about two hundred miles in a west-southwest direction.

About two thousand acres of mineral claims are held by the heirs of the late Jules Bryner, of Vladivostok, to whom the property originally belonged. About 1910, Messrs. Aaron Hirsch & Co., of Halberstadt, acquired a large interest, and a large deposit of calamine ore was developed by open-cut method. A Bleichert aërial tramway, one and one-half miles long, as well as the necessary surface buildings, and the light railway above noted, were installed. Although the claims were located in 1902, and patented in 1903, it does not appear that shipments were made on a commercial scale until 1907. Mr. Bryner informed me that about 140,000 tons of 50 per cent zinc ore (calamine), was shipped to Antwerp from Tiu-Tiu-He between 1907 and 1913.



SKETCH MAP SHOWING LOCATION OF TIU-TIU-HE MINE

Gluzdovaky ("Coastal-Amur Province"), Vladivostok, 1917, gives the detailed production for three years as follows:

	Calamine Ore (Tons of 2,000 Lb.)	Lead-silver Ore (Tons of 2,000 Lb.)
1912	31,600	5,700
1913	29,700	33,500
1914	22,600	15,300

Apparently the two estimates do not refer to precisely the same period, nor is it known what was the tenor of the lead-silver ore produced. As no considerable milling plant had been installed up to 1914, all the ore must have been of shipping value. It is reasonable to assume that the value of the ore produced in the period of operation has been between $5,000,000 and $6,000,000.

In superficial appearance the portion of the coastal Sikota-Aline mountain range resembles the Cœur d'Alênes of Idaho. It is heavily timbered with spruce, pine, and larch. The elevation of the range is from 2,000 to 3,000 ft., and in general the coast is bold and rocky. The region of the Sikota-Aline, lying between the 42d and 50th parallels, and between the Ussuri and Amur rivers and the coast of the Japan Sea, presents a striking similarity in size, form, and meridional extension to the area of the State of California. In the immediate vicinity of Tiu-Tiu-He, buttes or pinnacles of limestone are intersected with narrow canyons and jagged passes. The original calamine orebody, now worked out, was in the form of one or more stockworks occupying replacement cavities in limestone, in contact with quartz porphyry. The limestone lying on the west and the porphyry on the east, the general strike of the orebody is stated to be north-northeast in direction, with a dip of approximately 70 deg. to the east. The main orebody occupies the east side of a fairly sharp peak, near the summit, about 1,500 ft. above sea level. The mining and sorting were done by Chinese, and all ore above a certain grade was trammed to tidewater, as stated, loaded to steamers, and shipped.

The ore as taken out resembled chalcedony in appearance, was pearl-gray in color, translucent, botryoidal in structure, and with concentric laminations. It is stated that the sampling, after thorough development in 1907, resulted in the establishment of a calamine reserve of 200,000 tons of 48 per cent zinc tenor. As seen by the estimate of production given in the accompanying table, a large part of this ore has since been extracted.

The cost of mining, sorting, land and sea transport to Antwerp and marketing appears to have been about $15 per ton, before the Great War. Chinese labor then cost about 60c. per day gold, wages alone, and would probably be more than double today. Blasting dynamite cost in 1900 about 67c. per lb. at Vladivostok. All mining was done by hand, no air drills being used so far as I have been able to ascertain. The technical staff in charge of operations was composed of Germans and Russians.

Since 1914 a considerable number of foreign engineers have visited this property, and numerous metallurgical tests have been made on the concentrating zinc-lead-silver ore which has been found underlying the calamine orebody, and in adjacent veins. Between the top of the mountain and the creek, a vertical distance of about 800 ft., a tunnel for development purposes has been driven about one-third the distance from the summit to develop low-grade ore lying beneath the stockwork. This and other development work are said to have established the possibility of about a half million tons of ore carrying 18 per cent zinc, 12 per cent lead, and 8 oz. of silver per ton. What the recovery will be and what process is most suitable appear to be points on which opinions vary. Below the level of the tunnel, to that of Tiu-Tiu-He Creek, and even lower, there are stated to be further possibilities for the development of low-grade sulphide ores.

REGION POSSESSES ATTRACTIVE PROSPECTS—COAL AT SAGHALIN

The region has so far developed about twenty mines and prospects of base-metal ores, including some copper showings. Tiu-Tiu-He is the only mine on which any commercial work has been done, and as the region is little equipped with trails, and covered with dense vegetation, prospecting is difficult. Lines of structure are strong, and the known ore deposits follow the north-northeast strike before noted. The limestone cliffs and mountains in the vicinity are characterized by caves of great size due to solutional action. The largest of these, the "Mokrushinski," lying about twenty miles west of Olga Bay, slightly to the south of Tiu-Tiu-He, has been only partially explored. It has been penetrated for 500 ft., and contains one chamber over 200 ft. long and 60 ft. in height.

Large deposits of coking coal at seaboard on Saghalin Island, about 400 miles northeast from Tiu-Tiu-He harbor by sea, would provide necessary fuel if the lead and zinc deposits of the southern Sikota-Aline should prove of sufficient importance to establish a smelting industry.

Improving Treatment of Silver Precipitates

At the Intermountain Station of the U. S. Bureau of Mines, in a study of the treatment of silver precipitate from acidified brine leaches, a detailed examination showed that the difficulties being experienced in the precipitation of silver, because the precipation was of too low-grade, and therefore hard to refine, were due primarily to arsenic which was collected in the solution on acidifying the same with the acid roaster gas. Schemes were worked out to treat the impure product thus formed, and the necessity in future design of elimination of dust and arsenic from roaster gas before using this latter to acidify solutions under treatment was emphasized.

An Improvement in the Manufacture of Vessels Used in Retorting Zinc Ores

BY J. P. VARIAN

Written for Engineering and Mining Journal

Present practice in the manufacture of the clay retorts and muffles used in zinc distillation furnaces is generally as follows:

The crushed clay and grog, mixed in definite proportions with enough water to obtain the desired consistency, are put through a pug mill and then compressed into balls. These balls are piled in air-tight pits and allowed to remain intact for a certain period, after which they are repugged and made into retorts and muffles. These are thoroughly dried and are then put into preheating kilns, daily, where they are brought up to the temperature of the furnaces. Little improvement has been made in recent years in the preparation of the clay and grog for the first pugging.

It is good practice, but is seldom carried out, to have the grog sized so as to secure a minimum of voids. It is of still more vital importance to coat each individual grain, no matter how small it may be, with a thin film of clay. This seals up the pores and permits a stronger bond between the grains of grog and the clay. It would be ideal if this film was all that was necessary to bind the grains together. Unfortunately, sufficient plasticity would not be obtained to work the clay.

To obtain a film of this nature in any pug mill is difficult, if not impossible, because the clay cannot be thinned to a sufficient degree. To accomplish it and at the same time improve the process, if possible, the modifications as here set down are proposed:

The clay is received from the freight car into a large tank, which is at least 10 ft. high and 20 ft. in diameter. At the same time that the tank is being filled, enough water is added so that when the tank is full the mixture will be of the consistency of a thin mud. Some means of mixing should be provided, and it must be in operation from the addition of the first lot of clay. A sump should be provided at the bottom to receive the sand, pyrite nodules and other matter which may separate during the mixing. There should be a number of these tanks to provide sufficient storage.

As the tank is filled the grog should be added, in the proper ratio to the amount of clay present. This can be continued until the tank is full of clay, water, and grog in definite amounts. Agitation should continue until a uniform mixture results. The tank may now be allowed to stand; its contents should be of the consistency of a cement slurry, and the pulp should be of such a density that the grog will remain in suspension. The tanks are left in this condition until the desired "rotting" is accomplished. Some clear water may form a layer at the top and may be removed. If the clay-grog mixture cannot be dried enough in the tank, it may be removed, stored, and allowed to dry until it is hard enough to be pugged and made into vessels.

Crushing of the clay and one pugging is eliminated by this process. Drying and weathering of clay before crushing will be unnecessary. A washed and refined clay is obtained, freer from sand and other impurities. The clay mixture is constant and uniform. The individual grains are coated with a thin film of clay and porosity is thus reduced. Crushing, mixing, and "rotting" are accomplished in one operation, and all handling may readily be done mechanically. The mixing tanks permit of a minimum amount of storage space.

Mining at Stanford University

A Six-Year-Curriculum Arranged to Afford a Broad Foundation In Science, Language, English, Economics, and History Intensive Work in Mining and Metallurgy a Feature of the Graduate Course

BY GEORGE J. YOUNG
Western Editor, *Engineering and Mining Journal*

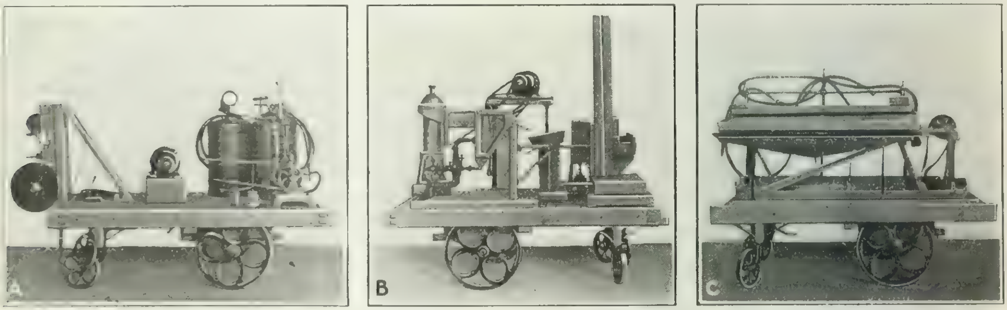
FOR A NUMBER OF YEARS Stanford University has had a course in mining and geology in which the geological element was perhaps strongest. Nevertheless, many able men were graduated who distinguished themselves in mining, metallurgy, and geology. Although the number is small, the quality is high.

After some discussion in 1915-16-17, participated in by mining alumni, the president and T. J. Hoover, the new head of the mining division, as to the best course in mining engineering and related subjects, a definite policy was agreed upon and put in operation.

As this policy resulted from the discussion of mature men, experienced in the mining industry, a statement of its important features should be of considerable interest. Four years, owing to the number and complexity of the vital subjects, was considered insufficient for a satisfactory education. The outcome of the discussion was to establish a two-year graduate course in which the mining, metallurgical, and petroleum specialties would be intensively given, the student having the option of any one of these specialties. Entrance to the graduate course would obtain from a four-year undergraduate course especially planned to lead up to the work of the graduate course.

MONEY GOES PRINCIPALLY INTO TEACHING STAFF

It was also decided to put the available money into the teaching staff, books, and small-scale laboratory equipment, with the objective of developing determinative work as related to the industry rather than facility in the operation of various commercial machines. Thus, the training was to be mental rather than objective. Emphasis was to be placed on a broad, sound, technical education. As T. J. Hoover put it, the objective was not a "glorified mechanic" but a well-trained technical man.



PORTABLE LABORATORY APPLIANCES

A—Power unit, with speed reduction, compressed air and vacuum to be attached to other units as needed.

B—Flotation machine unit, which was designed to be attached to a power unit as needed.

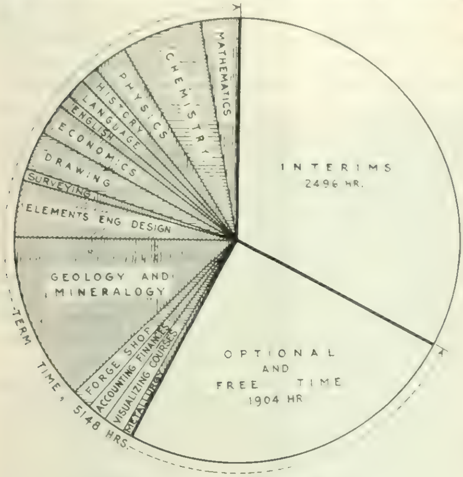
C—Concentrating table (gravity) unit; the device to be attached to power as needed.

The course as planned differs, according to T. J. Hoover, from the Columbia University six-year course. Mr. Hoover analyzed fifty mining courses and tried to discover the law underlying them. His conclusion was that mining courses have been built around men, each representing the work of some expert or leader. Starting out to plan his course, Mr. Hoover first decided upon two main subdivisions, mining and metallurgy. The subject headings used by Le Neve Foster suggested the naming of each principal subdivision.

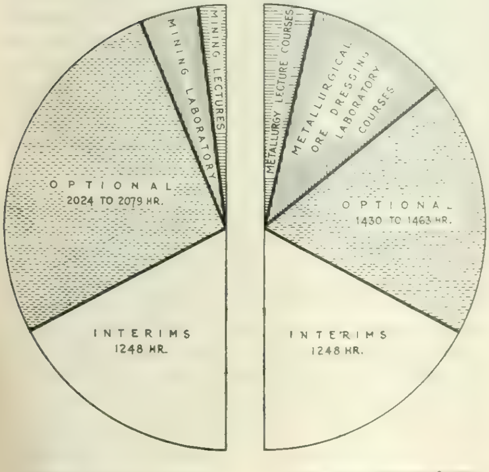
Four distinct sections were decided upon—economics of mining, mining proper, metallurgy, and petroleum. In each of these sections one course is planned which covers the entire subject in a general way. The course is given to undergraduates, allowing an option between the study of mining and metallurgy and the course in petroleum. The object of these general undergraduate courses is to enable the student to visualize the subject before he has definitely selected his graduate specialty. The detailed courses in mining and metallurgy and in petroleum are extensions of the general courses. Thus, if the undergraduate takes all of the general courses and digests them, he will have an authoritative review of the field and can select his objective in the graduate college with greater assurance than is possible with most mining courses.

Mr. Hoover, an engineer of mature experience in many capacities, has made a name for himself in the mining industry. So far as I am aware, this is his first experience in educational work. As his chief assistant in metallurgy, James M. Hyde has been selected. Mr. Hyde has also considerable experience in the industry and has had some educational experience. As associate professors, three young men of more or less experience, W. J. Crook, W. F. Dietrich, and F. G. Tickell, have been selected. W. D. Mills and W. H. Shockley, both well known in the industry, have been appointed as part-time lecturers. The component parts of the personnel represent maturity, experience, and youth. The dominating part of the personnel, it must not be overlooked, is representative of mining and not of the educational element.

A mining course evolved as this one was, and planned by men of considerable experience in mining, is of great interest and worth analysis. The pre-mining course of four years is arranged "to give prospective engineers a broad foundation of science, language, English, economics, and history." This course on an estimated time basis is given in the tabular summary and graphically depicted in the above illustration.



196 Weeks at 39 Hr. per Week, 7644 Hr
Pre-Mining Course, 4 Years



Graduate Mining Course
2 Years (3822 Hr.)

Graduate Metallurgical Course
2 Years (3822 Hr.)

Total Time Based on 39-Hr Week

PRE-MINING COURSE AND GRADUATE COURSES

In the two graduate years, it is not possible to lay out a precise course, as the minimum requirement is 90 units, or an average of 15 units for each of the six quarters. The maximum is approximately 120, of which 60 units are for mining and metallurgy courses and 60 units for cultural and other courses. The graduate student is allowed a liberal option, amounting to more than one-half of the total units. The optional courses are decided upon by consultation with the instructors, so that it can be said that the student is the arbiter of his own course. Thus individual talent can satisfy itself, limited only by the resources of the university in teaching staff and facilities. In economics of mining and the study of mining the following courses are offered:

PRE-MINING COURSES

	Hours	
Mathematics through calculus	220	
Chemistry—		
General	77	451
Determinative	22	
Physics—		
Lectures and laboratory	198	
History	99	
Language	99	
English	66	440
Economics (social, economic, political)	176	
Drawing (instrumental, lettering, descriptive geometry, machine drawing)	220	
Surveying (elementary)	55	
Theoretical mechanics	110	
Strength of materials	99	308
Hydraulics (a)	44	
Geology—		
Mineralogy—		
Paleontology	132	
Dynamic geology	55	
Mineralogy	88	
Crystallography	88	
Economic (non-metals)	44	946
Economic (ores)	44	
Field geology	(b) 264	
Topographic geology	(b) 231	
Systematic mineralogy (a)	88	
Mechanical (forge shop)	110	
Accounting	33	
Corporation and trust finance	44	
Accounting of investments (a)	44	
Principles of mining	55	
History of mining	11	
Principles of metallurgy	55	
Principles of petroleum mining (a)	55	
Pyrometry, assaying, metallurgical calculation	22	
Pyrometallurgy—Iron and steel (d)	33	
Valuation fuels and oils (d)	44	
	3,482(c)	

(*a*) Optional, principles of petrolum mining taken by petroleum students only. (*b*) Estimated. (*c*) Total, less hydraulics, pyrometallurgy iron and steel and systematic mineralogy, which are optional with accounting of investments, is 3,262 hours. Laboratory and field hours total 1,662. (*d*) Choice of either one.

	Hours		
Mine valuation	11		
Mine organization	11		
Mine management	11		
Mine rescue and first aid	11		154
Prospecting and development	33 to 55		to 176
Surface equipment	22		
Surface operations	22		
Underground operations	33		
Laboratory courses			
Valuation, organization, management	99		
Equipment plans	22 to 33		341
Mining machinery	44		to 374
Mine operations	44 to 66		
Mining research and thesis	132		
Total	495 to 550		

Total time in 66 weeks, 39 hours per week, 2,574 hours.

The graduate courses offered in metallurgy are as follows:

	Hours		
Crushing, sizing and classification of ores	22		
Concentration processes	22		
Hydrometallurgy—gold and silver	33		
Hydrometallurgy—copper, lead, zinc	33		
Pyrometallurgy—iron and steel	33		
Pyrometallurgy—copper, lead, zinc	33		286
Pyrometallurgy—nickel, aluminum and minor metals	33		
Electrometallurgy	22		
Metallography	11		
Pyrometry	11		
Metallurgical calculations	22		
Assaying	11		
Laboratory			
Ore dressing	66		
Hydrometallurgy	66		
Metallurgical machinery—design	66		
Pyrometallurgy	66		
Electrometallurgy	66		825
Metallography	66		to 858
Pyrometry	66		
Metallurgical analysis	99 to 132		
Metallurgical research and thesis	132		
Assaying	132		
Total	1,111 to 1,144		

In addition, the department of economic geology offers a seminar on ore deposits and special courses, and in the civil engineering department, a course in engineering estimates and reports is open to the mining students. All other departments in the sciences and arts are open to the graduates within reasonable limitations.

The pre-mining course gives a modest preparation in mathematics, chemistry and physics, in all 869 hours. In history, language, and economics there is an approximate total of 517 hours. In engineering subjects representing the foundation work in design there are 308 hours. Graphostatics is omitted and is probably optional. Drawing is apparently covered, but the time devoted to surveying is scant. Surveying is often designated a "bread-and-butter" subject for mining students, and it is interesting to note that this phase is not considered of the same importance as in other schools. Most of the geology is thrown into this pre-mining course, and herein is an apparent inconsistency. Shop work is included, as are the visualizing courses in mining and metallurgy. Apart from the generous proportion of time given to economics, the course is not especially novel, nor will other schools be greatly influenced by it.

In the graduate courses there is a considerable dissection of the general subjects, and the time devoted to some subjects, particularly the mining subjects, is limited. One hour per week lecture courses are considered by many instructors to be objectionable. Exceptionable efficiency would be required in imparting mine valuation in eleven hours. It is true that this course is extended into the laboratory, but even then the student must put much extra time upon it to cover it satisfactorily.

LARGE GRADUATE ENROLLMENT NOT EXPECTED

The dissection into many subjects is further aggravated by the Stanford system of dividing the year into three eleven-week quarters with an interim of a fourth quarter. The net result is that the beginning and ending time of a class unit in the aggregate represents a large waste of effort. There is the further waste of getting started and ending up a quarter, which is done three times in each year. Thus the work is carried out in small increments interspersed with larger increments, all interruptions to continuous effort. However, this is the obvious criticism. As the course is in process of experimentation, changes will undoubtedly be made both in the allotted time and in the number of separate courses.

Mr. Hoover informed me that a large graduate enrollment was not expected; in fact, thirty students is about all that preparations are being made for. With five faculty members and two lecturers in mining and metallurgy, there is abundant time for personal contact with faculty and graduate students. Broken up into three groups, mining, metallurgy, and petroleum engineering, this would give an average of five to each course in each year. Under such circumstances it is probable that the talents, aspirations, and even the family history of the students will be every-day knowledge to the instructors. Under such circumstances, also, segregation of courses and definite time allowances become unimportant.

Another interesting feature is the junking of large-scale equipment. No attempt is to be made with the milling of large lots of ore, nor with the conduct of mining operations. Instruments for quantitative laboratory measurements are to be liberally supplied and experiments will be on a small scale. In the ore-dressing laboratory small concentrating tables, flotation machines, and other units are mounted on wheeled stands, and can be moved wherever wanted. This will be looked upon as a "sacrilege" by some mining schools that have spent much money to avoid the stigmatization of "test-tube schools" and are proud of the "near-mills" and "smallest commercial unit" apparatus. In the race to be considered "practical," this recession at Stanford will provoke no little discussion.

The environment of Stanford suggests many of the things that appear in guide books about California, and no doubt this environment exerts an influence upon the thought of the professors, and, if upon the thought of the professors, then upon that of the students also. A horticultural, agricultural, and touristical setting for a "technical" school may in the end be beneficial. Parhaps its graduates will be able better to wear through the staid forties of life and the subsequent years than other graduates who have hocked their all upon intensive study of technology.

The ideal of quality rather than quantity is sufficiently scarce among Western technical schools to warrant applause when it appears. A measure of the ideal is indicated in the following, taken from one of the university publications upon the characteristics desirable in a student of mining and metallurgy:

> "The absolute essentials may be stated as absolute honesty and moral courage, perfect health, rugged constitution, capacity for hard work, and, probably most important of all, a strongly developed instinct for order; there is no place in this profession for disorder or slovenliness."

The outstanding features of the present mining course of Stanford University are the six-year course, with its manifest attempt to develop other as well as technical subjects, its loose curriculum as contrasted with the strictly prescribed one, its generous optional provisions, its insistence upon the student's initiative in selecting courses, its faculty contact, its avoidance of extreme objective instruction, and its faculty drawn from men experienced in the industries. It is another experiment in mining education, and its development and outcome will be viewed with interest.

Metals in Early History

In an address on "The Early History of Copper and Bronze," at the recent meeting of the Birmingham local section of the Institute of Metals, George Mullins said, according to *The Ironmonger*, that the earliest known use of copper was reported from Egypt and the Euphrates Valley probably as far back as 5,000 B. C. The Cretan civilization knew copper and bronze about 4,000 B. C., and after the subsidence of Cretan power the Phœnicians carried on the metallurgical tradition.

Metal work began in the British Isles with the use of Irish copper tools about 2,500 B. C., originating apparently under influences from the Mediterranean, probably through Spain. The first metal used in England was bronze, introduced about 1,800 B. C., and was imported from the Continent, the constitution of the remains found showing that the bronze must have been made by people who had been accustomed to its use. With regard to the use of iron by prehistoric man and in the earlier historic ages, the speaker remarked that it should be remembered that the word "iron," as well as the word "ore," was derived from *aes*, which was usually translated "brass," but often, as, for instance, in the Bible, meant "bronze." The word *aes*, in fact, was the name given to any metal that was worked.

Geologists of Note

James Furman Kemp

WHEN THE TITLE "Daddy" or "Uncle" is applied to a professor by his students, it is a dead sure sign that he has won a warm spot in their hearts. This note of university life finds expression in the great esteem in which James Furman Kemp is held by his students, old and new. Kindly, sympathetic, modest, an inspiring figure in his profession, he possesses qualities that have naturally endeared him to those who have been fortunate enough to come in contact with him in classroom and field. His career has been that of a scholar. Born in New York in 1859, he was one of the first students in Adelphi Academy, and, graduating in 1876, he entered Amherst. Being always fond of outdoor life, hunting, fishing, and the like, he was early attracted to geology. While at Amherst a mining excitement was engineered in the town, and many townspeople — the faculty was also not immune — suffered the usual severe losses. The little experience was a moving influence in his decision to prepare to teach geology from a mining standpoint and to do what he could to spread sound education on ores and minerals. Years afterward in reading J. D. Whitney's "Life and Letters" he was interested to observe that the same motive had actuated Whitney to prepare his "Metallic Wealth of the United States," an extremely influential work. On graduating in 1881 from a fairly severe classical and scientific course, Professor Kemp entered the School of Mines of Columbia College, as it was then called, and received an E. M. degree in 1884. He did all the work he could with Prof. J. S. Newberry, then one of the veterans of American geology and especially experienced in the West. He was his private assistant later, and in 1885 accompanied him to the International Geological Congress at Berlin, remaining in Germany after the sessions to study petrography and mineralogy at Leipsic and Munich. Returning to the United States, Professor Kemp taught at Cornell for five years and was called to Columbia in 1891 to succeed his old teacher, Professor Newberry, who had become incapacitated. Columbia has been his home ever since except for a short absence from his professional duties there on account of illness.

JAMES FURMAN KEMP

It has been Professor Kemp's aim to see all that he consistently could of the mining districts of America and Europe. His book, "Geology and Ore Deposits of the United States and Canada," was the first thorough work of its kind in the country. Practically all mining engineers are familiar with it. Adirondack geology, particularly its Pre-Cambrian problems, have greatly interested him, and he has written constructively upon the subject. The most active problem in his mind has been that of ore formation. Of the influence and importance of igneous agents in the cooling stages of intrusive rocks he early became convinced, and has written much to show not only that these agents *might* produce the effects but that there was no other reasonable cause which would. The comparatively shallow depths to which the evidence shows the ordinary ground water to extend was one important conclusion; and the necessity of contributions from the igneous mass to the contact zones was another, the last coincidentally advanced with Professor Lindgren. A list of the literature which Professor Kemp has contributed to better understanding of mineral deposits and geology would be far too long to include here. Occasionally he has appeared as an expert geological witness in mineral litigation, and has been engaged in a consulting capacity on both mineral and other projects. He has been very active in the affairs of the American Institute of Mechanical Engineering, was its president in 1912 and is now an honorary member. He is a familiar figure at practically all the meetings of the Institute, not to forget Mrs. Kemp, who has been his constant companion in all his trips. His interest has also extended to the Mining and Metallurgical Society, the Geological Society of America, and other scientific organizations.

The affection of his students for Professor Kemp is reciprocal. "I never would have been happy if I could not have taught and have had students around me who have been a hundred times more to me than I could tell them in words," is how he modestly expresses it.

THE PETROLEUM INDUSTRY

Rumania's Petroleum Industry During 1921

SPECIAL COMMUNICATION

According to returns so far available, the production of crude oil in Rumania for each month of 1921, compared with the same period of 1920, was as follows:

	1921 Metric Tons	1920 Metric Tons
January	97,825	70,028
February	82,724	66,354
March	93,165	79,149
April	97,601	90,735
May	99,368	78,436
June	79,722	79,757
July	83,694	83,313
August	106 217	99,005
September	102,338	99,960
October	112,311	91,098
November	105,920	101,248
December	100,000	94,934
Total for the year	1,160,885	1,034,017

The increase in production over the preceding year was about 125,000 tons, or 12 per cent. It is equal today to about 60 per cent of the pre-war production, when during 1913, the record year, 1,885,617 metric tons of petroleum was produced.

The industry is slowly recovering from the destruction brought about by the war. Indeed, it is a matter of record that during the winter of 1916 the oil wells were completely destroyed by the Allies, to avoid that large quantity of oil, badly needed by the Germans, falling into their hands. Notwithstanding the strenuous efforts which the invaders made to repair the wells, they were unable to produce more than 527,491 tons in 1917. Nevertheless, in 1918 the output was 1,214,219 tons, and the Rumanians have not been able, up to date, to equal this total.

The principal causes responsible for this situation were of three different orders: First, materials difficulties, due to lack of proper and regular means of transportation. Materials can be only slowly, at enormous cost, and with great pains sent by rail to Rumania, on account of the chaotic situation of the railroads in the neighboring countries—Hungary, Czecho-Slovakia, and Poland. On the other hand, for the maritime transports, only two ports, Braila and Galatz, can be used, and conditions are unfavorable, because these harbors are usually blocked by ice during several months in winter, and are lacking in modern and powerful equipment to handle the merchandise after its arrival.

Worst of all, in Rumania itself, the traffic facilities of the national railroads are utterly insufficient. The country has not at its disposal the cars nor the engines which it needs to carry from the harbor to the oil fields the general supplies which must come from industrial countries, like the United States, England, France, Belgium, and Germany. Production on the fields often has had to be limited because all available tanks were entirely filled. Producers could not ship the oils to the refineries or consumers, because they had no tank cars, and the pipe lines were not operating, or, if so, only at a reduced capacity.

In the fields where power is dependent on electricity operations have been greatly handicapped, and even suspended for weeks, by the frequent failure of the powerhouse of the electrical company of Campina, which supplies the greater part of the current used.

The sinking of new wells is entirely dependent on the material which operators can buy abroad, and purchases and replacements are rendered exceedingly difficult by the low rate of exchange on Rumania money. This financial difficulty is greater today than ever before.

The last, but not the least, cause of reduced output and difficulty in production which has handicapped the progress of the oil industry in Rumania is the continual interference of governmental regulation in the oil business. This has operated along three lines: fixation of maximum prices—but not in accordance with the producing cost—for the oil sold inside the borders of the country; limitation of the quantity which could be exported, and heavy taxation on the product sold on the foreign markets. Against all these difficulties the oil producers of Rumania have done their utmost, and they have not succeeded so badly, if one considers that the results obtained surpass by far those that have been possible in all other kinds of Rumanian industries.

The country as a whole is taking great interest in the oil business. National capital investment is much more largely represented in this branch of activity than it was before the war. The total nominal capital of all the companies is 2,650,000,000 lei[1], on which 2,273,000,000 have been paid. The increase during the last year alone has not been less than 950,000,000 lei, and it will not be surprising to learn that this increase has been the largest ever recorded in the Rumanian petroleum industry.

The prospects for the future are encouraging. The pipe lines are operating daily more satisfactorily; the railroads have bought some equipment, and the great harbor of Constanta, which is open all the year round, can be used regularly. Indeed, the large Carol bridge, on the Donau River, which was destroyed during the war, has been repaired, and it was reopened for traffic on Dec. 15, 1921.

In an effort to improve existing power conditions, the Steaua Rumania, one of the largest operating companies, is building a power house in Floreshti, which will furnish electrical current, conjointly with the centrals of Sinaia and Campina, to the oil fields of the Prahova district. It is expected that the new electrical plant will be in operation next summer. It cost 50,000,000 lei, and will be able to produce 6,300 kilowatts. Arrangements are provided to carry its capacity to 24,000 kva.

The number of wells which are now being drilled is 264, of which 30 are using rotary apparatus; 20 are being water-flushed, 14 are using cable tools, and 200 possess Canadian-Galician outfits. Compared with the production of the United States during 1920, 443,402,000 bbl., or 58,972,466 metric tons, the production of Rumania seems small. Other differences are interesting:

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[1] The lei was before the war rated as equivalent to 19½c. United States currency.

The number of producing wells in the United States on Oct. 31, 1920, was 258,600, which gave a daily average output of 3.9 bbl., or about 650 kg. each. The 700 wells of Rumania are producing daily 3,250 tons, or an average of 4,600 kg. per well in twenty-four hours. The American production in some fields like that of Pennsylvania (where 67,700 wells are operated) is less than 0.3 bbl. per well, and in the old region of that state, which has been worked for fifty-five or sixty years, the output varies from 0.2 to 1.1 bbl. per day.

In Bushtenari, the oldest field of Rumania, operated for twenty-five years, the production for the 225 wells is again 210 tons, or 900 kg. per well. These facts show the relative wealth of the Rumanian oil fields and the skill of the American oilmen, who are able to operate with a profit exceedingly poor wells.

Solubility of Oil Shales

In the course of certain experiments designed to determine the solubilities of different shales after they had begun to yield oil by distillation, it was found desirable to determine the quantity dissolved from certain unheated shales by various solvents, at or near the boiling points of these solvents. These experiments were made in connection with the oil-shale investigations being conducted by the U. S. Bureau of Mines, in co-operation with the states of Colorado and Utah, and are outlined in a paper by Martin J. Gavin and John T. Aydelotte which is included in *Reports of Investigations*, U. S. Bureau of Mines.

Five oil shales were used that are representative types from the districts in which they were collected, although not necessarily representative as regards richness. They may or may not be of greater richness than the average for the districts.

Each sample was ground to pass a 20-mesh screen, and all material that would pass a 60-mesh screen was rejected, as such fine material clogged the filter and made extraction slow. Twenty grams of the ground sample were placed in a filter paper capsule in an apparatus of the Soxhlet type and extracted with the solvent in the usual manner with this type of apparatus. Extraction takes place at a temperature somewhat below the boiling point of the solvent. Extractions were continued for two hours after the refluxing solvent became clear. Then the solvent containing the extract was removed from the apparatus, and the solvent distilled off at as low a temperature as possible. The dish containing the extract was carefully heated to remove last traces of the solvent, dried in a dessicator, and weighed. In each case, results reported are based on two or more closely agreeing tests. In should be noted that the percentage extracted is based on the weight extracted and not on the loss in weight of the shale.

In physical appearance, the extracts from all the shales were similar. They were dark brown or black in color, and with the exception of that from the Ione, Cal., material, were of the nature of a heavy asphalt, somewhat resembling some of the natural hydrocarbons. The extract from the Ione material was waxy and practically fluid at room temperature (72 deg. F.). Their volatilities were low. They were not appreciably affected by cold concentrated sulphuric acid, were insoluble in cold alcohol and slightly soluble in hot alcohol. They were not attacked by cold nitric acid. Each had a faint odor much like that of the freshly broken shale from which the extract was made.

The results of the experiments tabulated, show the source of the shale; the amount of oil produced from the shale by distillation in the Bureau of Mines type of assay retort, expressed in gallons per ton; the amount of oil recovered by such distillation, expressed as a percentage by weight of the raw shale; the percentage (by weight) of the shale extracted by the particular solvent, and the relative amount of extract produced, expressed as a percentage of the oil yield by destructive distillation.

Disregarding the Ione, Cal., material, which is evidently a lignite, it is noted that an appreciable amount of the organic constituents of the Utah, Colorado, and Wyoming shales tested may be removed by certain of the more commonly used solvents of petroleum. In the case of De Beque, Col., shale the extract with chloroform amounts to 18.22 per cent of the weight of oil produced by destructive distillation. This shale appears to be more soluble in each of the solvents used than the other shales examined.

It is evident, therefore, that such solvents as were used in these experiments do have an appreciable action on the organic oil-yielding matter of oil shales. The Kentucky shale is by far the most resistant to the solvents used. The extract in all cases, however, is not what would ordinarily be termed oil, and certainly, as is to be expected, it is not at all like the oil produced by distillation of the shale. Nevertheless, until the nature of these extracts has been determined, it would be well to accept with reservation the belief that oil shales contain no oil as such. The writers do not believe that the extracted materials are oils, in the common meaning of the word, but certainly the extracted material is much like certain of the natural hydrocarbons, supposed by many to have been formed from petroleum by oxidation. A careful study of such extracts might be of considerable value in determining the origin of oil shales. It is to be noted that the solubility of a shale is not an index of its relative oil yield. The shale that was most soluble in all the solvents was the Colorado shale, yet both the Utah and Wyoming shales yielded oil on distillation at a higher rate.

Wyoming Oil Sands

SPECIAL CORRESPONDENCE

Two thousand acres of oil sands, sixteen miles from Wamsutter, Wyo., have recently been sold. This is the first lease permit issued upon oil sands. It requires that a minimum of $20,000 be expended upon the lease each year for the next five years. The oil sands outcrop along an escarpment for three miles, an average of 50 ft. thick. They have been sampled by Government engineers, in 1,000-lb. lots, and contain 11 per cent petroleum, or 30 gal. per ton, of which 12 per cent is gasoline, 12 per cent kerosene, and 14 per cent gas oil, and the remainder lubricating oils.

A recent patent for the treatment of oil sands has been demonstrated in a small way, and a larger plant will soon be in operation. This will extract the oil in a short time with steam and hot water—a continuous operation. The sands are clean and white as they leave the plant. The residue contains enough carbon to supply all the heat necessary for the operation of the plant.

It is estimated upon a large body of sands similar to those in Wyoming, where the material can be handled by steam shovels, that the oil can be extracted for 27c. per bbl.

Technical Papers

Mining in California—A monthly publication entitled "Mining in California" will be issued by the California State Mining Bureau, beginning with the January, 1922, number. The new publication will be a monthly chapter of the state mineralogist's annual report and will disseminate information relative to all phases of the state's mineral industry and the various activities of the State Mining Bureau. Several features not customarily found in official reports, such as lists of buyers looking for particular minerals, lists of producers who are seeking a market, and a technical employment service, will be included. Those who wish to have their names on the mailing list should make request to the State Mining Bureau, Ferry Building, San Francisco, Cal.

Haynesville Oil Field—A report on the Haynesville oil field, in Claiborne Parish, La., by W. W. Scott, petroleum engineer, U. S. Bureau of Mines, and Ben K. Stroud, Supervisor of Minerals of the State of Louisiana, has been published by the Department of Conservation of the State of Louisiana. The report considers drilling methods, water conditions, production, and recommendations for further development. A map of the field which accompanies the report shows the location and status of the wells as of Dec. 31, 1921, the known limits of the field as of that date, the location of edge water with respect to structure, the encroachment of edge water during December, 1921, the status of the individual wells with regard to the production of oil and water, and the source of water. Copies of Bulletin No. 11, "The Haynesville Oil Field," may be obtained without cost by applying to the Department of Conservation, Ward Building, Shreveport, La.

Peruvian Petroleum—"Outline of the Geology and Development of the Petroleum Fields of Peru, S. A. With notes on Other Occurrences in the Peruvian Republic," by V. F. Marsters, has been published as a bulletin of the American Association of Petroleum Geologists. A short article on the same general subject by Mr. Marsters appeared in *Engineering and Mining Journal* of June 25. The bulletins may be secured from Mr. Marsters, 400 Reliance Building, Kansas City, Mo.

Petroleum Utilization—The *Journal* of the South African Institution of Engineers for December, 1921 (Johannesburg; price, 3s.), contains an eighteen-page illustrated paper entitled "Oil for Power Production: Some Notes on Recent Developments of Diesel and Semi-Diesel Engines." The paper is largely devoted to a description, with drawings and photographs, of the types of engines made by British manufacturers.

New Zealand Mineral Resources—The Geological Survey Branch of the New Zealand Department of Mines has issued Bulletin No. 23 (New Series) devoted to the geology and mineral resources of Western Southland. The clay, limestone, marl, and coal deposits are of importance. The bulletin is of eighty-eight pages, with maps and drawings, and may be obtained from the Government Printer, Wellington, New Zealand, for 5s.

Mining Methods—A twenty-nine-page paper describing the underground methods of mining the wide pyritic orebodies in the province of Huelva, Spain, is published in the December *Bulletin* of the Institution of Mining and Metallurgy (Cleveland House, 225, City Road, London, E. C. 1; price of the paper alone, 2s.).

Book Reviews

AT LAST a book on the metallurgy of zinc has been issued which looks as if it might be up to date and complete. Professor Hofman is the author, and the book is of the same style as his "Metallurgy of Copper" and "Metallurgy of Lead." We have turned it over, for review, to that veteran zinc metallurgist, George C. Stone, of the New Jersey Zinc Co., whose opinion, we feel sure, will be highly valued by our readers.

TO THOSE of our readers who read fiction only occasionally, and who, therefore, are not familiar with the merits of current books, we suggest "If Winter Comes," by A. S. M. Hutchinson. It is the best novel we have read for several years.

The Federal Reserve System—its purpose and work. Published in the *Annals* of the American Academy of Political and Social Science, Philadephia, Pa., for January, 1922. Price $1.

This 229-page collection of valuable papers written by eminent financiers, economists, and professors of banking deals with American currency prior to the passage of the Federal Reserve Act, the purposes of the act, and the operation of the system. To the business man or to any one equipped with a rudimentary knowledge of the working of the Federal Reserve System, a study of these papers will serve admirably to increase that knowledge. The engineer who may not be familiar with the subject will do better to read such a book as Professor Kemmerer's "A B C of the Federal Reserve System" before going into the details given in this volume of the *Annals*. As the governor of a Reserve bank states in the foreword, "It will not be easy reading; it may not be agreeable reading, but I think it mighty important that every business man should read it." It is well worth the time and trouble of close perusal.

Recent Patents

Platinum Recovery—No. 1,355,186. Russell Thayer, Philadelphia. Ores containing members of the platinum group are mixed with a halogen alkali-metal compound and water and heated to from 200 to 800 deg. C. The volatilized metals of the platinum group are caught in water and recovered by electrolysis. The process has not been operated commercially, but has been worked quite thoroughly in the laboratory.

Chloridizing — No. 1,403,516. Percy R. Middleton, New York, assignor of one-half to John C. Lalor, New York. A charge is made up of moist silver ore mixed with a heavy-metal chloride. This is dried and heated, thereby chlorinating the silver, which is subsequently extracted.

Flotation Agent—English patent No. 170,944, July 30, 1920. L. A. Wood, W. G. Sellers, and Minerals Separation, Ltd. Viscous oils such as coal tar, wood tar, blast-furnace tar, gas tar, fuel oil, and tar oil are neutralized with sodium hydroxide at 50 to 100 deg. C. and used either directly or as a base for a mineral flotation agent.

Molybdenum—No. 1,399,554. E. M. Hamilton, San Francisco, assignor to Hamilton, Beauchamp, Woodworth, Inc., San Francisco. Molybdenum ore or concentrate is ground, mixed with a solution of a non-volatile alkali metal and is heated to convert the molybdenum to a soluble compound. The material is then filtered and the valuable portion recovered from the filtrate.

Vanadium—No. 1,399,246. W. F. Bleecker, Boulder, Col., assignor to The Tungsten Products Co., Boulder, Col. Vanadium ores are mixed with an alkali-metal carbonate and water, the mixture is heated to a high temperature under pressure, the alkaline liquor separated from the product, the residue treated with an acid, the acid liquor filtered, and the vanadium-carrying slime removed from the residue.

Flotation—No. 1,398,989. E. W. Wilkinson, San Francisco, assignor to Minerals Separation North American Corporation, New York. An organic substance is subjected to partial decomposition in the presence of free oxygen and the mixed volatilized products are used for flotation. Patent No. 1,398,990 also covers the same subject, using a mineral frothing agent.

Ore Car—No. 1,399,746. A. Campbell, Chicago, assignor to Enterprise Railway Equipment Co., Chicago. A design for a single-hopper ore car with a central discharge opening.

Flotation Cell—No. 1,399,539. H. H. Bonnell, Denver. A V-shaped pneumatic flotation cell with a specially designed aërating apron and lift.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

One Hundred and Twenty-Fifth Meeting Of the A. I. M. E.

Arrangements Committee Successfully Carries Out Splendid Program—Joint Meetings With Mining and Metallurgical Society of America and Mining Section of National Safety Council

STAFF REPORT

THE ONE HUNDRED AND TWENTY-FIFTH MEETING of the American Institute of Mining and Metallurgical Engineers, held in New York City Feb. 20, 21, 22 and 23, 1922, will go down in the annals as one which was particularly successful and outstanding. Certainly the Committee on Arrangements left nothing to be desired, and the work done reflects a great deal of credit on William Young Westervelt, chairman, and his able assistants. Considering the present status of the mining industries—which, although not completely in the doldrums, cannot be regarded as being in a palmy stage of existence—the attendance and interest were most gratifying to the officers and committees. There was in all a registration of about eleven hundred, and every section was represented. Weather conditions, with perhaps the exception of Thursday morning, when the visitors had been promised a view of the New York waterfront, were ideal, and even at that time there was so much crowded into a busy day that no complaints were made of the weather man's *faux pas*.

With the election of Colonel Arthur S. Dwight as president, the Institute has put into effect a plan that has been under consideration since the change was made in the name of the organization in 1919; that is, of having a metallurgical engineer as the guiding spirit.

Of the technical meetings, the greatest interest to the largest number was in the mining sessions which were under the leadership of John E. Hodge, chairman of the Committee on Mining Methods. At this time a definite plan was outlined for the future work of the committee, and it can be expected that this will form a most important part of the Institute's activities.

ACTIVE DISCUSSION IN MINING SESSION

Chairman Gottsberger, opening the Monday mining session, spoke of the valuable work of the Mining Methods Committee and the importance of the topic to be discussed, sampling and estimating ore deposits. John E. Hodge read an abstract of R. J. Longyear's paper, "Diamond Drill Sampling," and in a subsequent discussion remarked that the Mining Methods Committee was anxious to obtain the sentiment of the engineers of the Institute, respecting collecting and publishing separately the papers gathered by the committee. W. Y. Westervelt presented I. B. Joralemon's paper, "Sampling and Estimating Disseminated Copper Deposits," and pointed to one of the important conclusions reached by the author that a so-called factor of safety was not found necessary, extraction closely checking sampling.

COLONEL ARTHUR S. DWIGHT
President of the A. I. M. E.

J. Parke Channing maintained that "auto-salting" was almost always introduced in sampling and that a corrective factor was necessary. He enlarged on his practical experience in many branches of mining and urged the keeping of actual diamond-drill samples and accurate records of all drilling done. The sampling and estimating of Lake Superior iron ore deposits was covered by a series of papers by J. F. Wolff, E. L. Derby, W. A. Cole and R. W. Bowers.

Arthur Thacher, in presenting W. F. Boericke's paper, "Sampling and Estimating Zinc and Lead Ore Deposits in Mississippi Valley," showed how totally different was the problem confronting the sampling of those irregular bodies as contrasted with other vein deposits. He emphasized the widely varying results obtained by drilling and prospecting. A paper, "Organization of Mine Sampling at Anaconda," by W. B. Daly and F. A. Linforth, was next read by Mr. Daly, who outlined the methods used in Butte. The psychological element in sampling was discussed by the chairman, Mr. Channing, Mr. Packard, Professor Sperr, and Mr. Daly, the latter stating that at Butte the chief sampler's work was taken as a gage of the accuracy of other sampling.

The discussion during the entire session was interesting and valuable.

ELECTRIC HAULAGE FEATURE OF MINING SESSION

Discussion of electric haulage consumed most of the time at the mining session on the morning of Feb. 21, which was presided over by William Kelly. Charles E. Stuart read excerpts from his paper on "The Storage-Battery Locomotive as Applied to Mine Haulage." C. D. Woodward's paper on "Electric Haulage Systems in Butte Mines" was presented by Graham Bright. The proper field for the storage-battery locomotive and the principal causes of trouble experienced with it were the points about which the discussion centered. Among the participants was H. N. Eavenson. Mr. Bright said that, in his opinion, unless the operation were big enough to warrant the use of five or six storage-battery locomotives with a skilled man to look after them, the trolley type was best. Comment by G. B. Rosenblatt was read by Mr. Bright. C. D. Woodward's paper on "Power Distributing System for Deep Metal Mines" was read in abstract form.

The session closed with a brief discussion of W. O. Hotchkiss' paper entitled "Effect of Rate of Production on Profits." Mr. Hotchkiss said that engineers should familiarize themselves with Hoover's theory that an orebody to show the greatest profit should be worked out in the shortest practicable time. He gave as an example a hypothetical case where a monthly tonnage of 13,000 yielded a profit of 35c. per ton, the life of the mine being thirty-seven years and its present value $570,000, as against a profit of 85c. per ton from a monthly output of 25,000 tons, the life being fifteen and one-half years and the present value $2,055,000.

MINING METHODS COMMITTEE PRESENTS OUTLINE

The Tuesday afternoon mining session was presided over by E. E. Hunner. John E. Hodge, the first speaker, outlined the work of the Mining Methods Committee and gave a résumé of the progress made. Mr.

Hodge was followed by C. F. Jackson, of the M. A. Hanna Co., who explained a diagram which he offered for the consideration of members and the committee as a means of correlating the information sought by the committee. Arthur Thacher, speaking extemporaneously on the subject of "Mining Engineers," sketched the history and development of the profession and emphasized the relationship between the engineer and the labor with which he has to deal. F. W. Sperr, of the Michigan College of Mines, explained a classification of mining methods, following which Mr. Hunner presented the general outline that the Mining Methods Committee had prepared. Other papers presented in the session were: "Spies Open-stope System of Mining," by S. R. Elliott; "Stope Cost Records and Mine Contracts of A. C. M. Co.," by C. I. Berrien; "Steam-shovel Operations at Bisbee, Ariz.," by H. M. Ziesemer and George Mieyr; and "Mining Methods at the Ashio Copper Mines," by M. Otagawa.

The mining session on Wednesday morning had a decidedly coal flavor, but was well attended by the metal men. An excellent discussion on the system of mining and the recoveries in the Pocahontas coal field, which was illustrated by lantern slides, was given by T. H. Clagett. This was followed by a paper presented by D. C. Ashmead, associate editor of *Coal Age*, "Can Anthracite Mines Be Operated Profitably on More Than One Shift?" This paper occasioned considerable discussion. Other papers covered in this session were: "Considerations Affecting the Extraction of Bituminous Coal in American Mines," by H. H. Stoek; "Mine Timber Preservation," by R. R. Horner and G. M. Hunt; "Underground Fire Prevention by the Anaconda Copper Mining Co.," by E. M. Norris, and "Mine Fires and Hydraulic Filling," by H. J. Rahilly.

WIRE ROPES AND HOISTING

There were three safety sessions, held jointly with the Mining Section of the National Safety Council. On Monday afternoon the subject of wire ropes and hoisting was considered. The first paper was that of W. N. Tanner and F. C. Jaccard, "Wire Ropes and Safety in Hoisting at the Butte Mines," which was read by W. B. Daly. One of the interesting features that was brought out is that all of the main shafts in Butte are provided with the "Lily" safety hoist control. Discussions of the paper were participated in by William Kelly, C. L. Colburn, Daniel Harrington, Robert Peele, Charles Locke, Graham Bright, B. F. Tillson, and Rudolf Kudlich.

The next paper read was by R. M. Raymond, on the subject "Safety Practice for Hoisting Ropes," which included the results obtained from a questionnaire, sent to operators, covering the class of rope used, specifications, methods, and other data. The information was of great interest, as were the recommendations made for safety practice in the use and care of hoisting ropes.

James F. Howe, of the American Steel & Wire Co., read an interesting paper on "The Use of Wire Rope in Mining Operations." He stated that improvement could be made in the manner of attaching the hoisting rope to a cage or skip, and classified the various methods used.

A reliable method of socketting recommends the use of zinc (we strongly suspect American Zinc Institute propaganda here), and this is described in Bulletin No. 75, U. S. Bureau of Mines. The last paper of this session was that of Rudolf Kudlich, which detailed safety devices for mine shafts and made a number of recommendations regarding safety practice in this particular.

MINE VENTILATION DISCUSSED

The second session, held on Tuesday morning, was presided over by H. F. Lunt, as was the Monday session. Daniel Harrington gave a résumé of his paper, "Efficient Ventilation of Metal Mines." Among the many interesting points mentioned, Mr. Harrington stated the "Failure to transmit fresh air currents to working faces is the most noticeable weakness of present-day metal-mine ventilation, and unfortunately this fault is only too frequent even where there is an abundance of fresh air in the main courses."

Mr. Daly summarized the paper, "Ventilation of the Butte Mines of the Anaconda Copper Mining Co.," which gave a résumé of conditions and the methods used there. J. J. Walsh, mine inspector of the Fourteenth Anthracite District in Pennsylvania, presented a summary of his paper, "Coal Mine Ventilation," and pointed out a number of instances of uneconomical practice in coal ventilation.

The safety session on Wednesday morning was more in the nature of a round-table discussion. Some exception was taken to the statement in C. A. Allen's paper, "An Inventory of Results of Accident Prevention in Utah," that the apprentice system be enforced. It was the general opinion of those present that the qualification of individuals, particularly those miners who had had experience elsewhere, should not be restricted. Discussion of the paper was participated in by Messrs Ryan, Walsh, Tillson, Charlton, Lunt, and Harrington. C. W. Goodale reviewed the paper prepared by himself and John L. Boardman on the "Bureau of Safety of the Anaconda Copper Mining Co." The paper "Electric Signal Installations in the Butte Mines," by C. D. Woodward, was summarized by Mr. Tillson.

PETROLEUM SESSIONS COVER PRODUCTION AND MARKETING

The symposium on Foreign Oil Possibilities and on Petroleum and Gas proved productive of much interesting material. These sessions began on Tuesday morning and continued, with the necessary intermissions, until the close of the meeting on Wednesday. The addresses on the first day were confined principally to reports on the oil reserves of the United States and the Latin-American countries. Ralph Arnold, who acted as chairman of the meeting, was somewhat pessimistic as to Mexico, and declared that no wells of importance have been brought in in the light-oil belt of Mexico during the last year. The industry there, he pointed out, was struggling with the discouragements of high taxation and salt water. Other geologists seemed more optimistic, and indicated a probable extension of producing area north of Dos Bocas and south of Tuxpam.

The address of V. F. Marsters on the oil reserves of Peru and Ecuador was delivered on Wednesday, time not permitting on the preceding day. This was followed by a highly interesting presentation of suggestions for stabilizing the oil industry, by Henry L. Doherty. He pointed out how fluctuating prices were injuring the oil business and showed that more expensive fuels were often used because marketing conditions were more stable. These fluctuating prices, he said, could be blamed chiefly on the paucity of oil stocks. The market has not been regulated to stand the shock of suddenly increased production from new fields. Consumers usually carry smaller supplies of oil than of any other raw material. Mr. Doherty indicated as among the remedies of present conditions: more economical and efficient means of storing; more favorable legislation; better methods of salesmanship; and the arrangement for credit funds to provide for the storing of oil in requisite quantities. He then dwelt on the advantages of oil in certain places and processes and mentioned open-hearth steel furnaces as offering a great opportunity for extending the use of petroleum.

In the discussion following Mr. Doherty's paper, H. F. Bain stated that the Government had not done much toward stabilizing the oil business so far, but will no doubt increase its activities in this direction in the future. He mentioned the U. S. Navy stocks as having a stabilizing influence.

Frank Fueille read extracts from a paper prepared as a supplement to Bureau of Mines Bulletin 206 "Petroleum Laws of All America." There is a tendency in Latin-American countries, he said, to adopt the Turkish system of legislation, which is considered a retrogression. Bolivia, Ecuador, and Peru have issued comprehensive petroleum laws since Bulletin 206 was issued, and the essentials of these were given. Panama is also soon to issue a new code. The development of petroleum resources in Latin American will be slow until the laws are more favorable, in the opinion of Mr. Feuille. Discussion disclosed the fact that the Philippine laws are more drastic and immoral than those of almost any other country in the world, though it was brought out as a redeeming feature that oil has not yet been produced there, and that the intending developer goes into the country with his eyes open.

Lester H. Woolsey then told what the U. S. State Department could and could not do in furthering American interests in foreign fields. The powers of the Secretary of State are somewhat limited, but his good offices may be taken advantage of in many ways, nevertheless.

GUESTS ADDRESS INDUSTRIAL RELATIONS GROUP

Robert Linton presided at the Industrial Relations Session on Tuesday evening. Dr. George F. Kunz, in presenting his paper, "Preservation of Natural Scenery and Attractiveness of Mining Camps," decried the useless destruction of the natural beauty of some mining camps and illustrated his lecture with lantern slides showing attractive natural scenery in America and abroad. Mr. Gottsberger was next asked to report for the subcommittee on Housing and Recreation of the Committee on Industrial Relations, and urged a greater interest in the human side of industry. Various other subcommittees reported—Dr. Sayers, of the U. S. Bureau of Mines, on "Prevention of Illness," T. T. Read on "Mental Factors in Industry," H. F. Lunt on "Safety," and Sidney Rolle on "Employment." In the discussion which ensued, Dr. Kunz suggested that the mining companies devote more attention to obtaining suitable cemeteries for their employees as a means for holding them together. Mr. Gottsberger said that where this had been done and where companies attempted too much regulation the charge was often made that the company handled the lives of the miners from the cradle to the grave.

The chairman introduced Mr. Hicks, of the Standard Oil Company of New Jersey, who related the successful experiences of his company with industrial representation. Mr. Elton, in charge of rehabilitation work in New York State, was invited to talk on the rehabilitation of cripples and cited examples of what could be done in that direction.

NON-METALLICS STANDARDIZATION URGED

There was considerable discussion of papers presented in the Non-Metallic Session, Wednesday morning, presided over by Prof. Heinrich Ries. R. B. Ladoo presented W. M. Weigel's paper, "The Non-Metallic Filler Industry," and Oliver Bowles his paper, "Undesirable Diversity in Non-Metallic Mineral Products." Dr. G. C. Stone remarked that a great variety of non-metallic products entered into tire manufacture and commented on the reluctance of manufacturers to give information concerning the properties given to the tires by the use of various non-metallics. It was generally agreed that standardization was greatly needed in the industry, and that it would work to the advantage of both producers and consumers. Dr Stone then suggested the A. S. for T. M. for that purpose, and said that success had usually attended efforts to bring producers and consumers together on standards committees. The subject of standardizing screen tests was also broached. W. C. Phalen in a written discussion also suggested the standardization of machinery used in non-metallic mineral processes.

On Wednesday afternoon the A. I. M. E. held a joint meeting with the Mining and Metallurgical Society of America on a subject in which both societies have taken a great deal of interest—"Waste in the Mining Industry." Owing to the absence of Mr. Spurr in San Francisco, H. F. Bain discussed the waste involved in preliminary investigation of mineral deposits. Mr. Bain is one of the best extemporaneous speakers we have ever heard. He advocated a freer interchange of reports on mining properties, so that unnecessary re-examinations of prospects would be discouraged.

ECONOMIC DISCUSSIONS IN JOINT SESSION

Pope Yeatman read an exhaustive paper on "Factors in Management of Mining Properties Which Lead to Loss and Waste." This is a truly admirable presentation of the problem which it will pay all mining engineers to digest when it appears in printed form, when it will be much more easy to assimilate than it was when read. W. R. Ingalls read a paper on the economic side of waste in the mining industries, which provoked some discussion from representatives of the coal industry. Edwin Ludlow followed with an address on "Waste in the Coal-Mining Industry," wherein he showed that conditions are far from ideal in the bituminous field and that the solution lay in a further limitation of the number of producing properties, so that those which are active can operate on more nearly full time. Anthracite production is more centralized in the hands of large producers who have carried out refinements having for their object increased efficiency.

The work of the Entertainment Committee, under the chairmanship of Albert C. Ludlum, received a high mark of approbation for the excellent staging of the smoker on Monday night. Amid a woolly, wild Western, pre-Volstead setting, this part of the entertainment started with a bang, and continued to fill in a most enjoyable evening. Certainly there was nothing lacking in variety. Through the courtesy of the Westinghouse Company an amplifier had been placed in the room and the necessary connections made so that members and their guests "tapped in" on various musical and other features that were relayed from the main office of the company. Several communications of direct and personal interest to Institute members were also received from South Africa, Paris, San Francisco, and other points through the medium of the amplifier.

Alkali Ike and Rattlesnake Pete, in true Western cowboy attire, performed a number of card tricks, orations and vocal selections. The use of a screen (in addition to that already provided by the smokers) aided considerably in the community singing, and was also effective in presenting the efforts of various members as limerick writers. The hand-painted majolica cuspidor, which was offered by the committee for the best poetical effort, was awarded to Lawrence Addicks. Light refreshments, of a most acceptable order, completed the program.

On Tuesday evening, before a large audience, the drama of "Mexico and Its Oil," and "Through India With the Duke of Connaught," in motion pictures, were presented. Both were highly interesting, the latter especially so, including glimpses of the beautiful Taj Mahal, a tiger hunt, and native life in India, as well as technically interesting exhibits of the Tata Iron & Steel Works, and the crookedest railway in the world (Mount Tamalpais not excepted?). After the picture an informal dance was held, with the men greatly outnumbering the ladies and in that respect not unlike dances we have attended in Western mining communities.

COMMITTEE DINNERS AND LUNCHEON

A number of committee dinners and luncheons were held throughout the sessions, which provided excellent opportunity for the transaction of such business as could not be conveniently carried on at other times. We are much in favor of such procedure, not only because much time can be thereby saved, but the gatherings are particularly conducive to good fellowship and actual accomplishment. On Monday, dinners were held by the following: Executive committee and past officers of the Institute of Metals Division, at the Engineers' Club; Petroleum and Gas Committee at the Harvard Club, and the Industrial Relations Committee also at the Harvard Club. Tuesday, lunch of Mining and Metals Committee at the Engineers' Club. Wednesday, lunch of Iron and Steel Committee at the Engineers' Club. Thursday, dinner of Milling Methods Committee at the Engineers' Club.

EXCEPTIONAL ATTENDANCE AT BANQUET AND BALL

There were over six hundred members and guests in attendance at the annual banquet on Wednesday evening at the Pennsylvania Hotel. This attendance, we were told, is the second largest that has been present at a similar function in the history of the Institute. The arrangements were well ordered and carried out by the Dinner Committee, under the chairmanship of Donald M. Liddell. The toastmaster's chair was ably filled by George Otis Smith, who explained in quite a satisfactory manner just exactly why he had been selected for that honor. He introduced Edward Ludlow, the out-going president, and Mr. Ludlow, presiding as president, gave an account of his stewardship of the organization during the last year. He pointed out particularly the expansion in the formation of new local sections of the industry and emphasized the necessity of keeping up the interest of individual members in their own sections as a means of increasing the scope of the parent body. Colonel Arthur S. Dwight, the newly elected president, in his address, pointed out particularly the place that the mining engineers must take in public affairs. Following Colonel Dwight's address, the tables were removed and dancing began. This continued until an early hour, but as is characteristic of the mining engineer, it was evident that such a display of strenuousness made but little difference, for the attendance at the excursions the following morning suffered no discounting.

CRUCIBLE STEEL EXCURSION

The first stop of the excursion train out of Jersey City on Thursday morning was made at Newark, where a large number took advantage of the opportunity to visit the Atha works of the Crucible Steel Co. at Harrison. The chief points of interest were the six-ton Heroult electric furnace, from which a charge of Monel metal was being poured, and the wire mill. The plant as a whole is only working about 25 per cent capacity, many departments, chiefly those equipped during the war for munition manufacture, being closed.

BAYWAY REFINERY OF STANDARD OIL

The second stop was made at the Bayway plant of the Standard Oil Co., and here a well-arranged schedule enabled the visitors to cover the various departments. The party was divided into five groups, and each was taken to one of the departments and thence through the entire plant. Production at this refinery consists of gasolene, kerosene, fuel oil, and paraffine, the oils treated consisting mostly of Mexican and some of the Mid-Continent oils. The following comprised the departments visited: Boiler house, crude coking house, continuous crude house, pressure stills, crude treating house, continuous treating plant, steam stills, steam and fire stills, and paraffine department.

CHROME EXCURSION MEMORABLE

About 125 people visited the refinery of the U. S. Metals Refinery at Chrome, N. J. Guides were provided to escort small groups through the entire plant. It was evident that every effort had been made by the operating officials to make the various processes used in the plant clear to inquiring guests through the lavish use of explanatory samples, charts, and models—a feature greatly appreciated by the ladies. Each visitor was supplied before leaving the plant with a miniature copper ingot and a beautifully prepared booklet containing views of the refinery, and all brought away the memory of unexcelled industry hospitality.

Following the assembling of the three groups on the train and the completion of the journey to Perth Amboy, the visitors were entertained at lunch by the industries of that city. The sight-seeing of the morning was of a fairly strenuous order, and previous to the arrival of the entire party at Perth Amboy some doubts had been expressed as to whether sufficient food would be available. But there remained no question on that score, for a meal of the most substantial order was served at the Y. M. C. A. by a committee composed of the local women. At the conclusion of the lunch short addresses were given by A. C. Clark, of the Raritan Copper Co., vice-president of the industrial association of Perth Amboy, and President Dwight and A. R. Ledoux, of the Institute.

In the afternoon visits were made by various groups to the copper-fabricating plant of the Standard Underground Cable Co., and the copper-refining plant of the Raritan Copper Co., both at Perth Amboy, and the roofing plant of the Barber Asphalt Paving Co. and the refractory plant of Henry Maurer & Son at Maurer, N. J.

FOR THE LADIES

A separate program for the ladies had been prepared by a committee of which Mrs. A. S. Dwight was chairman. Monday's activities included conducted visits to several points of interest, most of the visitors electing to go either to Tiffany's, where they enjoyed the sensation of toying with thousands of dollars' worth of Oriental pearls, or to the Hotel Pennsylvania, where they marveled at the magnitude, order, and cleanliness of the household arrangements. In the late afternoon Mr. and Mrs. Ludlow entertained at a reception at the new Ambassador Hotel, which was largely attended, even some of the gentlemen availing themselves of the president's hospitality. That London thriller, "Bulldog Drummond," attracted many to the Knickerbocker Theater in the evening.

Tuesday a delightful time is reported at the residence of Mrs. George D. Barron, at Rye, N. Y., where a luncheon was served, followed by cards. In the evening moving pictures at the Institute headquarters were followed by an informal dance. The business meetings of the Woman's Auxiliary were held the next day. In the afternoon Senator Clark held a reception at his galleries, which attracted many ladies and gentlemen and proved as thoroughly enjoyable as it has in former years. The dancing at the Hotel Pennsylvania in the evening, following the banquet, provided the one opportunity to appear in evening dress.

The ladies were well represented on the special excursions to industrial plants on Thursday, and many preferred the sightseeing in the afternoon even to the allurements of tea and cards at the Raritan Yacht Club.

The convention was in every sense an unqualified success. Professionally and socially it conformed to previous high standards.

Oil Drilling Expensive in Isolated Fields

To Encourage Development, Government Requires No Royalty on Small-Scale Production on Alaskan Public Lands

The cost of oil-drilling operations in remote and isolated fields may easily amount to ten times that of similar operations in favorably situated producing oil fields in the United States, declared A. W. Ambrose, chief petroleum techologist of the U. S. Bureau of Mines, before a recent gathering of Pan-American diplomats in Washington. It is probable that the first well drilled by one of the prominent producing companies in Colombia cost not less than $500,000, said Mr. Ambrose, whereas the average well drilled to the same depth in a proven field in the Mid-Continent district of the United States would not cost $50,000.

This factor of excessive cost of production should be taken into account in the consideration of policies designed to encourage the development of an oil industry in regions or countries where the petroleum resources have not yet been exploited, Mr. Ambrose declared further. The Government has recognized this fact in trying to encourage development of the remote oil possibilities of Alaska. For example, the royalties are much higher on oil produced on the public lands in the oil fields of the United States, where there are good railroad facilities, and where a network of pipe lines gives a ready outlet to the refineries, than in Alaska, where railroads are scarce and no pipe lines or refineries exist.

For the first five years the Government does not charge any royalty unless the wells on each tract in the public lands of Alaska average 100 bbl. per day per well or more. Should the average production be greater than this, the Government exacts a royalty of only 5 per cent. During the second five years of operation the Government charges a royalty of 5 per cent on all the oil produced, and during the succeeding ten years a royalty of 10 per cent, which is the maximum that an operator ever has to pay. Other lenient features have been provided to encourage oil development; for instance, during the first five years no rental is charged. It is interesting but disconcerting to note that despite these attractive features little if any drilling will be done in Alaska during 1922.

Much prospectively valuable oil land in the Latin-American countries is at present almost inaccessible because transportation of the needed tons of drilling and camp equipment and other supplies is practically impossible. The expense of building roads to overcome this difficulty is a considerable factor in the high cost of oil production in the tropics. The establishment of the absolutely essential sanitation is generally another expensive proposition. Furthermore, the establishment of fully equipped machine shops and forges is necessary in an adventure of this kind.

High salaries must usually be paid to workers as compensation for unfavorable living conditions in such localities. The matter of pipe-line transportation to ports is also a serious cost factor.

In general, Mr. Ambrose declared, the success of an enterprise in a remote and unexplored territory will depend primarily upon the strength of the organization attempting the development, and on the skill and knowledge of its responsible members. For that reason only the strongest established companies are in a position to interest themselves in exploiting areas particularly remote. This is readily appreciated when it is considered that in this type of work the area is far removed from the manufacturing centers and consequently from the centers of oil-well supply manufacturers; also if oil is found, it must be transported and marketed, all of which requires much capital.

MEN YOU SHOULD KNOW ABOUT

Rush T. Sill, mining engineer, of Los Angeles, recently examined property near Randsburg, Cal.

J. K. Turner, mining engineer, of Goldfield, Nev., is in Oatman, Ariz., on professional business.

W. J. Loring left San Francisco recently on a business trip to Boston, New York, and Washington.

George Gray has resigned his position as manager of the Canadian Association Goldfields of Larder Lake.

Robert F. McElvenny, manager of the American Smelting & Refining plant at Omaha, was a visitor in Colorado recently.

Henry C. Carr, who has been investigating mineral deposits in Brazil during the last six months, has returned to New York.

Luther W. Lennox is mill superintendent of the Veta Grande unit of the American Smelting & Refining Co., at Parral, Chihuahua, Mexico.

W. H. Blackburn, general manager of the Tonopah Mining Co., has returned to Tonopah from a business trip to the Mother Lode district in California.

James F. McCarthy, of Wallace, Idaho, president and manager of the Hecla Mining Co., is in Milwaukee attending a meeting of the directors of the company.

Walter S. Weeks will discuss mine ventilation at the meeting of the San Francisco Section of the American Institute of Mining and Metallurgical Engineers on March 14.

Frederic Keffer, formerly manager of the Canada Copper Co.'s Boundary, B. C., operations, is recovering at his home in Spokane from an operation performed during February.

Frederick Burbidge, of Wallace, Idaho, general manager of the Federal Mining & Smelting Co., is inspecting the zinc mining operations of the company at Baxter Springs, Kan., and Picher, Okla.

F. J. Katz, who has been in charge of mineral statistics for the Bureau of the Census during the time that the 1920 returns were coming in, has completed that work and will resume his duties with the U. S. Geological Survey. He specializes in work on abrasives and on metallics generally.

F. J. KATZ

H. A. Megraw has resigned as engineer for the Kennedy-Van Saun Manufacturing & Engineering Corporation, of New York, to become vice-president and treasurer of the Crown Oil & Wax Co., of Baltimore, Md.

Lieutenant Colonel John G. Barry, formerly of the geological department, Massachusetts Institute of Technology, and now mining geologist and engineer of El Paso, Tex., recently returned after completing an extensive geological study in the region of Parral, Chihuahua, Mexico.

E. J. Donohue has resigned the position of general manager of the Britannia Mining & Smelting Co., after having been with the company for about nine years. Having entered the service of this company in the early years of its enterprise on Howe Sound, B. C., he has been closely identified with its development and expansion. Mr. Donohue feels that his health demands a prolonged rest, and so has asked to be relieved of the responsibilities of his office.

Mining and metallurgical engineers visiting New York City last week included: **W. B. Plank**, Easton, Pa.; **Herbert W. Smith**, Washington, D. C.; **Paul R. Cook**, Bulgaria; **C. F. Jackson**, Cleveland; **Harrison Souder**, Cornwall, Pa.; **W. R. Chedsey**, State College, Pa.; **Richard R. Smith**, Bolivia; **R. R. Wilson**, Victoria, B. C.; and **Francis Nicholson**, Charlotte Court House, Va.

SOCIETY MEETINGS ANNOUNCED

The Association Alumni of the School of Mines at Liege, Belgium, will celebrate their seventy-fifth anniversary by an international scientific congress to which are invited the engineers of Belgium and the allied countries. The congress will consist of seven sections, mines, metallurgy, mechanics, electricity, chemical industries, civil engineers, and geologists. In the course of the session of the congress, papers will be presented which will be published by the *Revue Universelle des Mines*. Further information may be had by addressing, O. Lepersonne, Secrétaire Général, de l'A. I. Lg., 16, Quai des Etats-Unis, à Lié, Belgium.

OBITUARY

George P. Harrington died recently in Los Angeles at the age of seventy-four. He was for years engaged in mining in the Crown King district of Arizona.

J. A. Bauer, who went to Arizona in the early days of Tombstone, and who was later connected with the management of the Hill Top mine, in southeastern Arizona, died recently from heart disease in a Douglas hotel.

Schuyler Lawrence, for many years a resident of Chihuahua, Mexico, died Jan. 9 at Mysox, Pa. Mr. Lawrence was interested in a number of mining properties near Santa Eulalia. He was a member of the A.I.M.E. and the A.S.M.E.

Frederick Corkill died in Oakland, Cal., on Feb. 13 at the age of sixty-five. He was at one time foreman of the Northern Belle mine, at Candelaria, was later superintendent of the West End mine, at Tonopah, and in recent years has been in the employ of "Borax" (F. M.) Smith as field and consulting engineer.

George Robert Smith, member of the Legislative Council of Quebec, died at Thetford Mines, Quebec, on Feb. 20 at the age of sixty-two years. Mr. Smith was born at Newark, N. J., and went to Canada to engage in the mining industry. He became interested in the development of the asbestos deposits of Quebec, and was president and general manager of Bell's Asbestos Co., Thetford mines, and vice-president and general manager of the Asbestos Manufacturing Co., of Montreal. Mr. Smith was one of the founders of the Canadian Mining and Metallurgical Institute, of which he was president for some time. He took an active part in public affairs, and in 1911 was appointed a member of the Provincial Legislative Council.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

Patents for treating copper ore so as to recover the copper in oxidized minerals, either alone or in the presence of sulphide copper, have been awarded to Milton F. Webster, following litigation.

The American Smelting & Refining Co. has deferred its annual meeting from April until June.

Phelps Dodge copper is to be refined at the A. S. & R. Co.'s Perth Amboy refinery beginning next fall, instead of at the Nichols Copper Co.'s Laurel Hill plant, as in the past.

Rumors that the Rio Tinto Co., Ltd., may pass its next dividend also, as it did its last, are in circulation abroad.

The outcome of the British America Nickel Corporation's enterprise is linked with a bank failure in Norway in the Norwegian press, according to foreign correspondence.

Copper Ore Treatment Patents Awarded to Webster

Process Seeks To Recover Metal in Oxidized Minerals in Presence of Sulphides—Assigned to Merrill Co.

A recent decision of the Court of Appeals of the District of Columbia awards to Milton F. Webster patents in what promises to be an important ore-treatment process. The process has for its purpose the recovery of the copper in oxidized copper minerals, either alone or in the presence of sulphide copper minerals. A dilute solution of sulphuric acid is first used to dissolve the copper present in oxidized form in a finely ground pulp. Finely divided iron is then added and the copper is precipitated in the pulp. The metallic copper and the sulphides are then recovered by subjecting the pulp to flotation. The steps in themselves are not novel, but the combining of them and the precipitation of the copper in the pulp are original and lead to important results in the treatment of a type of copper ore which has given considerable trouble to metallurgists.

Milton F. Webster worked on leaching oxidized copper ores at Butte, Mont., and, owing to difficulties in the separation of the acid copper solution from the pulp, evolved the idea of precipitating the dissolved copper in the pulp as metallic copper, when the separation would be easily accomplished. Later, some experimental work was done at the East Butte Copper Mining Co.'s plant, with encouraging results.

Mr. Webster attempted to interest different people in the process, but without success until Charles W. Merrill realized its possibilities. It being found that others had filed application for the process, interference proceedings in the Patent Office were begun and the ensuing litigation was carried to a successful conclusion. The process has been assigned to the Merrill Co., of San Francisco, for commercial exploitation.

Australia To Continue Control of Base Metals

By Cable from Reuters to "Engineering and Mining Journal"

Melbourne, Feb. 23—With a view to frustrating any possible attempt on the part of Germany to regain control of the Australian base-metals industry, the federal government has renewed the war-time restriction on the exportation of certain minerals and on the export of gold in specie or bullion without the consent of the federal treasurer.

Phelps Dodge Copper Refining To Be Done at Perth Amboy

Copper produced by the Phelps Dodge Corporation will be refined by the American Smelting & Refining Co., beginning this year, instead of at the Laurel Hill refinery of the Nichols Copper Co. as in many years past. A contract consummating the arrangement has been signed by the two companies. The metal will be handled at the Perth Amboy plant of the American Smelting & Refining Co., in New Jersey. A clause in the contract will permit the Phelps Dodge company to lease this plant, if it desires to do so. The refinery has been closed down for over a year.

New Seneca Board Slated

At the annual meeting of the Seneca Copper Corporation to be held March 8, a new board of directors composed of the following will be elected: W. F. Bartholomew, of Boston; R. N. Atwater, Jr., J. Parke Channing, Thomas F. Cole, Joseph Deering, W. B. Anderson, Robert Linton, and Walter Lewisohn, all of New York, and George A. Tomlinson, of Cleveland, Ohio.

Frederick Lewisohn, Hamilton Fish, and E. C. Westervelt will retire as directors. Their successors will be R. M. Atwater, Jr., of Ladenburg, Thalmann & Co.; Robert Linton, president of North Butte Mining Co., and George A. Tomlinson. There will be no contest over the election, it is said.

American Smelting & Refining Co. Postpones Annual Meeting

Stockholders' Investigation Committee Defers Report—Draws Fire of Karl Eilers

The board of directors of the American Smelting & Refining Co. has by amendment of the bylaws postponed the date for the holding of the annual election of directors from April 4 to June 27. This action has been taken with the assent of the stockholders' committee of investigation.

The committee has advised the stockholders that its work of investigation has practically been completed. "The committee," it states, "is under obligation to submit its findings to, and desires to secure the criticism and suggestion of, Senator Root, and as the Senator, because of duties in Washington, has been unable at this time to give the matter consideration, the committee will be unable to make its report to stockholders until later, but expects to have its report sent to stockholders so that they may have the benefit of a statement of facts founded upon the work of investigation in ample time for their consideration before the annual meeting."

Karl Eilers, who was active in opposing the Guggenheim management a year ago, commented on the announcement of the postponement as follows:

"It is particularly significant that the meeting should be postponed in order to afford an opportunity to submit the proposed report of the stockholders' committee to Senator Root, who is of counsel for the Messrs. Guggenheim and who also has been retained in this matter by the smelting company. It would be interesting to know just what are the findings of the committee which require the comments and explanation of Senator Root, the counsel for the Messrs. Guggenheim, before being permitted by the company to be seen by their stockholders." Mr. Eilers is one of the chief individual stockholders of the company.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Seek To Prevent Waste of Oil and Gas

Appropriation Asked To Permit Investigation by Bureau of Mines—Government Aid Favored by Bain

Representative Jacoway, of Arkansas, recently appeared before the House Appropriations Committee in behalf of an appropriation of $15,000 for investigations by the Bureau of Mines to prevent waste in drilling and producing oil and natural gas in that state. He said there were 110 wells in the El Dorado field producing 40,000 bbl. daily, but that there was trouble with water getting into the wells. Representatives Cramton, of Michigan, and French, of Idaho, suggested that the state conduct the work or that private interests contribute. Mr. Jacoway said that if the matter were left to private interests or to the state, much of the oil resources would be wasted.

Director Bain, of the Bureau of Mines, favors Government assistance for the reason that new wells will probably be discovered in Arkansas, which may involve new problems. Demonstrations by Government specialists would be helpful, he said. He referred to numerous co-operative agreements under which private interests furnished funds for work and opposed a suggestion of Representative French that all Government work be based on financial assistance from outsiders, as sometimes outsiders would not request it and it frequently is necessary for the Government to do work on private lands, particularly those adjoining Government wells.

As to co-operative agreements, Director Bain referred to the fact that oil companies in Wyoming had contributed $47,000; Oklahoma had contributed $37,500 for oil and gas work; Colorado $14,000 and Utah $3,000 for oil-shale work; the Shipping Board $1,800 for fuel-oil analysis; the Mid-continent Oil & Gas Association $1,000 for gas-burner investigations, and the Navy $15,000 for supervision of operations on naval reserves. He pointed out that persons developing oil usually lack engineering experience. Mr. Bain said that oil producers individually are not always in full sympathy with the conservation program of the Bureau.

The Bureau is more concerned, he said, in computing back oil royalties and supervising drilling operations in known pools under the leasing law than in checking up oil operators to determine if they are drilling in the time required by law. He said that the Navy is working on a plan to store above ground a large quantity of fuel oil obtained from naval reserves.

War Mineral Relief Claim Recommended

One award was recommended by the War Minerals Relief Commission during the week ended Feb. 25. It was in the case of Howard M. Maple, of El Paso, Tex. The commissioner recommends the payment of $7,565. The amount claimed was $12,065. The mineral involved in the claim is manganese.

Ore Carrying Corporation a Common Carrier

The Interstate Commerce Commission has ruled that the Ore Carrying Corporation of New York is a common carrier subject to the Interstate Commerce Act and that it may lawfully receive divisions of joint interstate rates from its trunk-line connections.

The entire capital of the Ore Carrying Corporation is owned by Witherbee, Sherman & Co., a corporation engaged in mining and selling of iron ore, pig iron, phosphates, and other materials. It transports property by water, it is shown in the statement to the Interstate Commerce Commission, between points in the State of New York and points in New Jersey from New York Harbor to various points on Lake Champlain.

Government's Silver Purchases 94,351,628 Oz.

Purchases of silver by the Bureau of the Mint during the week ended Feb. 25 amounted to 165,000 fine ounces. This brings the total purchases under the Pittman Act to 94,351,628 fine ounces. The total amount of silver that is to be purchased under the terms of the Pittman Act is 208,000,000 oz.

Mexico's Precious-Metal Output Decreases Slightly

Production of silver in Mexico in 1921, as given by the Ministry of Industry, Commerce and Labor, was 2,005,143 kg. Gold production was 21,275 kg. This is only slightly less than the production in 1920, when the country produced 2,068,938 kg. of silver and 22,864 kg. of gold.

The minister in charge of the department, in giving out the preliminary figures for 1921, said the country had reason to be proud of the 1921 record, which almost equaled that of the boom year of 1920. Simultaneously with the announcement of the annual figures, the production figures for December, 1921, also were given. During that month silver production was 211,286 kg. and gold production 1,952 kg.

Free List for Zinc Approved by Some in Washington

Ills of Industry Too Deep To Be Cured by Tariff, It Is Held by Certain Specialists

The reported decision of the Senate Finance Committee to put zinc on the free list meets the approval of some of the metal-mining specialists in Washington. They believe the refusal of the committee to adopt the high rate of duty urged upon them will do more than will any other one thing to alter the character of the zinc industry from one satisfied to be self-contained to one, comparable to the copper industry, based on exports. They point out that copper formerly was on the dutiable list, and that it took strenuous efforts on the part of the industry to get it on the free list so that it could not be accused of hiding behind a tariff barrier and so that the access of its product to foreign markets might be facilitated. The ills of the zinc industry are too deep to be met by a tariff, they further maintain.

Nitrates 7 Per Cent of Panama Tonnage

Of the 435,943 tons of freight which passed through the Panama Canal during December en route from the Pacific to the Atlantic, 59,957 tons consisted of nitrates. Shipments of crude oil totaled 4,723 tons for the month; ores, 9,805 tons; metals, 10,959; and phosphates, 8,900. The total tonnage moving from the Atlantic to the Pacific during December was 517,110 tons. The tonnage of crude oil was 48,272 tons; coal and coke, 46,462 tons; metals, 22,007; and sulphur, 4,000 tons.

Regret Loss of Non-Metallics Appropriation

Though the Bureau of Mines fared better than did most bureaus at the hands of the Appropriations Committees, the loss of the $35,000 intended for the continuance of the work on non-metallic minerals is particularly regretted. A large amount of work had been done in the one year that this appropriation was available.

Patent Office Relief Bill Signed

The President signed the Patent Office Relief Bill on Feb. 18. As the bill carries only the authorization for the appropriation, the reorganization and installation of additional personnel must await the actual granting of the money. It is probable, however, that the appropriation can be carried in a forthcoming deficiency bill.

NEWS BY MINING DISTRICTS

London Letter

Aid for Dolcoath Tin Mine Sought Under Trade Facilities Act—Rio Tinto May Pass Dividend Again

By W. A. Doman

London, Feb. 4—Cornish mines die hard. They have their difficulties, both in the way of mining and of raising additional capital, but hope evidently springs eternal in the breasts of the Cornish mining engineers. It was thought some time ago that the misfortunes of the Dolcoath were almost too great to be overcome. But no. Attempts are being made to give this grand old property another chance. It is in a worse way financially than technically, and it is the former aspect that is under consideration.

At the present price of the metal no one will subscribe capital for a Cornish tin-mining company. It is felt, however, that prices will not always remain at their present level, and that some effort should be made to relieve the distress among the workers in the Duchy. The directors of the Dolcoath, therefore, are endeavoring to gain some benefit under the Trade Facilities Act of November last. According to the provisions of this act, the Treasury may guarantee loans and interest, and application has been made for the guarantee of a capital sum and interest thereon sufficient to carry out a modified scheme of development of the northern areas of the property. If the money can be obtained, a new shaft will be sunk between the North and South Roskears, and the South Roskear mine will be unwatered. Until the receipt of the Treasury reply, nothing can be done, but it is hoped the company will come within the scope of the act.

Rumor is not always to be trusted, because it is so frequently set in motion for interested purposes. Nevertheless, a story concerning the Rio Tinto has got into circulation, and, being so far uncontradicted, is worth mentioning. It is said that the price of sulphur has fallen heavily on account of the keen competition of Norwegian companies, and that, as a result, the company may again have to pass the dividend, and, further, it may be under the necessity of making an issue of debentures. The Rio Tinto has had such a remarkable history that this turn in its affairs, if correct, is most unfortunate. The French public are the principal holders of [illegible].

J[illegible] A. Agnew has been appointed a director of the Consolidated Gold Fields of South Africa and of the New Consolidated Gold Fields, in the place of Major Sapte. Mr. Agnew has an established reputation, and in appointing him to pay special attention to the technical side of the Gold Fields business the directors have made a good move, and one that will be unquestionably popular. The opinion has been expressed by various shareholders that new blood was required in the management.

While indications are not wanting that the strike of white miners on the Rand is coming to an end, the evils resulting from the cessation of operations are already beginning to make themselves apparent. The New Goch and the Roodepoort United have already closed down, never to reopen, and now an announcement is made that the existence of the Luipaards Vlei is jeopardized. The company has been living from hand to mouth for some time, and the expense of keeping the mine free from water during the cessation of operations would have exhausted the limited resources of the company. As a result, the mine is being closed down. Presumably, the company will not go entirely out of existence, for one part of the property on which the East Battery Reef has been worked, and on which expenses would be relatively low, may be reopened. No hope is held out, however, of anything in the nature of substantial profits accruing from the working of this area.

Object to Changing Mount Massive's Name

A special meeting of the Leadville, Col., Chamber of Commerce has been held to protest against the action of the U. S. Geographic Board in designating the highest point of Mount Massive as "Gannett Peak." In 1901 an effort was made by the U. S. Board of Geographic Names to change the name of this peak to Mount McKinley, but the change was resisted by the Society of Leadville Pioneers, who in their remonstrance said in part:

"To us, Mount Massive represents more than the attributes of any human entity. In frontier days we washed its feet, gleaning a harvest of golden sands. Later we drove our steel into its rocky heart and wrestled wealth from its concealment there. In decades past our camp fires scattered increase o'er its breast. For many years our eyes have watched the sun chase shadows in the morn adown its rugged sides, and shadow follow sunshine to its topmost peak at close of day. In early times it was a landmark from afar to guide us to our cabin hearths. Our children, and our children's children, first learned its name from oft-told tales of our adventurous lives. God's acre, where our brothers and our loved ones sleep, nestles within its keeping. Mount Massive is a name endeared to us by old associations, and is a heritage we would bequeath to after generations of our kindred. Therefore we plead for the retention of its ancient name."

Johannesburg Letter

Details of Strike Situation on Rand—Cost of an Ounce of Gold at Twenty-two Mining Properties

By John Watson

Johannesburg, Jan. 24—The strike at the gold and coal mines still continues. No trams have been running in Johannesburg since Jan. 20, and the electric light is only available to a limited extent. As showing how the cost of production has gone up in the past eight years, the following figures are instructive. They are based on bona fide returns:

COST OF AN OUNCE OF FINE GOLD

Mine	Dec., 1921		Year 1913	
	s.	d.	s.	d.
Luipaards Vlei	110	10	73	3
Geldenhuis Deep	99	8	70	3
Durban Roodepoort Deep	99	3	71	2
New Goch	96	5	68	5
Randfontein Central	96	3	59	1
Village Deep	95	8	58	1
Simmer and Jack	94	11	47	5
New Kleinfontein	93	9	57	11
E. R. P. M	93	5	53	0
Robinson	93	2	32	11
Wolhuter	92	8	58	2
Nourse	92	7	60	9
West Rand Consolidated	92	3	67	8
Roodepoort U. M. R.	92	2	81	1
Knight Central	91	3	75	3
Aurora West	91	0	63	0
Rose Deep	88	7	53	2
Witwatersrand	87	6	48	7
New Unified	86	11	58	7
Witwatersrand Deep	86	3	50	1
Consolidated Main Reef	85	8	57	5
Robinson Deep	85	7	50	3

The premium on gold is falling rapidly, and it is obvious that the above mines, under present conditions, are being worked at a loss. An industrial conference has now been sitting for ten days, under the chairmanship of Justice Curlewis. The question of the collieries was first discussed, then the condition of the Victoria Falls & Transvaal Power Co. This company generates power, locally, from coal and has never brought any power from the Victoria Falls, as the name might imply. It was only on Jan. 24 that the conference reached the main issue of the strike—that is, the gold-mining industry. None of the other matters in dispute has really been settled, except that the difficulty as affecting the town engineering shops is to be submitted to arbitration.

The loss to the community of South Africa caused by the strike is incalculable; but some idea may be formed from the fact that in 1920, on the Rand alone, close on £14,000,000 was paid for supplies to the gold mines.

BURMA

Namtu—During January, 16,468 tons of ore was milled, producing 10,527 tons of lead concentrates; and 9,234 tons of lead-bearing material was smelted, producing 3,465 tons of hard lead for treatment in the refinery. Refinery products were 3,202 tons of refined lead and 355,573 oz. of refined silver.

NORWAY AND SWEDEN

Effect of British America Nickel Enterprise — Metal Mining Industries Show Improvement

From Our Special Correspondent

Arbeider Politiken, a Norwegian paper, published recently an eight or nine column article purporting to explain the cause of the Söndenfjeldske Privat Bank's liquidation. "As is known," says the paper, "it was the connection between the bank and the A. S. Kristiansands Nikkel Raffinerings Verk that brought the former into difficulties," and the publication states, further, that in reality it was the association of the A. S. K. N. Raffinerings Verk with the British-America Nickel Corporation that caused the catastrophe. The paper has also communicated with Prime Minister Blehr on the subject and asked if the government is prepared to take measures to establish a public commission to inquire into the matter. The Premier replied that the government had taken measures to have the documents on the subject sent in, but could not state what steps may be taken after the papers were received. A decision would be reached when they had been examined. *Bergverksnyt* learns, later, that there is a majority of the government for a committee of inquiry. Verdens Gang has been informed by Admiral Börresen that the *Arbeider Politiken* article is a biased description of conditions. He refuted several of the points, and repudiated personal charges as groundless. In the meanwhile, a committee, chosen by the shareholders, will inquire into the matter; for which purpose they have, it is stated in the press, "all the cards on the table."

Mining activities remain in a stagnant condition in Norway, pending the expiration in the spring of the high tariff established three years ago by the Compulsory Arbitration Court, when the bulk of the industry suspended. There are signs, however, of animation in one or two directions, especially in the pyrites export line; and from the Orkla Mines, in Norway, where 700 men are employed. There has been a brisk shipment to Germany, Sweden, and in the super-phosphate works at Knarrevik. The total export figures for the eleven months of 1921 of ore low and rich in copper, respectively, were 47,325 tons and 118,625 tons, as against 75,346 tons, and 182,476 tons for the first eleven months in 1920. Of iron ore there was exported during the first eleven months of 1921 from Norway 2,884,099 tons, as against 1,461,717 tons in the first eleven months of 1920.

Of the 1,056,362 tons of Swedish ore in transit to the Norwegian port of Narvik during the first three quarters of 1921 there was re-exported 627,223 tons. In both countries every effort is being made to get the accumulated ore stocks out of hand. At the Sydvaranger mines, a property with an equipment book-entered at 54,600,000 kronen, nearly 5,000,000 tons of ore is still available. The Dunderland Iron Ore Co., Ltd., from all accounts, appears to be financially prepared to take up work again when the proper time arrives. In the meanwhile the company has received permission to postpone the regulation of the Reinsfossen Falls for twelve months.

The aluminum demand has again put the A. S. Höyangfaldene into working, with a reduced labor and staff tariff, and about 400 men have been taken on. The product is being exported to England, Germany, and Japan.

The latest silver figures available from the Kongsberg mines (for the month of December, 1921) give the output from Kongens grube, 200.5 kg.; Gottes Hülfe, 447.5 kg.; Gabe Gottes, 154.5 kg.; and Underberget (Samuel), 1,585.5 kg., or a total of 2,388 kg. From the Samuel mine there was an additional 60 kg. of coarse silver.

KOREA

Unsankinko—The Oriental Consolidated Mining Co. ran 160 stamps twenty-two days in December, crushing 16,908 tons. Gross receipts for the month were $104,247 and operating costs $97,349, giving an operating profit of $6,898. Of this $6,475 was put back in improvements, leaving a net profit of $423.

CANADA

British Columbia

Provincial Ore-Testing Plant Promised —Spring Rush Expected to Cedar Creek and Taseko Lake Areas

Victoria—A number of delegations have gone to Ottawa to interview the new Dominion Government with reference to problems affecting British Columbia. One of the matters taken up was that of the treatment of the complex ores of the Kootenay district. As a result of representations made, assurance has been received that $100,000 will be voted at the next session of the Dominion Parliament for the construction in the province of an ore-testing plant. It was argued by the Westerners that if ore-testing facilities were provided in this province, small-mine operators and prospectors who now are compelled to send their ore out of the province would be in a position to have it tested here.

Lillooet — Gold strikes having been reported in the Cedar Creek area, near the northeast end of Quesnel Lake, and at the south end of Taseko (Whitewater) Lake, a spring rush is expected. Considerable areas in both localities have been staked, and preparations are being made for the transport of men to the scenes of the strikes as soon as weather conditions permit. There will be little difficulty in reaching either field. The Cedar Creek strike lies forty or fifty miles from Williams Lake as the crow flies. By motor stage, via 150-mile House and Beaver Lake, at both of which points road houses have been established, it is only seventy-four miles, a journey which an automobile can easily make in one day. The Whitewater, however, is a little more difficult to reach, involving a journey of about 175 miles. Motor stages connect Williams Lake with Big Creek, at which point a road house has been opened. From Big Creek a horse stage will run this summer to the south end of Whitewater or Taseko Lake. The Provincial Government is expected to begin building a road from Hanceville to the Whitewater district this year.

Alberni—S. P. Silverman, president of the Tidewater Copper Co., has gone to the company's Indian Chief mine, for the purpose of resuming work at the mine and mill, which have been shut down since December, 1920. Production, it is expected, will be maintained at about 300 to 350 tons of copper concentrates per month, which will be shipped to the Tacoma smelter. It is planned to increase the capacity of the flotation mill this summer, and to do considerable development work. The mine is dry, requiring no pumping, and the ore is easily broken. Tunnelling, stoping, and open quarrying eliminate the sinking of shafts. The recovery is good. Water power is used. The property of the Tidewater Copper Co. was acquired by its present owners in July, 1916. Previous to this several thousand tons of high-grade ore had been shipped by former owners, the Dewdney Estate and the Tyee Smelting Co. Exploration work by the new owners demonstrated that though there was considerable high-grade ore, the chief production would come from the bodies of low-grade ore which were being developed. Since the mill was closed down much exploration and development work has been done, including 2,500 ft. of diamond drilling.

Ontario

Nipissing Takes Option on Claims in Manitoba—Longyears To Drill West of Hollinger

Cobalt—The Genessee property is being dewatered and underground work will be resumed soon.

The Nipissing has taken an option on the Gordon gold properties at Copper Lake, in northern Manitoba, and will diamond drill them. Work is also proceeding on the Rochester property, in Porcupine.

The New York interests which have taken an option on the Colonial property are arranging to do some work.

Severe snowstorms have practically paralyzed railroad traffic throughout northern Ontario and have seriously interfered with the operations of some of the miners.

Porcupine—The Hollinger is preparing to carry out extensive development below the 850 level. The main shaft will be deepened from 1,250 ft. to 1,550 ft. and levels run at 950, 1,100 1,250, 1,400 and 1,550 ft. This is all practically virgin ground, as last year's report showed only $3,000,000 in ore reserves below the 850 level. It is understood that in these new workings about fifty faces will be eventually opened. It is also proposed to throw out all the stamps and substitute ball mills, which will give increased capacity without additional space. At the annual meeting next month it is not expected that any increase will be shown in the reserves. There is, however, talk of an increased dividend.

The McIntyre is pushing the new mill additions, which will give a total capacity of 1,000 tons a day when the carbonaceous ores are not being treated.

Work is being rushed on the new power development at Sturgeon Falls. The right of way for the transmission lines is being cut, and an order has been placed for ninety miles of cable for the power lines.

Officials at the Vipond have been notified that it has been decided to dewater the mines in April.

It is understood that the Longyear interests are considering an extensive diamond-drilling campaign on the sand plains west of the Hollinger, which would necessitate an expenditure of $100,000. In this section there are no rock exposures, and the sand overburden is from 100 to 150 ft. deep. It is believed, however, that there is a strong probabilitiy of the Hollinger vein systems extending into this unknown area.

The main shaft at the Dome has reached 1,450 ft. and a station is being cut. Gross production for February will be over $300,000.

Kirkland—The Argonaut shaft will be sunk from 350 to 500 ft., and it has also been decided to diamond drill the property.

During January, the Lake Shore treated 2,335 tons of ore and recovered $51,883, or an average of $22.20 a ton.

Preparations are being made to start work on a number of properties. Work is being resumed on the Canadian Kirkland. Diamond drilling will be started on the Highland Kirkland. A 400-ft. shaft will be sunk on the Elkstone-Dunkin, and the Montreal Kirkland will sink from 100 to 300 ft.

Dip Compass Useful in Locating Non-Magnetic Iron Ore

The usefulness of the dip compass for locating non-magnetic iron ore deposits has been demonstrated, in the opinion of W. R. Crane, the superintendent of the Bureau of Mines Southern Experiment Station at Tuscaloosa, Ala. Further experiments are to be conducted in an effort to improve the interpretation of results, particularly with reference to the character of the deposits.

An advisory committee, which will assist in working out the program of investigations at the same station, has been selected as follows: C. E. Abbott, Tennessee Coal, Iron & Railroad Co.; C. E. Bowron, Gulf States Steel Co.; W. M. Lacey, Woodward Iron Co.; W. J. Penhallegon, Republic Iron & Steel Co.; [illegible] E. Strong, The Alabama Co.; H. J. Thomas, Sloss-Sheffield Steel & Iron Co.

WASHINGTON

Labor Still Plentiful—Premier Shipping More Ore to Tacoma—Labor Plentiful

By Hilliard W. Power

Spokane—With the Star-Hecla-Day-Smith litigation settled, and the Northwest Mining Convention, held in Spokane every February, adjourned, Northwest mining men are for the most part entirely out of conversational material. That is, aside from their own troubles and hopes. With the long and cold winter, which continues lingering upon the lap of spring, and gives promise, according to indications, of continuing to linger, there are at present ample excuses for Northwest mining men to mention trouble. While the cold remains, water will freeze up or get low; fuel run out; employees slip down an icy hill and get hurt, and there are prospects of damage from snowslide looming up, as soon as soft weather comes. However, a general feeling of optimism is prevalent, and expectations are that 1922, as far as mining in the Northwest is concerned, will show a distinct improvement over operations in 1921.

February has been a duplication of January. The same producers and smelters have operated as in January with approximately the same tonnage handled. The Tacoma smelter, however, has begun to receive increased shipments of ore from the Premier mine, Portland Canal, B. C., now that the 11¾-mile aërial tramway has been completed. With more favorable arrangements for custom shippers in effect, the Trail smelter has been receiving a slightly greater tonnage of ore from independents. The Silversmith's high-grade output has been consigned for the most part to the Bunker Hill plant at Kellogg, which has been able to keep two furnaces in operation for several weeks.

Official announcements by the Bunker Hill & Sullivan of a definite intention to install an electrolytic plant at Kellogg make it appear likely that construction upon this scheme will be well under way by midsummer. Actual preparation for building has hinged in a large measure upon the outcome of the Star-Federal and Day-Smith-Hecla litigation.

There is more inquiry for Northwest mining stocks from the East than at any time in the last two years. This upward tendency locally is regarded as a barometer of improvement, as the Spokane Stock Exchange quotations began slumping heavily long prior to the big reduction in operations and output which took place in the district over a year ago.

Labor continues plentiful, although there has been a considerable exodus of miners and other mine workers to Butte, more particularly from the Cœur d'Alenes, following announcement of Anaconda's plans for resumption of operations.

MONTANA

Anaconda Employing 5,500 Men at Butte; Hoisting 5,000 to 6,000 Tons of Ore

By A. B. Keith

Butte—Anaconda will soon be producing copper and zinc shingles at a daily rate sufficient to roof twenty ordinary dwellings, according to an announcement made by Frederick Laist. New machines, designed especially by the company's engineers for turning out this product, have been installed at the Raritan plant, in New Jersey. These have a capacity of 40,000 units every twenty-four hours. It was Mr. Laist's belief that his company would be ready to make shipments of the shingle practically at once. Merchandising plans of the Anaconda company now call for a package of shingles weighing 40 lb., instead of 100, as it was found to be too difficult to carry a bundle of 100 lb. up a ladder to a roof, whereas 40 lb. was found to be a convenient weight.

Anaconda now has seven properties at work in the Butte district, employing 5,500 men, and is increasing this force as experienced men present themselves. Applications for employment at the time of resumption brought an average of 100 workmen daily, which number has now dwindled to about sixty, with the number of experienced miners small.

The daily tonnage is ranging from 5,000 to 6,000, and this will be increased steadily, under the present plans for expansion. The electrolytic department of the Great Falls copper refinery of the company has resumed operations, and it is expected to have the furnace at this plant working soon. The schedule called for the employment of 1,000 men at the Great Falls works by March 1, to be built up to 1,200 this summer, as compared with a normal maximum of 1,500. The force at the Washoe smelters at Anaconda will be kept at 2,000 for some months as against a normal of 3,000 before the shutdown.

The Anaconda company shipped last week from its Great Falls rod and wire plant six carloads of copper wire to Valparaiso, Chile, for use in connection with the electrification of the Chilean National Railways, the shipment weighing more than 2,000,000 lb. The company has received many inquiries for copper wire.

The Greene-Cananea company, of whose stock the Anaconda is an important owner, will be called upon to help out in the matter of supplying American Brass Co. with its metal needs, and its capacity, of both mill and smelter, will, it is reported, be increased 500 tons daily.

In a report made by Prof. James F. Kemp, of Columbia University, the following interesting observations are made in connection with Anaconda Copper Mining Co.: The ore mined averages 3.30 per cent copper, of which an average recovery of 96 per cent is had through oil flotation, with a net recovery after smelting and refining of

91.50 per cent of all values in the crude ore. Dr. Kemp states that the company has opened 2,200 miles of workings and in normal years operates twenty-three different mines or shafts. Ore reserves indicated are of sufficient tonnage to support operations on a normal scale for fifteen to sixteen years to come. This number of years in no way covers the life of the Butte mines, as it is uneconomical to develop ore far ahead in deep mining properties. In its South American properties the Anaconda has the following ore reserves:

Property	Tonnage	Copper, Per Cent
Andes	128,000,000	1.49
Cerro Verde	20,000,000	1.92
Lo Aguirre ...	8,000,000	1.98
Africana	2,000,000	3.50

Improvement observable in the shaft vein of the Tuolumne Copper Co. as depth is attained is attracting more attention to the possibilities attendant upon deep development in the east side. Increasing confidence is indicated in the zone of mineralization, which is looked for when the Main Range shaft has reached its objective, which is the 2,600 level.

The Davis-Daly interests have been negotiating with the W. A. Clark officials to handle the second-class ore of the Davis-Daly at the Timber Butte mill, the concentrates to be shipped to the Washoe smelter of Anaconda for treatment.

The East Butte Mining Co. has under construction with the C. V. Nordberg Machinery Co., of Butte and Missoula, an electrical hoist to cost about $35,000, good for about 3,500 ft. in depth. This will be installed at the new shaft recently raised through to the surface. Early delivery of the hoist is anticipated.

Formation of a new company with a capital of $2,500,000 in shares of $10 to operate the old Butte-Bullwhacker and the Butte-Duluth in consolidated form is proposed by a number of Butte business men, in a formal statement to stockholders and bondholders of both companies, outlining an exchange basis. Both properites were operated during pre-war years on a scheme for leaching copper ore with sulphuric acid and precipitating the copper electrolytically. The process was not a commercial success.

Spokane Oil Boom Collapses

A feature of the month of February was an almost total collapse of an incipient "oil boom," which started in Spokane last fall, and continued throughout the winter, and which was due largely to the discovery of an alleged "seepage" a year ago inside the city limits. The Geological Survey investigations put a damper upon the whole affair. Notwithstanding this fact, drilling is being continued by two or three concerns, which incorporated and sold a considerable volume of stock to local investors. No discovery of petroleum has been made.

OREGON

Medford-Jacksonville Railway Purchased by Owner of Opp Mine—Stamp Mill To Be Enlarged

Jacksonville — J. W. Opp, owner of the Opp mine, one and one-half miles west of Jacksonville, has purchased the Medford-Jacksonville electric and steam railway extending between these two points and three miles beyond Jacksonville past the Opp mine. This transaction is expected to result in new activity in the district west of Jacksonville, and to meet the resulting conditions the Opp mine will enlarge its stamp mill to handle the output of the smaller mines by building feeders to them. A cement, brick, and tile plant is also planned for establishment at the Opp for the utilization of ore tailings. Extension of the road west of the present terminus would tap a rich timber and mining belt, long undeveloped.

The Opp mine was discovered many years ago, but its chief development has taken place within the last sixteen years. Its holdings aggregate 373 acres. It is opened by eighteen adits, disclosing three main veins. The longest crosscut entry is 850 ft.; another is 550 ft. long. The total underground workings amount to about 7,000 ft.

Hecla Company Strikes Rich Ore in Tiger-Poorman Group

When the Hecla Mining Co. took over the old Tiger-Poorman group of claims in settlement of pending apex litigation with the Federal Mining & Smelting Co., it added an asset to its holdings more valuable than had been surmised. Evidence of this came to light a few weeks ago, when a remarkably fine shoot of lead-silver ore, carbonate and sulphide, was discovered on the Wide West claim. It is about 2 ft. wide at a depth from the surface of about 150 ft., all shipping grade, and ten or twelve tons are being sacked a day, taken out in extending the drift.

Bunker Hill's New Zinc Plant To Be Started Soon

The decision in the Star case in favor of the Hecla Mining Co. and the Bunker Hill & Sullivan Mining & Concentrating Co., which insures the joint ownership and operation of the Star mine, settles beyond question that the Bunker Hill & Sullivan company will begin the erection of an electrolytic zinc plant at Kellogg, Idaho, soon. Announcement to this effect was made by F. W. Bradley, of San Francisco, president of the company, immediately following the victory in the courts. The initial plant will probably have a capacity of twenty-five or fifty tons of refined zinc per day, and will be completed by the time the Star mine is ready for production, which, it is estimated, will be within two years. Additional units will be added, with the view to eventually providing a local market for the entire zinc product of the Cœur d'Alenes.

CALIFORNIA

Engels Copper Mining Co. Has New President—New Organization Plans To Erect Smelter

San Francisco Correspondence

San Francisco The stockholders of the Silver Hills Nevada Mines Co. are to be offered the opportunity for transferring their shares in a new corporation to be known as the Silver Hills Comstock. The new corporation is to take over the Buckeye Consolidated mine, in the Comstock district, Virginia City. This property had been abandoned, but appears to offer some opportunities under present-day conditions. The offer, it is understood, is tentative, and final announcements have yet to be made by W. J. Loring.

It is also currently reported that the option held upon the property of the Melones Mining Co. will be exercised by the Carson Hill Gold Mining Co. The cyanide plant and mine have been used for some time by the Carson Hill company in working and developing the latter's Morgan claim.

At a recent meeting of the directors of the Engels Copper Mining Co. the following officers were elected: F. Klamp, president, succeeding Henry Engels; J. F. Humburg, vice-president; E. E. Paxton, manager, and R. A. Kinzie, operating engineer. The existing policies are to be continued.

Preliminary announcement of price reductions for high explosives and black blasting powder have been made by one explosives company, effective Feb. 17, 1922.

Local reports state that the Jo Rand Smelting Co., a new company incorporated in California, intends to erect a smelter at Mojave, Cal. R. L. Gilmore, of Bakersfield, is stated to be secretary and treasurer.

Northern California — At French Gulch (Shasta County), the Gladstone mine is reported to have reached a condition where a small initial production can be made. The property employs twenty-two men and has a thirty-stamp mill. Development work has begun at the Lone Pine mine, a small property in Squaw Gulch near Cecilville. Prospecting for channel leads is also under way at the junction of the East and South forks of the Salmon River. The new wire-rope tramway of the Mountain Copper Co., Ltd., connecting with Mathewson, is being tried out, and in a short time will be in operation.

Mother Lode Region—According to Stanley Arnot, about 750 miners are at work in Amador County. The Shenandoah mine, a mile north of the Plymouth, is being unwatered. The Moore mine, near Jackson, has been unwatered, and development is being carried out, but just what the mine will do in the future is uncertain. In the Fremont, old workings in the vicinity of the North Gover orebody have been reclaimed, with the exception of the drift in the ore which was found caved. Production at the mine is still in the future.

PLANT OF PRINCE CONSOLIDATED MINING CO., AT PIOCHE, NEV.

NEVADA

Snowslides Hold Up Operations in Tonopah District — Tonopah Belmont Cuts Charges on Custom Ore

From our Special Correspondent

Tonopah—Operations are normal in this district. All work in this and adjoining districts was suspended for twenty-four hours on Feb. 11 and 12, owing to lack of electric power. Snowslides on the White Mountains temporarily obliterated the power line which supplies southern Nevada, and no power was available for a period of twenty-two hours. No extensive damage resulted, according to reports that have been received.

The Tonopah Belmont Development Co., which operates a 500-ton plant on its own and custom ore, has announced a new and reduced scale of treatment charges on custom ore. Reductions vary from 75c. to 50c. per ton, the greatest reduction being based on ore valued up to $20 per ton. This reduction will undoubtedly stimulate the mining of low-grade blocks by leasers in the Montana, Midway, MacNamara, and Jim Butler mines.

Hornsilver—In the Orleans Hornsilver mine work has been resumed in the southeast drift on the 7th level in ore. The winze from this level continues in ore, the last 15 ft. being said to show 6 ft. of ore of excellent grade. Official reports are to the effect that the company is now negotiating the sale of a block of treasury stock to finance mill construction.

Royston—Weather conditions have moderated, and surface lease work has been resumed in this district. Another shipment is being prepared from the Betts lease. The grade is reported to be lower than the last shipment, which ran $311 per ton, but is good shipping ore. The orebody was faulted in the Betts shaft and has not yet been located west of the fault. Contractors are at work sinking the incline shaft, already 300 ft. deep, of the Hudson Company.

Virginia City — The Buckeye Comstock mine, on the Brunswick-Accidental lode and about one mile east of Silver City, has been purchased by the Silver Hills Nevada Mines Co., of which W. J. Loring is president. The purchase price is said to be $65,000, most of which is cash. The property is opened to a depth of 650 ft., and is flooded below the 200 level. Past production of the property is reported to have been $1,200,000, mostly in gold.

Ely — Assays from the Bowen-Ely property, which is situated on the East side of Steptoe Valley about nine miles from Ely, demonstrate that the mine will soon be in the shipping class. The principal value in the ore is gold, the vein across a width of 2 ft. carrying 5 oz. in gold, with less than an ounce in silver.

Rumor points to a resumption of activity by the Nevada Consolidated on April 1. However, no increase is noted in the number of men put on. In fact, the recent increase has been offset by a number of men being laid off in the repair departments.

Pioche—The Virginia Louise Mining Co. may be forced into the hands of a receiver owing to the action of certain bond holders who are apparently not in sympathy with the present waiting policy of the management. Substantial ore reserves are reported to be present in this property by Walter Harvey Weed, who recently examined the mine. Litigation with the neighboring Prince mine caused the bonding of the property in its early stages of development, but though the company's mining operations have been conducted at a profit, it has been found impossible to retire the bonds.

Resumption of operations is expected at three of the mines in the Silverhorn district, which enjoyed a brief but lively boom just a year ago. The properties expected to resume are the Silver Horn, the Silver Dale, and the Silver Peer. Stock manipulation and lack of underground development were the principal causes of the cessation of operations on July 1 of last year.

Ore shipments from the Pioche district for the week ended Feb. 17 were curtailed on account of serious washouts on the Pioche Branch of the Union Pacific system, six days elapsing before a train was able to make the trip. The following shipments were sent forward to the Salt Lake Valley smelters: Black Metals mine, 285 tons; Bristol Silver Mines, 110; DeWitt Cunnington Lease, 40; Clark Lease, 35; a total of 470 tons for the district. The ore bins at the Bristol and Jackrabbit are full of ore. Two leasers at the latter shipped ore of higher grade.

UTAH

New Mill of Silver King Coalition Operating—Eight Valley Furnaces Running

From Our Special Correspondent

Park City—Shipments for the week ended Feb. 18 amounted to 2,662 tons, compared with 2,354 tons the week before. Shippers were: Judge allied companies, 1,532 tons; Silver King Coalition, 1,661; and Ontario, 479.

The Judge Mining & Smelting Co. places its net return or net earnings for 1921 at $19,926 in its annual report to the State Board of Equalization. Production was 17,259 tons of ore, which gave a gross return of $582,606. The company lists the value of its property, improvements, and machinery at $299,080, and the total value for assessment purposes at $358,860.

The Daly Mining Co. in 1921 mined 903 tons of ore, from which there was received a gross return of $37,752. The expenses of extraction amounted to $9,415 more than this figure. The valuation of the mine for assessment is placed at $11,336, all of which is represented in machinery.

The Daly West Mining Co. reports 7,510 tons of ore mined during 1921, from which gross returns of $233,019 were received. The assessed valuation is $46,340.

The new mill of the Silver King Coalition is practically completed, and some of the machinery is being tried out. Regular operation has begun. The new mill will have a capacity of 450 tons a day and was built to replace the old plant destroyed by fire on Jan. 27, 1921. Active construction was begun July 1. Production has been held down the last few months, and only enough first-class ore shipped to enable the company to get along. Much second-class or milling ore has been developed, and when it has been necessary to break this it has been stored in stopes and drifts. Much development has been done in the last two years, and numerous new orebodies have been opened. As soon as milling is started the output will be largely increased, as it will be possible to ship more first-class ore in addition to the material milled. The property is stated to be in better condition on account of extensive development than it has been in the last seven or eight years.

Salt Lake City—The road to the Alta Tunnel & Transportation Co.'s property in Big Cottonwood has been reopened for the first time since the blizzard early in February, and ore has been hauled to the stockpile in the main canyon, and to the smelter at Murray, by reloading. This is the eighteenth lot shipped. Development has been in progress since shipping ceased, and the opening of the main stope has continued. A raise here has followed ore, and the presence of other ore beds overlying the first bed is expected to be disclosed.

Furnaces in operation at the Salt Lake Valley smelters during February were as follows: The U. S. Smelting, Refining & Mining Co. at Midvale ran three lead furnaces, including one furnace on matte concentration. The A. S. & R. at Murray ran two lead furnaces. The Garfield smelter of the A. S. & R. had two reverberatories and one blast furnace in operation, treating siliceous silver ores chiefly. The matte, which went through the hearth of one of the reverberatories, and of which there has been a gradual accumulation for some time, amounting to between 4,000 and 5,000 tons, is being mined out and reworked in the other furnaces. This material, besides the copper, carries about 300 oz. silver and up to 5 oz. in gold per ton. There is some talk of the International smelter at Tooele resuming.

The Cardiff Mining & Milling Co. places a valuation of $93,183 on its property in the annual report made to the State Board of Equalization. In all, 6,023 tons of ore was produced, yielding $122,720 gross and $14,609 net profit.

Eureka—Ore shipments from the Tintic district for the week ended Feb. 18 amounted to 148 cars, as compared with 136 cars the week before. Increased shipments were made by the Chief Consolidated, Grand Central, and Tintic Standard, and shipments from the Eagle & Blue Bell and Victoria decreased on account of labor trouble. Shippers were: Tintic Standard, 59 cars; Chief Consolidated, 51; Grand Central, 11; Swansea, 5; Iron Blossom, 6; Centennial Eureka, 4; Dragon, 3; Eagle & Blue Bell, 2; Gemini, 2; Bullion Beck, 2; Tintic Milling, 1; Empire Mines, 1; and Victoria, 1.

Bisbee and Douglas to Educate Tourists

The mines at Bisbee and the smelters at Douglas, Ariz., are to be capitalized for sightseeing by the Chambers of Commerce of the two cities, working together. It is proposed to pluck the traveler from the trains, on granted stop-overs, and to halt the speeding auto tourists, to extend them guidance and hospitality and thus to educate the American public in detail regarding the wonders and riches of the copper producing section visited.

ARIZONA

Conditions Improved Owing to Resumption by Copper Companies

By JAMES H. MCCLINTOCK

Phoenix—Generally, the mining industry of Arizona has taken on a much healthier tone during February, with the starting of a number of copper reduction plants and consequent employment of many men in mining and transportation work. Arizona Commercial is the last to start work in the Globe section, though ore will not be produced till the Old Dominion mill will receive it. Miami is running with a closer approach to normal than any other Southwestern copper camp. At Bisbee the principal companies are adding men, and at Douglas they are smelting ores that have been in stock for a long time.

Official advices from Mexico are to the effect that the Cananea Consolidated Copper Co., at Cananea, and the Moctezuma Copper Co., at Nacozari and Pilares, are preparing to resume operations. The Moctezuma is a Phelps Dodge subsidiary. Magma, at Superior, with a remarkable ore showing at 2,000-ft. depth, may delay increased operations until its own smelter has been built and its private railroad widened. United Verde has awarded a $150,000 contract for the foundations of its new $1,500,000 crushing plant, to be built near Clarkdale.

Among the smaller mines, work has been resumed at the famous Fortuna gold mine, near Yuma; a twenty-five-ton concentrator is operating on the Sunshine-Sunrise property, near Tucson, on gold-silver-lead ore; the Mildred gold mill, near Congress, has been started; Verde Inspiration, near Jerome, is installing a cyanide milling plant; the well-known Little Butte copper property, near Bouse, has passed into the hands of a southern California corporation formed for the purchase; and a fifty-ton silver mill is to be placed on the Stargo property, near Morenci, which is financed by Morris Kullman, of New York.

The Phelps Dodge Corporation has deposited $100,000 in the United States Court at Tucson, Ariz., and has received receipt for payment for the Rough Rider group of twelve claims in the Warren district of Arizona, adjoining the Copper Queen. The purchase price was $200,000, payable to Hovland & Smith, mining operators whose affairs have been before a master in chancery in Tucson for a year, in the final adjustment of which Hoval A. Smith was adjudged to have about $1,000,000 coming to him on dissolution of the partnership. The master receives a fee of $11,000, ordered by the court.

The Phelps Dodge Corporation has asked relief from all connection with the matter, save in so far as it may have concern in holding 32,585 shares of the stock of the Washington Mines Development Co. as security for advances made Hoval A. Smith and F. O. Bostwick.

Prescott—Ore is being received at Humboldt from the Swansea lease, in northern Yuma County. It is expected that one of the furnaces of the old Consolidated Arizona plant will be started in the event of reorganization by the Southwest Metals Co

It is understood that the Shea, at Jerome, has been absorbed by Calumet & Arizona interests. Its ores are siliceous, of a kind needed in the C. & A. smelter at Douglas.

All machinery and equipment of the Rigby reduction plant and Great Western smelter at Mayer are being offered for sale, piecemeal. The smelter consists of a 200-ton water-jacketed blast furnace.

Oatman—The San Francisco Mining Co. has closed a contract for a definite diamond-drilling program. This will be done from the surface. The ground lies just to the northeast of the Oatman United. The company is headed by W. K. Ridenour, with J. A. Hassell, F. Van Sayer, and W. B. Phellps as the other officers.

United American and Telluride are ready for ore shipments to the Tom Reed mill. Delay in the arrival of a weighing machine and a few minor changes at the mill have resulted in the date for ore acceptance being set for early in March. The contracts of the two properties mentioned call for a minimum delivery of twenty-five tons per day.

Diamond drilling at the Merry Widow is well under way. The first hole has been started from the surface at an angle and is down 200 ft. It is expected that this will cut the first ledge at a depth of 350 ft. and the second at 800 to 900 ft.

White Hills—F. W. Traphagen, of Golden, Col., has arrived to take charge of metallurgical work at the White Hills mill. Twenty stamps with twelve pan amalgamators are to be started at once. Damage done recently by fire in the hoist house at the Grand Army shaft has been repaired and another hoist mounted. The Occident shaft has been sunk 100 ft. below the lowest old level. Drifts will be driven under the ore shoots so as to get about 75 ft. of new backs.

Would Revise Sampling Methods in Joplin District

Mine and smelter operators in the Joplin district are trying to revise the present plan of sampling, assaying, and settling for ore in this field, believing that a plan can be worked out that will mean a big saving to the district. Committees appointed by the Tri-State branch of the American Zinc Institute and the Tri-State branch of the American Mining Congress have conferred for joint recommendations, submitted to and approved by the operators, at a meeting held at Picher on Feb. 17. The representatives of the smelters will hold a meeting in the immediate future, and it is believed a new plan will be worked out and agreed upon.

MICHIGAN

The Copper Country

Trimountain's Output Continues To Increase—Reduction in Rail Freight Rate on Ore Desirable

By M. W. Youngs

Houghton—Not much metal is moving out of the Lake district, shipments being confined to small lots to domestic buyers. Foreign business is almost negligible. Copper Range has a three months' supply of metal on hand at present rate of production, and Quincy, Mohawk and Wolverine also have good-sized stocks. No large increase in the metal movement is now expected until spring, after the season of navigation has opened.

Calumet & Hecla is nearing the end of its supply of mineral, mass, and cupola blocks at its smelter, and April 1 will see this accumulation exhausted, it is believed. Soon after that date, with mining operations in progress, a new supply will be available. Seven furnaces are in operation at the smelter, and the present net output is in excess of 100,000 lb. daily.

Several of Calumet & Hecla's conglomerate shafts undoubtedly will be ready for resumption of mining operations on or about April 1. The work of cleaning out the shafts, removing trap or vein rock which has accumulated through a crushing of the ground, retimbering and straightening out the skipways is slow, for only a limited number of men can be employed, and several months will be required to put all shafts in readiness.

In Calumet & Hecla's Red Jacket shaft, where three shifts of men are at work, timbering has been completed to the 57th level, and attention is now being paid to the crosscut extending into the tract below Tamarack Junior. This probably will be the only important section of mining ground available until next fall. In No. 2 shaft, extensive repairs will be necessary only for one level, the 17th. The greater part of the ground yet to be removed in this shaft consists of shaft pillars, arches and backs. Though the life of this shaft is limited, an immense amount of rock is still available, and it will be a heavy contributor to production before it is finally abandoned. In No. 4 shaft timbering is also under way. The ground below Tamarack Junior also can be reached from this shaft, and in addition there is still a large amount of ground to be mined in the bottom levels. From Nos. 6 and 7 shafts considerable vein rock is being removed during the course of reopening, and this will be available for milling. The Red Jacket shaft and Nos. 4, 6 and 7 probably will be the shafts to start operations with the resumption of regular mining.

At the Copper Range mines the improvement noted in Trimountain during the last six months continues, and production from this property is steadily increasing. It has reached a total of 14,000 tons a month, the rock averaging 30 lb. to the ton.

The work of putting Seneca's Gratiot No. 2 shaft in condition for resumption of sinking will now proceed rapidly. The concrete shaft collar is practically completed. The task of straightening out the shaft to conform with the dip of the lode has been completed to below the 6th level. Seven more levels are to receive attention. The shaft is to be sunk to a depth of 3,200 ft., at which point it will be connected with the Seneca shaft. The five drifts, north and south, from the Seneca shaft are proceeding in good ground.

The recent reduction in rail freight rates on refined copper shipments has led to the hope that rates on rock (ore) shipments from mine to mill will be reduced. The high cost of rock transportation, more than double the pre-war rates, is a considerable factor in increased mining costs, amounting to from 1 to 2c. for mines not owning their own railroads. Mohawk, Wolverine, and Ahmeek are particularly hard hit by these high rates.

The February production of refined copper in the Lake (Michigan) district was 8,300,000 lb., as compared with 8,650,000 lb. for January. The present rate of output is slightly under 40 per cent of normal for the district. Eleven furnaces were in operation in February, as follows: Calumet & Hecla, seven; Copper Range (Michigan), three; and Quincy, one.

ALABAMA

Iron Output Continues To Increase—Rock Asphalt Deposits Studied—Interest in Gold Mining Possibilities

By George Huntington Clark

Birmingham—Pig-iron production in Alabama thus far in 1922 is by way of fulfilling recent predictions, with some excess. The January output is now officially stated at 121,067 tons, which is greater than for any month of 1921 except January and February.

The single furnace in blast of the Republic Iron & Steel Co. at Thomas during January broke all its previous records as an iron maker. Other furnaces in the district are also making a larger production. February's output will probably be around the 125,000 ton mark. The blast furnace of the Gulf States Steel Co., at Alabama City, has just been fired, to be followed later by the blowing in of the company's two open-hearth furnaces. The stack just fired will handle 750 or 800 tons daily.

The No. 4 blast furnace of the Tennessee Coal, Iron & R.R. Co. at Ensley, which has been practically rebuilt, and has had its capacity increased to 400 tons per day, is to be blown in about March 1, which may bring the March output above 140,000 tons. Four of the Tennessee company's Ensley furnaces have been in operation for some months, so the addition of another stack will mean an increase in the output of basic iron.

Seven of the nine Ensley open-hearth furnaces were in operation during February.

To summarize, the fourteen stacks now in blast in Alabama, eight of which are in the immediate Birmingham district, represent approximately 56 per cent of the average normal pig-iron production, showing an increase of 180 per cent over July, 1921.

The amount of ore being raised is not precisely ascertainable, as an unknown percentage of it is drawn from reserve furnace stocks. If mined for February melt, it would amount to about 330,000 tons on a basis of average analysis.

Outside of iron making, mining operations in Alabama have generally shown a limited reaction from the post-war depression, but greater confidence seems manifested.

Much attention is being given to deposits of rock asphalt, suitable for road building purposes, which occur in a wholly undeveloped condition in about eight or nine different counties in the Paleozoic or Valley district of the state. Kentucky has so fully demonstrated the usefulness of this material on heavy-traffic highways, when it is of good quality and properly laid, that the production of these asphalts and their manufacture may assume definite commercial form in Alabama if prospecting shows that conditions warrant.

Interest is being shown in the gold-mining possibilities of Alabama. At one time there were properties under profitable development, operations being mainly confined, however, to the recovery of free gold by crude methods. The refractory gold ores which occur are being studied by experienced miners, who say they plan to erect reduction plants if a method of treatment can be developed.

COLORADO

New Dredging Company Organized

Rollinsville—The Pactolus Dredging Co. has been organized to work placer ground at Rollinsville, Col., forty-two miles west of Denver on the Moffatt road. It has leases on an acreage of between 5,000,000 and 6,000,000 cu.yd. of gravel, 12 to 16 ft. deep. The ground has been tested by drilling and shafts and is said to average a minimum of 50c. per cu.yd. A contract has been let for a 2,000 cu.yd. dredge, to be in operation this May. The above-named company also holds leases on Gamble gulch, above Rollinsville, and below the old Gold Dirt mill, from which, on the Gold Dirt claim in the early days, the surface was washed and coarse gold secured. The gulch also contains tailings from the old mill, worked in the early days.

Lake City—The Golconda company, in Hinsdale County, above Lake City, has raised a cash fund of $50,000 for further development. The property has been operated to some extent the last two years to determine its value and to block out sufficient ores for the erection of a mill.

THE MARKET REPORT

Daily Prices of Metals

Feb	Copper, N. Y., net refinery* Electrolytic	Tin		Lead		Zinc
		99 Per Cent	Straits	N. Y.	St. L.	St. L.
23	12.625	28.625	29.875	4.70	4.40	4.475
24	12.50@12.625	29.00	29.875	4.70	4.40	4.475@4.50
25	12.50	29.125	30.00	4.70	4.40	4.475@4.50
27	12.35@12.50	29.75	30.375	4.70	4.40	4.50
28	12.50	29.25	29.875	4.70	4.40	4.50
Mar. 1	12.50	28.50	29.50	4.70	4.40	4.50@4.55

*These prices correspond to the following quotations for copper delivered: Feb. 23rd, 12.875c.; 24th, 12.75@12.875c.; 25th, 12.75c.; 27th, 12.60@12.75c.; 28th, 12.75c.; March 1, 12.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Feb.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
23	57⅜	58⅜	63½	142	144	20⅝	20⅝	24⅜	24⅝
24	58	58⅞	63½	144	146	20½	20½	24⅜	24¾
25									
27	59¾	60¾	63½	147½	149½	20⅝	20⅝	24½	24¾
28	58¾	59¾	63½	145	146¾	20½	20⅜	24½	25
Mar 1	58⅞	59⅞	63½	141	143	20⅝	20½	24½	25

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Feb.	Sterling Exchange "Checks"	Silver			Feb	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
23	440¾	99⅝	64⅜	33	27	443	99⅝	63¾	32½
24	439	99⅝	63½	32⅞	28	442	99⅝	62¾	32⅛
25	440	99⅝	63½	32⅞	Mar 1	443⅜	99⅝	63⅝	32⅜

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Average Metal Prices for February

Copper:	
New York Electrolytic	12.864
London Standard	60.250
London Electrolytic	66.125
Lead:	
New York	4.700
St. Louis	4.396
London	20.681
Silver:	
New York, foreign	65.290
New York, domestic	99.625
London	33.891
Sterling Exchange	435.511
Zinc:	
St. Louis	4.485
London	24.213
Tin:	
99 per cent	29.835
Straits	30.767
London	149.850
Antimony	4.416
Quicksilver	48.295
Platinum	89.545

Metal Markets

New York, March 1, 1922

The market has been quiet, throughout the week, with the principal activity in lead. Copper seems to have been arrested in its decline, and greater interest has been manifested in that metal. Zinc has become appreciably stronger, and tin, as usual, has fluctuated considerably in price.

Copper

The net movement in copper for the week was downward, but a noticeable stiffening on the part of producers, to prevent, as far as they are able, a further descent, is apparent. Several agencies which were freely offering copper on practically every drop on the way down to 12.50c. refuse to go lower for the time being, and as these producers are an important factor in the situation, it may become difficult to pick up lots at lower prices, which presumably is what the consumer is anticipating. The rumor of a sale of over five millions pounds of copper to an electrical manufacturer at a price of 12.50c. delivered did much to unsettle the market earlier in the week. We have been unable to trace any sale of that magnitude and at that price, the lowest price reported netting the producer 12.35c. and being for a considerably smaller lot and partly in forward copper. The general level at which producers are now holding is 12.75c. delivered at which price the metal is freely obtainable; higher quotations have been made, but without securing the business. Consumers have lately been more interested, making bids for tonnages below the market level, but without receiving much encouragement from producers. The large producers have participated in the market, but have not made heavy sales. Export business has picked up a bit.

In the issue of Feb. 25, London standard spot copper should have been quoted £57⅜ and three-month standard copper, £58⅜ for Feb. 22.

Lead

The official contract price of the American Smelting & Refining Co. remains at 4.70c. Lead has been sold by other interests at this general New York level. In fact, business has been unusually brisk for several producers, and not a few large-sized orders were placed in both markets. Corroding lead has been in particular demand in the Middle West at a premium amounting to about one-tenth cent per pound over the prices we quote. Besides the paint business, cable companies, storage-battery and other manufacturers have been filling their requirements. One producer reports sales in carload lots to a number of different consuming classes and hails this as an encouraging sign of reviving and prospective activity. Possibly, producers have been anxious to book lead freely because of the possibility of Mexican lead coming into the United States. However, the prices received for Mexican lead shipped abroad have been too attractive lately to encourage shipments of the metal to this country.

Zinc

The market has recovered slightly from Thursday's low of 4.75c., but sales have not been made in great volume. Producers do not apparently wish to sell at the present level, and the market has been as quiet.

Tin

Some buying took place every day, but generally in small volume, and interested parties have become somewhat apprehensive of the London and Banca situation. Owing to the arrivals of rather heavy shipments of metal, the premium on spot tin has disappeared, and it would not be surprising if there develops, as in the London market, a premium on forward metal.

Straits tin for June delivery was quoted as follows: Feb. 23d, 29.50c.; 24th, 29.50c.; 25th, 29.50c.; 27th, 30.375c.; 28th, 29.875c.; March 1, 29.50c.

Arrivals of tin in long tons: Feb. 21st, 50; 23d, London, 425; 27th, London, 10; Straits, 475; 28th, London, 25.

Gold

Gold in London, Feb. 23d, 93s. 9d.; 24th, 93s. 10d.; 27th, 93s. 7d.; 28th 93s. 6d.; March 1, 93s. 3d.

Foreign Exchange

With the exception of marks, foreign exchange continues the strength shown last week, sterling, francs, and lire generaly moving upward. The recent rise is felt to be partly psychological. On Tuesday, Feb. 28th, francs were 9.16c.; lire, 5.315c. and marks 0.44c. New York funds in Montreal, 2 13/16 per cent premium.

Silver

Continued sales by China have been the feature of the market for the last week, with bear covering the only support to the market. On March 1, however, the Indian bazaars come in as heavy buyers for spot silver, their resumption of buying being due undoubtedly to the definite assurances that the rumored import duty of one-quarter rupee per ounce on silver coming into India will not be imposed. The market closes uncertain, with business in New York at slightly lower level than the parity of the London spot quotation.

Mexican Dollars—Feb. 23d, 49⅜; 24th, 48¾; 25th, 48¾; 27th, 49; 28th, 48; March 1st, 48¾.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 16@17c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 4.35c.; market dull. W.C.C. brand, 5@5¼c. per lb. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—7@7½c. per lb.

Bismuth—$1.90@$2 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Cobalt — Metal, $3@$3.25 per lb., black oxide, $2 per lb. in bbls.

Iridium—Nominal, $170@$190 per oz.

Molybdenum Metal—In rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

Nickel—Standard market, ingot and shot, 41c.; electrolytic, 44c. Small tonnages, spot, nominal at 32c.

Monel Metal—Shot, 35c.; blocks, 35c., and ingots, 38c. per lb., f.o.b. Bayonne.

Osmium—$70 per troy oz. Nominal. $70, Los Angeles, Cal.

Palladium—Nominal, $55@$60 per oz.

Platinum—$85@$90 per oz.

Quicksilver—$49.50 per 75-lb. flask. San Francisco wires $48. Strong.

Rhodium—$100@$115 per troy oz.

[1]**Selenium**—Black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $18@$20 per lb.

[1]**Tungsten Metal**—Wire, $35@$60 per kilogram, according to purity and gage.

Metallic Ores

Chrome Ore—Ore analyzing 40@45 per cent Cr_2O_3, crude, $18@$20 per net ton; ground, $25; annalyzing 45@50 per cent Cr_2O_3, $19@$21; ground, $25; f.o.b. Atlantic ports. Quotations are nominal.

Iron Ore—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $6.45; Mesabi bessemer, 55 per cent iron, $6.20; Old Rang non-bessemer, 51½ per cent iron, $5.70; Mesabi non-bessemer, 51½ per cent iron, $5.55.

Magnetite Ore—F.o.b. Port Henry N. Y.: Old bed 21 furnace, $4.85; old bed concentrates, 63 per cent, $5.75; Harmony, cobbed, 63 per cent, $5.75; new bed low phosphorus, 65 per cent, $8.50.

Manganese Ore — 22@26c. per unit, seaport; chemical ore, $45@$60 per gross ton, lump. Nominal.

Molydenum Ore—85 per cent MoS_2, 45c. per lb. of contained sulphide, New York. Quotation purely nominal.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots. Nominal.

Titanium Ores—Ilmenite 52 per cent TiO_2, 1¾@2c. per lb. for ore. Rutile, 95 per cent TiO_2, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore—Scheelite, 60 per cent WO_3 and over, per unit of WO_3, $3, f.o.b. Atlantic ports. Chinese, as low as $2. Nominal.

Uranium Ore (Carnotite) —Ore containing 1½ per cent U_3O_8 and 5 per cent V_2O_5 sells for $1.50 per lb. of U_3O_8 and 75c. per lb. of V_2O_5; ore containing 2 per cent U_3O_8 and 5 per cent V_2O_5 sells for $2.25 and 75c. per lb., respectively; higher U_3O_8 and V_2O_5 content commands proportionately higher prices.

Vanadium Ore—$1 per lb. of V_2O_5 (guaranteed minimum of 18 per cent V_2O_5), New York. Nominal.

Zircon — Zirconium silicate, f.o.b. Pablo, Fla., 4½@13c. per lb.

[1]**Zirkite**—According to conditions, $70@$90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

Zinc and Lead Ore Markets

Joplin, Mo., Feb. 25—Zinc blende, per ton, high, $30.70; basis 60 per cent zinc, premium, $26@$27; Prime Western, $25@$24; fines and slimes, $23. Calamine, basis 40 per cent zinc, $12; average settling prices: Blende, $26.31; all zinc ores, $26.21.

Lead, high, $63.85; basis 80 per cent lead, $60; average settling price, all grades of lead, $62.16 per ton.

Shipments for the week: Blende, 7,700; calamine, 70; lead, 2,161 tons. Value, all ores the week, $311,460.

Heavy buying was initiated late today, with a strong demand for Prime Western zinc ores on $25 basis. The same company bought heavily late last Saturday, the buyer claiming he bought 2,500 tons on $24 basis. Buying has been light all this year, and this movement was anticipated by sellers, who have persistently declined to accept lower offerings.

The extraordinary demand and strong price for lead has induced a growing output of this mineral.

Platteville, Wis., Feb. 25—Blende, basis 60 per cent zinc, no sales. Lead ore, basis 80 per cent lead, $60 per ton. Shipments for the week: Blende, none; lead ore, 41 tons. Shipments for the year: Blende, 1,703; lead ore, 560 tons. Shipped during the week to separating plants, 377 tons blende.

Non-Metallic Minerals

Asbestos — Crude No. 1, $800@$1,000; No. 2, $500@$750; spinning fibers, $200@$300; magnesia and compressed sheet fibers, $100@$175; shingle stock, $70@$120; paper stock, $40@$50; cement stock, $12.50@$17.50; floats, $6@$10, all per short ton, f.o.b. Thetford, Broughton, and Black Lake mines, Quebec, Canada. Market weak. No demand.

Barytes—Crude, $6@$8 per ton, f.o.b. mines. Ground white, $23, f.o.b. mills. Off-color grades, $17-$21, f.o.b. Southern mills. Foreign barytes, f.o.b. New York, $7 per ton crude.

Bauxite — American, crushed and dried, $6@$8 per gross ton; pulverized and dried, $12@$14 per gross ton; calcined, $20@$22 per gross ton, all f.o.b. shipping points. Foreign bauxite offered at $6@$8 per metric ton, c.i.f Atlantic ports, depending upon grade.

Borax—Granulated, crystals or powdered, in bags, carloads, 5½c. per lb.; in bbls. 5¾c.

Chalk—English, extra light, 5c. Domestic light, 4½c; heavy, 4c. per lb all f.o.b. New York.

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[1] Furnished by Foote Mineral Co., Philadelphia, Pa.

China Clay (Kaolin)—Crude, $6@$8; washed, $8@$9; powdered, $12@$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $13@$20, f.o.b. Virginia points. Imported lump, $14@$20, f.o.b. American ports; powdered, $35@$45, f.o.b., quoted at New York.

Emery—Turkish emery, 6c. per lb. American, 4c. Inferior grades, 3½c., f.o.b., from New England points.

Feldspar—No. 1 pottery grade, $6.50@$6.85 per long ton; No. 2 pottery, $5.75; No. 1 soap grade, $7.25@$7.50, f.o.b. cars. No. 1 Canadian, $22@$23, f.o.b. mill.

Fluorspar — Gravel, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $20@$22.50 per ton, f.o.b. Illinois and Kentucky mines; gravel, $15; lump, $12.50, f.o.b. Lordsburg, N. M. Ground, acid grade, 97 per cent CaF_2, $30, New Mexico.

Fuller's Earth—16 to 30 mesh, $20 per ton; 30 to 60 mesh, $20; 60 to 100 mesh, $17; 100 mesh and over, $15, f.o.b. Pennsylvania points. English, $23@$25, f.o.b. New York.

Graphite—Ceylon lump, first quality, 4½@6½c. per lb.; chip, 3½@5c.; dust, 2@3½c.; No. 1 flake, 5@6c.; amorphous, crude, $15@$40.50 per ton. All f.o.b. New York.

Gypsum — Crushed rock, $3@$4.50 per ton, depending upon shipping point. Ground, $4, f.o.b. shipping point.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¾ in. size, $1@$1.75 per net ton; 1½ in., $1@$1.25. Prices for other sizes practically the same. Agricultural limestone, $2.50@$3.75 per net ton, f.o.b. eastern shipping points, depending upon analysis.

Magnesite—Crude, $12@$15 per ton. High-grade caustic calcined, lump form, $30@$40 per ton. Plastic calcined, $45@$50 in bbls., carload lots, f.o.b. California points. Atlantic seaboard, $60.

Dead-Burned — $33 per net ton, Chewelah, Wash.; $58@$64, Chester, Pa. Austrian grade, $28 per ton, f.o.b. Baltimore. (Magnesite brick — See Refractories.)

Mica — India block mica, slightly stained, per lb.; No. 6, 35c.; No. 5, $1.25; No. 4, $2.25; No. 3, $2.90; No. 2, $3.65; No. 1, $5.50. Clear block: No. 6, 50c.; No. 5, $1.75; No. 4, $3.25; No. 3, $5; No. 2, $6.50; No. 1, $8; A1, $6.50@$8.50; extra large, $25; ground, wallpaper grade, $90@$160 per ton (depending upon quantity); ground roofing mica, $25@$70, all f.o.b. New York. Water-ground mica, 100 and 160 mesh, 6½c. per lb., f.o.b. Virginia points.

Monazite—Minimum of 6 per cent thorium oxide, $30 per unit, duty paid.

Phosphate Rock—Per long ton, Florida ports, pebble grade: 77 per cent tricalcium phosphate, $9.50 ($10.50 for hard rock; 75 per cent, $7.50; 75@74 per cent, $7; 70 per cent, $4.75; 68 per cent, $4.25; 68@66 per cent, $4.

Pumice Stone—Imported, lump, 3@40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

Pyrites—Spanish fines, per unit, 12c., c.i.f. Atlantic seaports; furnace size, 13c.; Spanish lump, 13@14c.; domestic fines, f.o.b. mines, Georgia, 11@12c.

Silica—Glass sand, $1.25@$2.25 per ton; sand-blast material, $2.25@$4.50, f.o.b. Indiana and Illinois points. Amorphous or decomposed variety, soft silica, 250 mesh, $14; 350 mesh, $18; 450 mesh, $28 per ton. Ganister, crude, $2.50 per ton, f.o.b. Illinois points. Molding sand, building sand, glass sand, $2.25@$3, f.o.b. Pennsylvania points.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s. New York.

Talc—20 to 200 mesh, $7@$12 per ton, f.o.b. Vermont; $8.25@$13, f.o.b. points in Georgia; 200 mesh, $16@$20, f.o.b. Los Angeles.

Mineral Products

Copper Sulphate — Large crystals, 5.65c.; small crystals, 5.55c. per lb., f.o.b. New York.

Potassium Sulphate — Powder, domestic, $1 per unit, basis 90 per cent, f.o.b. New York.

Sodium Nitrate — $2.45@$2.50 per cwt., ex vessel, Atlantic ports.

Sodium Sulphate—For 95 per cent material, $12.50 per ton, f.o.b. in bulk, Western mines, spot and six months' contract; $17@$20 per ton, New York.

Ferro-Alloys

Ferrotitanium—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrocerium—Per lb., $12@$15.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 11½c. per lb. of chromium contained; 4 to 6 per cent carbon, 12c., f.o.b. works.

Ferromanganese—Domestic 78 to 82 per cent, $59@$60, f.o.b. furnace; English and German, $62.50, c.i.f. Atlantic seaport. Spiegeleisen, 16@19 per cent, $30 per gross ton, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorous, and arsenic, $2.25 per lb. of contained metal, f.o.b. works. Imported material, $1.70@$2.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, $38@$40; 50 per cent, $54@$55; 75 per cent, $115@$120.

Ferrotungsten—Domestic, 70 to 80 per cent W, 40@45c. per lb. of contained tungsten, f.o.b. works. Foreign, 50c., duty paid, f.o.b. Atlantic ports.

Ferro-uranium—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

Ferrovanadium—$4 per lb. of V contained, according to analyses and quantity.

Metal Products

Copper Sheets—Current New York list price, 20.25c. per lb.; wire, 14@14.25c.

Lead Sheets—Full lead sheets, 7¾c.; cut lead sheets, 8c. in quantity, mill lots.

Nickel Silver—26.75c. per lb. for 18 per cent nickel Grade "A" sheets.

Yellow Metal — Dimension sheets, 17.25c.; sheathing, 16.75c.; rods, ⅜ to 3 in., 14.25c.

Zinc Sheets—$8 per 100 lb. less 8 per cent on carload lots, f.o.b. works.

Refractories

Bauxite Brick—56 per cent alumina, $130 per 1,000; 76 per cent, Suprafrax, $200 per 1,000; f.o.b. works, St. Louis and Pittsburgh.

Chrome Brick—$40@$43 per net ton.

Chrome Cement — 40@45 per cent Cr_2O_3, $30@$32 per net ton, and $31 in sacks, carload lots, f.o.b. eastern shipping points.

Firebrick—First quality, 9-in. shapes, $32@$35 per 1,000, Pennsylvania, Ohio and Kentucky.

Magnesite Brick—9-in. straights, $53 per net ton, f.o.b. works.

Silica Brick—9-in., per 1,000, $30@$35 in carload lots, f.o.b. shipping points.

The Iron Trade

Pittsburgh, Feb. 28, 1922

Railroad buying has increased considerably. James McCrea, vice-president of the Pennsylvania Railroad, announced at a meeting of the Pittsburgh Chamber of Commerce last week that his road is working on plans involving expenditures of $100,000,000 in this district.

Steel buying has increased somewhat. Production of steel ingots is at about 28,000,000 tons a year, and seems to be increasing slightly.

The most active demand in steel is for construction work, particularly in sheet and pipe for garage and dwelling-house construction, with a fair tonnage in fabricated steel construction.

Bars, shapes, and plates are now steady, a reflection of the price, 1.40c., which is extremely low. Black and galvanized sheets are firm at 3c. and 4c. respectively. Concessions for large lots of tin plate, priced regularly at $4.75, are more common, and there is slightly more extensive shading in steel pipe. Nails are unchanged at $2.40 to large buyers.

Pig Iron—Bessemer iron seems to be down 50c. to $19, Valley, as a result of a sale of a few hundred tons. Basic, quoted at $18, Valley. Foundry remains at $18.75 to $19, Valley. Demand is light.

Coke

Connellsville—Furnace, $3.25@$3.50; foundry, $4@$4.25.

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[1] Foote Mineral Co., Philadelphia, Pa.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York 1921	New York 1922	London 1921	London 1922	Sterling Exchange 1921	Sterling Exchange 1922
January	[illegible]	[illegible]	[illegible]	35 135	[illegible] 650	421 75
February	[illegible]	[illegible]	34 745	33 891	385 932	435 511
March	[illegible]		32 470		389 806	...
April	59 337		[illegible]		391 784	...
May	[illegible]		[illegible]		396 580	....
June	[illegible]		[illegible]		377 236	....
July	[illegible]		37 481		362 365	..
August	[illegible]		[illegible]		364 505	
September	66 160		[illegible]		371 725	
October	70 970		[illegible]		386 315	
November	68 234		[illegible]		396 315	
December	65 760		[illegible]		414 880	
Year	[illegible]		36 841		384 191	

[illegible] London, pence per ounce, [illegible]

Copper

	New York Electrolytic 1921	New York Electrolytic 1922	London Standard 1921	London Standard 1922	London Electrolytic 1921	London Electrolytic 1922
January	12 597	13 465	70.964	65 226	79.119	72.321
February	12 556	12 864	70 925	60 250	75.925	66.125
March	11 976		67 565		71 190	...
April	[illegible]		69 381		71 786	.....
May	12 742		[illegible]		74 298	.....
June	[illegible]		71 852		75.682	....
July	12 174		71 155		75 286	
August	11 634		65 614		72.705	
September	11 948		67 977		72.295	
October	12 673		67 327		73.476	
November	13 035		[illegible]		74.386	
December	13 555		[illegible]		74.525	
Year	12 502	......	69.356	.....	74.223	

New York, cents per lb. London, pounds sterling per long ton.

Lead

	New York 1921	New York 1922	St. Louis 1921	St. Louis 1922	London 1921	London 1922
January	4 821	4 700	4 747	4 388	23 387	23 667
February	4 373	4 700	4 228	4 396	20 650	20 681
March	[illegible]		4 000		[illegible]	.
April	4 356		4 272		21 589	
May	4 452		4 784		23 399	
June	4 485		[illegible]		22.563	
July	4 410		[illegible]		23.399	
August	[illegible]		4 217		23 489	
September	4 600		[illegible]		23 148	
October	4.690		[illegible]		23 679	
November	4 683		[illegible]		24 483	
December	4.700		[illegible]		[illegible]	
Year	[illegible]		4 363		22 752	

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York 99% 1921	New York 99% 1922	New York Straits 1921	New York Straits 1922	London 1921	London 1922
January	31 470	31 480	36.000	32 100	199 464	163 045
February	29 534	29 835	32 142	30.767	166 250	149 850
March	27 296		[illegible]		[illegible]	
April	28 990		[illegible]		[illegible]	
May	31 431		[illegible]		177 411	
June	28.514		[illegible]		167 506	.
July	26.755		[illegible]		164 530	
August	25 662		[illegible]		[illegible]	
September	25 280		25 680		156 750	.
October	27 275		[illegible]		156 350	.
November	[illegible]		[illegible]		[illegible]	
December	[illegible]		[illegible]		[illegible]	
Year	[illegible]		[illegible]		165 265	

New York quotations, cents per lb. London, pounds sterling per long ton

Zinc

	St. Louis 1921	St. Louis 1922	London 1921	London 1922
January	5 413	[illegible]	[illegible]	26.321
February	4 928	4.485	24.850	24.213
March	4 737		25.077	.....
April	4 747		25.530	....
May	4 848		25 923	....
June	4 421		26.750	...
July	4.239		26 262	
August	4 186		25.068	
September	4 235		25.256	
October	4.605	...	26.315	
November	4.667	...	25 949	
December	4 835	...	26.900	
Year	4.655		25.845	

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York 1921	Antimony (a) New York 1922	Quicksilver (b) New York 1921	Quicksilver (b) New York 1922	Platinum (c) New York 1921	Platinum (c) New York 1922
January	5 258	4 463	48 440	49 960	73.400	97 260
February	5.250	4 416	49 545	48 295	70.227	89 545
March	5 282		46.796		72.463	
April	5.137		45.423		73.404	
May	5.250		47 000		73.740	
June	5 087		46 846		74.942	
July	4 735		44.950		70.440	
August	4 597		45 028		73.222	
September	4 564		42 660		75 960	
October	5 085		39 840		81 800	
November	4 754		39 804		82 609	
December	4 590		49 212	..	78 192	
Year	4 957		45 462	..	75 033	

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer 1921	Bessemer 1922	Basic 1921	Basic 1922	No. 2 Foundry 1921	No. 2 Foundry 1922
January	33.96	21 55	31 96	20.15	33.88	21.34
February	28.96		26 96	.	30.25	
March	28.16		26 46	.....	27 85	
April	26.96		24 46	......	26 77	..
May	26 21		23.84	....	25 56	..
June	24.96		22 66	......	24.38	..
July	22 84		20 76	....	22.36	.
August	21 96		20 29		21.53	..
September	21.96		21 21	...	22.82	
October	21 96		20 96	.	22.96	....
November	21 96		20 96	...	22.74	
December	21 96		20 65	.	21 96	
Year	25 15	.	23.43	.....	5.26	

In dollars per long ton.

Monthly Crude Copper Production

	1921 October	1921 November	1921 December	1922 January
Alaska shipments	6,160,847	4,841,506	8,881,013	6,909,383
Anaconda	(a)	(a)	(a)	(a)
Arizona Copper	(a)	(a)	(a)	(a)
Calumet & Arizona	(a)	(a)	(a)	(a)
Calumet & Hecla	(a)	(a)	(a)	(a)
Other Lake Superior	4,250,000	5,500,000	5,500,000	6,000,000
Chino	(a)	(a)	(a)	(a)
Con. Ariz. Smelting	(a)	(a)	(a)	(a)
East Butte	1,000,000	750,000	(a)	(b) 750,000
Inspiration	(a)	(a)	(a)	(a)
Magma	(a)	(a)	(a)	(a)
Miami	5,084,000	4,514,000	5,030,941	5,348,000
Nevada Cons	(a)	(a)	(a)	(a)
New Cornelia	1,536,725	1,605,936	1,717,183	1,692,909
Old Dominion	(a)	(a)	(a)	(a)
Phelps Dodge	(a)	(a)	(a)	(a)
Ray	(a)	(a)	(a)	(a)
Shattuck Arizona	(a)	(a)	(a)	(a)
United Verde	(a)	(a)	(a)	(a)
United Verde Extension	(a)	(a)	(a)	(a)
Utah Copper	(a)	(a)	(a)	(a)
Others, estimated	5,200,000	11,130,000	8,500,000	11,400,000
Total United States	23,231,572	28,341,442	29,629,137	32 010,292
Imports: Ore and concentrates, matte	8,445,551	7,297,583	14,844,641	.
Imports of blister, unrefined	23,360,893	10,561,454	14,731,185	.
Imports of refined	761,125	2,139,144	2,447,925	
Grand total	55,799,141	49,339,623	61,652,888	....
Backus & Johnston	198,000	900,000	822,000	1,118,000
Boleo	1,041,863	976,815	954,765	1,102,080
Cananea	(a)	(a)	(a)	(a)
Cerro de Pasco	5,539,000	5,618,000	5,536,000	4,726,000
Chile	4,000,000	4,000,000	4,000,000	4,000,000
Cons. M. & S. of Canada	156,940	200,000	313,290	97,985
Falcon Mines	550,710	518,600	550,800	582,000
Furukawa	2,541,508			
Granby Cons.	2,593,250	2,365,017	2,215,403	1,974,162
Hampden Cloncurry	(a)	(a)	(a)	(a)
Katanga	6,189,435	5,984,370	6,570,900	6,772,600
Mount Morgan	(a)	(a)	(a)	(a)
Mount Lyell	1,220,000	1,068,000	782,000	
Phelps Dodge Mexican	(a)	(a)	(a)	(a)
Sumitomo	1,444,315	2,910,964	2,732,392	
Wallaroo & Moonta		835,760	954,795	

(a) No copper produced during this month. (b) Estimated.

Comparative Annual Copper Production

	1919	1920	1921	1922
January	135,733,511	121,903,744	90,596,597	32,010 292
February	111,649,512	117,540,000	86,682,941	....
March	102,040,460	120,309,316	91 046,345	....
April	98,808,998	116,078,871	46,946,523	....
May	92,652,975	114,964,207	25,310,511	....
June	95,856,570	116,107,856	24,623,693	....
July	100,369,247	109,729,610	22,033,739	....
August	107,994,040	112,460,254	23,248,398	....
September	108,703,075	104,919,562	23,855,316	....
October	115,143,143	105,231,571	23,231,572	....
November	117,289,735	106,700,178	28,341,442	....
December	102,997,633	95,709,009	29,629,137	......

COMPANY REPORTS

St. Mary's Mineral Land Co.

A report of operations of St. Mary's Mineral Land Co. for 1921 shows the following receipts and expenditures:

RECEIPTS

Cash on hand Dec. 31, 1920		$69,154.26
Payments for surface	$3,844.50	
Payments for wood and timber	17,592.81	
Distributions	640.00	
Interest	39,355.96	
Ground rent	5,567.75	
Notes collected	39,305.00	
Accounts collected	895.92	
Deferred payments collected	50,000.00	
Treasury certificates of indebtedness	50,000.00	
Sundry other receipts	20.00	204,821.94
		$273,976.20

EXPENDITURES

Houghton Copper Co. advances	$2,800.00	
Charter and land taxes	6,711.93	
Salaries and expenses at Portland, Boston and Houghton	27,564.81	
1921 Distribution No. 1	160,000.00	
		197,076.74
Cash on hand Dec. 31, 1921		$76,899.46

For another year the demand for mineral lands has been absent and for timber there was little inquiry. Several small sales were made, and in the latter part of the year one fair-sized sale. Many of the mines of the district were idle for the greater part of the year. The Champion Copper Co. operated throughout the year, but made no distributions either of capital or income. From sales of timber and other similar sources a distribution of $1 per share was paid Dec. 15 to stockholders of record Nov. 15.

Sales during the year were as follows: 1,123.99 acres of wood and timber to yield $34,873; 160 acres of surface only, $2,400; 12.89 acres of surface for railroad right of way. For county road construction, 33.28 acres of surface was donated.

The real property of the company Dec. 31, 1921, consisted of 92,175.89 acres, besides the mineral rights to 14,969.76 additional acres.

United Verde Extension Mining Co.

A report of operations of the United Verde Extension Mining Co. for the year ended Dec. 31, 1921, together with report of the treasurer setting forth the financial condition and results for the fiscal year, states that owing to the condition of the copper market, the smelting plant was shut down on May 1, 1921. Ore smelted during the first four months of the year amounted to 53,643 dry tons, which yielded 12,498,005 lb. copper, 2,328 oz. gold, and 112,864 oz. silver. Copper on hand Dec. 31, 1921, amounted to 6,955,942 lb. Amount of ore developed above the 1,500 level was 1,102,000 tons, averaging 11.75 per cent copper, .023 oz. gold, and 2.22 oz. silver.

Approximately $95,000 was spent on construction during the year, consisting of installation of a fuel-oil system at the smelter, completing the hospital, and the building of several company houses.

The table below shows the average cost per pound of copper produced during the year. Owing to the fact that the smelter was operating only four months of the year, the cost per pound of copper shown is abnormally high, as production was charged with the total expenses for the entire year. The cost stated, therefore, should not be taken as a criterion of the cost to the company of its copper produced during normal years.

	Per Lb.
Mining	$0.0590
Smelting	0.0317
Freight on ore	0.0022
Freight on bullion, refining and selling	0.0355
Other expenses	0.0062
	$0.1346

The costs do not include depreciation, reserve to return capital (depletion), or taxes.

General conditions for future operations are slightly improved since the shutdown and wages somewhat reduced, but the reduction of freight rates is essentially necessary to future successful operations at the present price of copper, as is likewise a reduction in the present high taxes. The state and county taxes paid during 1921 amounted to $566,553.04, and if production had continued during the year at the rate of 3,000,000 lb. a month, taxes would have amounted to 1.574c. per lb. of copper. On the actual production, these taxes amounted to 4.533c. per lb. of copper.

STATEMENT OF EARNINGS FOR 1921

Gross revenue from metals and ore produced		$2,043,519.10
Other revenue		275,740.37
		$2,319,259.47
Deductions		
Mine and smelter operating, freight and selling expenses	$1,603,838.27	
Other expenses, including taxes paid, and accrued	678,424.47	2,282,262.74
Earnings from operations		$36,996.73
Less		
Amounts written off to reserves for depletion and depreciation		1,565,538.13
Net loss to surplus		$1,528,541.40

BALANCE SHEET, DEC. 31, 1921

ASSETS

Mining property, including appraised value of developed orebodies		$40,615,717.16
Less depletion reserve		13,778,874.09
		$26,836,843.07
Smelter plant, mine and other machinery, equipment and buildings	$5,875,369.01	
Less depreciation reserve	2,275,122.36	3,600,246.65
Investments, at cost		2,088,116.35
Land, ranches		269,768.42
Accounts and notes receivable, including interest acrued		1,432,665.04
Inventories of materials and supplies		376,359.91
Cash in banks and on hand		846,146.37
Liberty bonds, at par (Market value Dec. 31, 1921—$3,253,646.58)		3,365,100.00
Due on metals sold, ore and bullion on hand		1,882,283.65
		$40,697,529.46

LIABILITIES

Capital stock, authorized		$750,000.00
Less treasury stock		225,000.00
		$525,000.00
Accounts payable, including taxes and other accrued charges		1,247,541.93
Reserve for liability insurance		93,670.20
Surplus from appraisal of developed orebodies	$40,000,000.00	
Less amount refunded in 1918 to the stockholders out of reserve fund for depletion	1,575,000.00	38,425,000.00
Surplus account, balance as at Jan. 1, 1921	$2,984,858.73	
Less dividends paid, Nos. 19, 20, 21	1,050,000.00	
	$1,934,858.73	
Deduct net loss for 1921	1,528,541.40	406,317.33
		$40,697,529.46

Mining Dividends for February, 1922

The following dividends were paid by mining companies during February, 1922:

Companies in the United States:	Situation	Per Share	Totals
Chief Consolidated, s. l	Utah	$0.05 Q	$44,201
Colorado Fuel & Iron, pfd	Col., N. M., Wyo.	2.00 Q	40,000
Homestake Mining, g	S. D.	0.25M	62,790
International Nickel, pfd	N. J., Ont	1.50 Q	133,689
Miami Copper	Ariz	0.50 Q	373,557
Mohawk Mining, c	Mich	1.00	100,000
New Cornelia, c	Ariz	0.25	450,000
New Jersey Zinc	N. J	2.00 Q	840,000
United Verde Ext., c	Ariz	0.25 Q	262,500
Companies in Canada and Mexico:			
Amparo Mining, g. s	Mex	0.03 Q	60,000
Hollinger Consol. Gold	Ont	0.05 4wks.	246,000

The Mohawk Mining Co. resumed the $1 distribution which was last paid in November, 1920; and the new Cornelia Copper Co. again paid 25c., for the first time since Aug. 23, 1920. A resumption of dividends by these two copper companies is a result of lower costs and the gradually improving condition of the copper industry. International nickel continues its preferred dividend and is likely to do so in the future, though producing operations have been suspended.

MINING STOCKS

Week Ended February 25, 1922

Stock	Exch.	High	Low	Last	Last Div.	
			COPPER			
Ahmeek	Boston	62	61	61	Sept. '20, Q	$0.50
Alaska-Br. Col.	N. Y. Curb	[illegible]	[illegible]	[illegible]		
Allouez	Boston	26	24	[illegible]	Mar. '19	1.00
Anaconda	New York	48	47	48	Nov. '20, Q	1.00
Arcadian Consol.	Boston	2	2	2		
Arizona Com'l	Boston	8	8	8	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*25	*22	*22		
Bingham Mines	Boston			14	Sept. '19, Q	0.25
Calumet & Arizona	Boston	59	57	57	Dec. '21, Q	0.50
Calumet & Hecla	Boston	286	277	277	June '20, Q	5.00
Canada Copper	N. Y. Curb	*26	*23	*23		
Centennial	Boston	11	11	11	Dec. '18, SA	1.00
Cerro de Pasco	New York	34	33	33	Mar. '21, Q	0.50
Chile Copper	New York	17	16¾	16¾		
Chino	New York	26	25	25	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*30	*29	*30		
Consol. Arizona	N. Y. Curb			*2	Dec. '18, Q	0.05
Consol. Copper Mines	N. Y. Curb	1½	1¼	1¼		
Copper Range	Boston	42	40	40	Sept. '20, Q	0.50
Crystal Copper	Boston Curb	*58	*56	*57		
Davis-Daly	Boston	7½	7	7½	Mar. '20, Q	0.25
East Butte	Boston	10½	10	10½	Dec. '19, A	0.50
First National	Boston Curb	*65	*55	*58	Feb. '19, SA	0.15
Franklin	Boston			1¼	...	...
Gadsden Copper	Boston Curb	*50	*50	*50		
Granby Consol.	New York			28	May '19, Q	1.25
Greene-Cananea	New York	26¼	26¼	26¼	Nov. '20, Q	0.50
Hancock	Boston	3	3	3		
Howe Sound	N. Y. Curb	2½	2½	2½	Jan. '21, Q	0.05
Inspiration Consol.	New York	38¼	37	38¼	Oct. '20, Q	1.00
Iron Cap	Boston Curb	*8	*7¼	*7¼	Sept. '20, K	0.25
Isle Royale	Boston	23	22	23	Sept. '19, SA	0.50
Kennecott	New York	27¼	27	27¼	Dec. '20, Q	0.50
Keweenaw	Boston	1	1	1		
Lake Copper	Boston	2½	2⅜	2⅜	....	
La Salle	Boston	...	.	[illegible]		...
Magma Copper	N. Y. Curb	30½	28	28¼	Jan. '19, Q	0.50
Majestic	Boston Curb	†*6	†*5	*3		
Mason Valley	Boston	1⅞	1⅝	1¾		
Mass Consolidated	Boston	2½	2½	2½	Nov. '17, Q	1.00
Miami Copper	New York	26¾	26½	26¾	Feb. '22 Q	0.50
Michigan	Boston	2	1¾	2		
Mohawk	Boston	56½	55¼	55½	Feb. '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	7¾	7	7⅜		
Nevada Consol.	New York	13½	13½	13½	Sept. '20, Q	0.25
New Cornelia	Boston	18¼	17	17½	Feb. '22, K	0.25
North Butte	Boston	11¾	11	11½	Oct. '18, Q	0.25
North Lake	Boston	...		*25		
Ohio Copper	N. Y. Curb	*10	*10	*10		
Old Dominion	Boston	23	23	23	Dec. '18, Q	1.00
Osceola	Boston	32	32	32	June '20, Q	0.50
Phelps Dodge	Open Mar.	†190	†175	.	Jan. '22, Q	1.00
Quincy	Boston	43¼	42	42½	Mar. '20, Q	1.00
Ray Consolidated	New York	14	13⅝	13⅝	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*6	*2	*4		....
St. Mary's Min. Ld.	Boston	44½	43¼	43¾	Dec. '21, K	1.00
Seneca Copper	Boston	12⅛	11	12⅛		
Shannon	Boston	1.00	*90	*90	Nov. '17, Q	0.25
Shattuck Arizona	New York	8½	7¼	7¼	Jan. '20, Q	0.25
South Lake	Boston	...	.	*65		
Superior & Boston	Boston	1⅛	1	1⅛		
Tenn. C. & C. cfs.	New York	10½	10	10½	May '18, I	1.00
Tuolumne	Boston	*55	*55	*55	May '13,	0.10
United Verde Ex.	Boston Curb	28¼	27	28¼	Feb. '22, Q	0.25
Utah Consol.	Boston	1	1	1	Sept. '18,	0.25
Utah Copper	New York	62¼	61⅜	61½	Dec. '21, Q	0.50
Utah Metal & T.	Boston	1⅛	1	1 1/16	Dec. '17,	0.30
Victoria	Boston	2⅛	2⅛	2⅛		....
Winona	Boston	*40	*40	*40		....
Wolverine	Boston	10½	10½	10½		....
			NICKEL-COPPER			
Internat. Nickel	New York	12⅛	11	12	Mar. '19,	0.50
Internat. Nickel, pfd	New York	67¼	62	67¾	Feb. '22, Q	1.50
			LEAD			
National Lead	New York	90¼	89	89	Dec. '21, Q	1.50
National Lead, pfd.	New York	113¼	111	113¼	Dec. '21, Q	1.75
St. Joseph Lead	New York	13½	13	13	Dec. '21, Q	0.25
			QUICKSILVER			
New Idria	Boston	*50	*50	*50		....
			ZINC			
Am. Z. L. & S.	New York	13⅛	13	13	May '20,	1.00
Am. Z. L. & S. pfd.	New York	.		36⅜	Nov. '20, Q	1.50
Butte C. & Z.	New York	5⅜	5¼	5⅜	June '18,	0.50
Butte & Superior	New York	...	...	26	Sept. '20,	1.25
Callahan Zn-Ld.	New York	5¾	5½	5½	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	137	135	137	Feb. '22, Q	2.00
Yellow Pine	Los Angeles	.	...	*50	Sept. '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.	
			GOLD			
Alaska Gold	New York	½	⅜	⅜	...	...
Alaska Juneau	New York	⅞	⅞	⅞	...	...
Carson Hill	New York	15⅛	14⅝	14⅝	...	
Cresson Consol. G.	N. Y. Curb	2 11/16	2¼	2 [illegible]	Jan. '22, Q	$0.10
Dome Extension	Toronto	1.00	*84	1.00	...	
Dome Mines	New York	25	23¾	24⅞	Jan. '22, Q	0.25
Florence Goldfield	N. Y. Curb	*28	*25	*27	...	
Golden Cycle	Colo. Springs	*77	*75	*75	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*4	*4	*4	Dec. '19,	0.05
Hollinger Consol.	Toronto	9.50	8.95	9.15	Feb. '22,	0.05
Homestake Mining	New York	61¼	60	61¼	Feb. '22, M	0.25
Kirkland Lake	Toronto	*47½	*38½	*46		
Lake Shore	Toronto	1.95	1.73	1.73	Nov. '21, K	0.02
McIntyre Porcupine	Toronto	2.87	2.84	2.00	Jan. '22, K	0.05
Porcupine Crown	Toronto	*27	*25	*27	July '17,	0.03
Porcupine V. N. T.	Toronto	*28	*25	*28½		
Portland	Colo. Springs	*39	*36	*36	Oct. '20, Q	0.01
Schumacher	Toronto	*48	*37	*47½	...	...
Silver Pick	N. Y. Curb			*2	...	...
Teck Hughes	Toronto	*43	*31	*43		
Tom Reed	Los Angeles		.	*77	Dec. '19,	0.02
United Eastern	N. Y. Curb	2	1 15/16	1 15/16	Jan. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*22	*21	*21	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb			*3		
Yukon Gold	N. Y. Curb	1¼	1 1/16	1 1/16	June '18,	0.02½
			SILVER			
Batopilas Mining	New York			½	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*36	*27½	*35¼	May '20, K	0.03
Coniagas	Totonto	1	1	1	May '21, Q	0.12½
Crown Reserve	Toronto	*25	*16½	*24	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3¼	3⅛	3¼	Jan. '22, Q	0.12½
La Rose	Toronto	*52	*38	*52	Apr. '18,	0.02
McKinley-Dar.-Sav.	Toronto	*23	*15	*23	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.15	1.00	1.15	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6½	6	6⅜	Jan. '22, Q	0.15
Ontario Silver	New York	5½	5¼	5½	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb			*12	Jan. '12,	0.10
Temiskaming	Toronto	*34	*33	*34	Jan. '20, K	0.04
Trethewey	Toronto	*5	*3¼	*5	Jan. '19,	0.05
			GOLD AND SILVER			
Boston & Montana	N. Y. Curb	*46	*40	*41	...	
Cash Boy	N. Y. Curb	*4	*4	*4	...	
Dolores Esperanza	N. Y. Curb	1	*75	*82	...	
El Salvador	N. Y. Curb	*5	*3	*4	...	
Jim Butler	N. Y. Curb	6	6	*6	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	4	3	*4	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*8	*7	*8	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1⅝	1½	1 9/16	Jan. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*63	*58	*58		
Tonopah Extension	N. Y. Curb	1⅜	1⅜	1⅜	Jan. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1⅞	1¾	1¾	Oct. '21, SA	0.05
West End Consol.	N. Y. Curb	*75	*75	*75	Dec. '19, SA	0.05
			SILVER-LEAD			
Caledonia	N. Y. Curb		.	*5	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	1.00	1.00	1.00	Dec. '20,	0.15
Chief Consol.	Boston Curb	3⅝	3½	3½	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	19	18½	18½	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†3.00	†1.00	...	July '20, Q	0.10
Daly-West	Boston	2½	2½	2½	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†3	†2⅞	2½	Apr. '21, K	0.05
Electric Point	Spokane	*5	*4⅛	*4⅛	May '20, SA	0.03
Federal M. & S.	New York	†12	†8	.	Jan. '09,	1.50
Federal M. & S., pfd	New York	39⅛	39	39	Dec. '21, Q	1.00
Florence Silver	Spokane	*22	*19½	*22	Apr. '19,	0.01½
Grand Central	Salt Lake	†*44½	†*42	*42	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	5⅞	5⅜	5⅞	Dec. '21, Q	0.17
Iron Blossom Con.	N. Y. Curb	*19	*19	*19	Dec. '21, Q	0.02½
Judge M. & S.	Salt Lake	†3.10	†2.50	3.00	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*5	*5	*5	June '21, I	0.02
Prince Consol.	Salt Lake	*8¾	*7½	*8¾	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*6½	*5½	*5½	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*9	*7	*8		
South Hecla	Salt Lake	†*60	†*35	...	Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*15	*15	*15	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*3	*3	*3	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.25	2.00	2.25	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.12½	2.00	2.02	Dec. '21, Q	0.05
Utah Apex	Boston	3⅛	3	3⅛	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	.	...	*2	Nov. '17,	0.01
			VANADIUM			
Vanadium Corp.	New York	38¼	33⅞	36½	Jan. '21, Q	1.00
			ASBESTOS			
Asbestos Corp.	Montreal	48	47	48	Jan. '22, Q	1.50
Asbestos Corp., pfd.	Montreal	...	...	74	Jan. '22, Q	1.75
			SULPHUR			
Freeport, Texas	New York	14½	13¾	14	Nov. '19, Q	1.00
Texas Gulf	New York	46⅝	43¼	46⅛	Dec. '21, Q	1.00
			MINING, SMELTING AND REFINING			
Amer. Sm. & Ref.	New York	46⅞	45½	46¼	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	90¾	89½	89½	Dec. '21, Q	1.75½
Am. Sm. Sec. pf. A.	New York	88¾	88½	88¾	Jan. '22, Q	1.50
U. S. Sm. R. & M.	New York	33¾	33⅛	33⅛	Jan. '21, Q	0.50
U.S. Sm. R. & M. pf.	New York	43	43	43	Jan. '22, Q	0.87

NEW MACHINERY AND INVENTIONS

The Summer Camp—A Welfare Provision

Welfare work is generally considered as confined principally to the larger industrial and mining enterprises. Its value in general business and mercantile firms is certainly just as important, but in this extensive field little has even been attempted.

The Hendrie & Bolthoff Manufacturing & Supply Co., of Denver, Col., has always maintained close and friendly relations with the company's 275 employees. To meet the problems of sickness and to promote entertainments and social relations, a mutual benefit association was established in 1903 with 75 charter members. The enrollment is purely voluntary, and has averaged over 90 per cent during the eighteen years. The association is self-governed by regularly elected officers and by various committees who visit the sick, administer relief, and also arrange for entertainments and other social gatherings.

SUMMER CAMP OF HENDRIE & BOLTHOFF

The sick fund is maintained by assessments, the average cost to each member being about $4.50 per year. The firm itself contributes 50 per cent additional toward the fund. During sickness, a benefit of $10 per week is paid for a period of ten weeks if required. In cases of special emergency, this can be extended for another ten weeks.

The firm, at its own expense, also carries group life insurance, which covers all who have been in its employ for a year. This pays $1,000 to the family of a married man, $500 to the beneficiary of a single male, and $500 to any woman employee's beneficiary.

The most interesting branch of the firm's welfare work is the mountain recreation camp. Summer vacations for the average working man with a wife and children do not mean a trip to some cool resort and a week or two at a good hotel with the usual recreations and sports. The railroad fare is often the deciding factor against it, to say nothing of the cost of board during the outing. So he generally spends the period restlessly at home and is glad when the time is up to go back to work. The wife and children get no change whatever.

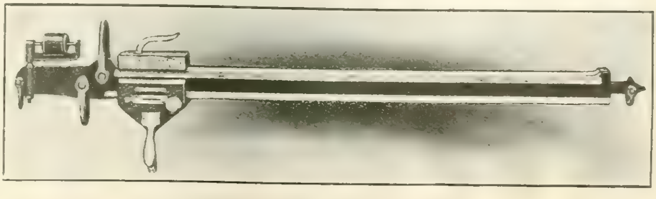
It was to provide the means of enjoying a real vacation that the Hendrie & Bolthoff Manufacturing & Supply Co. purchased a former summer resort, comprising 80 acres of mountain land beautifully situated on the South Platte River about thirty-two miles from Denver. Summer rates on the C. & S. Ry. make the transportation costs reasonable. There is a good automobile road for those who prefer the trusty flivver.

The water supply is piped from a small mountain stream for a quarter of a mile and provides ample fresh cold water under good pressure.

There were six cottages on the property, well situated but in poor repair. These have been rebuilt, new floors put in, and wide porches added. There is running water in the kitchens and every comfort and convenience appropriate for the purpose is to be found. In addition, the cottages are completely furnished, even to blankets and cooking utensils, only bed and table linen being excepted. Accommodation is provided for seven families each week, the larger cottages being allotted to those with the largest families. The firm makes no charge for the cottages. Even the fuel is supplied, so that the cost of food and railway fare is the only expense to those who take advantage of this unusual opportunity for a real summer vacation.

Type-Registering Scales

Inquiry has been made as to what manufacturer supplies a type-registering beam scale described in the article, "Gold Mining at Carson Hill, California," appearing in *Engineering and Mining Journal*, Nov. 5, 1921, p. 727. Fairbanks, Morse & Co. manufacture the track scales used at the Carson Hill mine. In this type of scales the single beam is fitted with a metal type-strip and a printing mechanism which is part of the poise itself. The poise runs on smooth-turned rollers upon the milled top of the beam, the back roller having a groove corresponding to a rib milled on the beam which prevents the poise from sticking or jumping off. The poise has a handle at the top, the end of which engages with notches on the beam, so that the poise must always rest over a graduation and not between two graduations. A fractional poise is operated by a knurled handle on the front of the main poise. The face of the beam is beveled for convenience in reading. The type-registering ticket is placed in a slot in the poise. The printing plunger is operated by a handle in conjunction with a stationary hand-hold attached to the front of the poise. This obviates twisting the beam on its hangers. A slide on the poise allows for gross and tare weights. Tickets of standard size are available, and the device is of utility in preventing blunders in writing down weights.


TYPE-REGISTERING BEAM SCALE

New Dynamite Claims Several Advantages

A dynamite which, it is announced, will prove an important factor in reducing explosives costs in quarrying and other open-cut work has been perfected recently. The new "powder" is known as "dumorite" and is made with a double base of modified nitroglycerin and guncotton. It cannot freeze and does not produce headache. It is claimed that the explosive will effect a saving in cost of one-third. It is as powerful, stick for stick, under ordinary conditions, as regular 40 per cent dynamite, its economy consisting in the fact that each case contains approximately one-third more sticks. The new dynamite is being produced by the Du Pont company.

When "Free as Air" Loses Its Meaning

Air when compressed and converted into a form of energy and power ceases to be "free"; fuel, machinery, equipment, and labor enter into making it an item of cost. And cost of compressed air rises greatly through any waste by leakage before final distribution to the tool which it operates or to the points of its ultimate use. Owing to leakage through joints in piping, valves, split pipe, defective castings, and wastage at a tool or machine, the over-all efficiency of compressed air is often reduced 40 to 60 per cent throughout the system.

Jenkins Bros., manufacturers of Jenkins valves, have recently perfected and are now marketing a brass air gun, which is air-tight and an assurance against costly air waste. The Jenkins renewable disk with which this air gun is fitted is an innovation in equipment of this kind, and is especially suited for air service. The disk forms a perfect contact on the seat and takes up the wear of frequent usage. It gives long service, but can be easily and quickly renewed, if necessary.

The Jenkins air gun is finding wide use in foundries for blowing off cores, cleaning core boxes, flasks, patterns, and for general dusting and in machine shops for blowing off chip borings, trimmings, and for cleaning tools, taps, dies; in fact everywhere that a blast of air is required.

INDUSTRIAL NOTES

The Hercules Powder Co. has reduced prices on high-explosives, permissibles and blasting powders. The new prices, effective Feb. 17, will be quoted on request.

C. L. Dewey has become associated with the Cement-Gun Construction Co. of Chicago, Ill. He will devote his time exclusively to the development of "cement-gun" contract work.

The Philadelphia office of the Hauck Manufacturing Co. has been moved to 1726 Sansom St. Herbert Vogelsang, who has been connected with the company for six years, will be in charge.

Wilson Welder & Metals Co., Inc., 132 King St., New York, manufacturer of arc welding machines and certified welding metals, announces the appointment of R. L. White as district manager in charge of the company's Detroit office, at 809 Kresge Building, Detroit, Mich.

The Rathbun Jones Engineering Co., Toledo, Ohio, has appointed the Ingersoll-Rand Co., New York, general sales agent for Rathbun gas engines. The large sales organization and service department of the Ingersoll-Rand Co., combined with the fact that gas engines are used to drive compressors, pumps, and other machinery which it manufactures, places it in a position to serve with satisfaction the users of gas engines and other complementary machinery.

The Chillingworth Engineering Corporation announces that Frank H. Plum, Herbert Pluemer, George E. Mellin, and Harold von Thaden, formerly of the C. W. Hunt Engineering Corporation, have become associated with the Chillingworth interests and will carry on a business of a character similar to that conducted by the C. W. Hunt Engineering Corporation. The corporation will occupy offices at 143 Liberty St., New York.

The New York branch of the Electric Storage Battery Co. announces the consolidation of its various offices in that city. That part of the sales force formerly situated at the Exide factory, 64th St. and West End Ave., has been moved to the New York branch office at 23-31 West 43d St., which will hereafter be the headquarters also of the export sales department. F. L. Kellogg, manager of the North Atlantic district; F. F. Sampson, New York branch manager; and J. F. Kelly, Jr., export sales manager, will make their headquarters at the West 43d St. offices.

The East Butte Copper Mining Co. has just purchased an 8-ft. by 30-in. Hardinge conical ball mill for the company's flotation plant at the Silver Plume mine, in Colorado. The Mazapil Copper Co. at Saltillo, Mexico, has just purchased a 6-ft. x 22-in. Hardinge ball mill to grind a copper ore, also for flotation. The Pittsburgh Exploration Syndicate has bought a 3-ft. ball mill for its plant in Nicaragua. The Atlas Mining & Milling Co. of Sneffels, Col., has bought a 7-ft. x 36-in. Hardinge conical ball mill for the recovery of silver from the company's ore by flotation. The Oceona Development Co. of Arivaca, Ariz., has purchased two 4½-ft. x 16-in. Hardinge conical ball mills to be used to grind for flotation.

TRADE CATALOGS

Manganiferous Iron Ores—Clement K. Quinn & Co., Duluth, Minn., and Cleveland, Ohio, have recently issued an instructive little bulletin which contains interesting facts regarding the uses and effects of manganiferous iron ores as used in blast-furnace practice.

Oil Burners—The Denver Fire Clay Co., Denver, Col., has issued a new bulletin of thirty-two pages, "D. F. C. Oil Burners," which deals with the types of burners and equipment manufactured by the company. The first twenty-one pages are devoted to a general discussion on the combustion of fuel oil. The company will send a copy to those interested.

Mesabi Sinter—Clement K. Quinn & Co., Kirby Building, Cleveland, Ohio, has recently issued a leaflet which describes briefly the features and advantages of "Mesabi Sinter," in addition to interesting facts regarding its manufacture. This sinter, or manufactured iron ore, is being produced on the eastern end of the Mesabi Range by the Mesabi Iron Co. Clement K. Quinn & Co. are the exclusive sales agents.

Coal Crushers—The Jeffery Manufacturing Co., Columbus, Ohio, has recently issued Catalog No. 3559, which illustrates and describes the construction and operation of the Jeffery Single Roll crusher, including typical installations in service, table of capacities of the different sizes of machines for use in crushing various grades of bituminous coal, and other valuable information for crusher users. Besides the crushing of coal, this type of crusher is well suited to the reduction of salt, alum, bone, and similar substances.

Dry Dust Collectors—By-Products Recoveries, Inc., 328-332 Seventh Ave., New York, has issued Bulletin No. 326, descriptive of the reverse-nozzle type of dry dust collectors which the company is manufacturing. This collector consists of a chamber containing a multiplicity of perforated baffles with a unique circulating system which causes them to function to the best advantage. It may also be used as a classifier, as the coarser particles are recovered in the first sections of the receiving bin. No provision is considered necessary for cleaning.

Dorr Equipment—The Dorr Co., 101 Park Ave., New York, has issued an attractive pamphlet, printed in sepia on tinted paper and tied with a silk cord, describing the testing facilities of the company. These are unique, as many of our readers know, for the company maintains a complete plant at Westport, Conn., at the junction of the Saugatuck and Aspetuck rivers, where the natural environment as well as the man-made equipment is most conducive to scientific research. The Dorr pulp-handling and settling apparatus has almost unlimited applications where the handling of mixtures of finely divided solids and liquids in large quantities is involved.

Pulverized Fuel—A bulletin on the Quigley fuel systems, comprising methods of preparing, transporting, and burning of pulverized fuels, has been issued by the Hardinge Co., 120 Broadway, New York. This bulletin is known as No. 12, and treats the subject of pulverized fuels in a manner never before attempted. One of its distinguishing features is the fact that emphasis is laid upon the methods employed properly to prepare and burn the powdered coal, rather than on a discussion of the pulverizer. This catalog will undoubtedly be useful to the engineer designing power plants or furnaces requiring considerable quantities of heat, as facts and figures are given which will aid him in his work. At the same time, it is written in a way that will interest the non-technical person who is seeking a general knowledge of the subject covered.

Pumps—With the intention of encouraging suitable standards of manufacture and of engineering practice in the pump industry, and assisting in the development of standard methods of procedure, the Hydraulic Society, C. H. Rohrbach, secretary, 50 Church St., New York, has recently issued a nineteen-page bulletin, "Trade Standards in the Pump Industry." These standards consist of a number of recommendations and suggestions which are offered as a guide for buyers and sellers. The work explains what is meant by trade pumps, plain fitted pumps, or brass fitted pumps; what is considered standard equipment for a trade pump and what the manufacturer considers as extras; typical sizes of trade pumps are shown; and definitions are given of terms used in the industry, such as static head, total dynamic head, suction lift, static suction lift, dynamic suction lift, and other nomenclature.

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Volume 113 New York, March 11, 1922 *Number* 10

Unfit for Self-Government

WHAT DID WE MEAN when we enthusiastically chorused, a few years ago, that we were going to whip Germany to make the world "safe for democracy"? A recent official report on the Philippines has stated that, as a result of investigation, the Filipinos are not yet ripe for the responsibilities of self-government—in other words, they are unfit for democracy. Among nations which are or which consider themselves fit for democracy you will doubtless place the United States, England, and France. The vote, if a referendum in the United States were taken, would doubtless declare strongly the disbelief that Mexico, the Central American countries, and some of the South American countries were ripe for successful self-government: the record proves glaringly the contrary. India surely, in the opinion of the British, would be, by an overwhelming majority, judged unfit for self-government. The Chinese and the Russians have not yet demonstrated their possession of the qualities which render it safe to give to each individual an equal voice in selecting the legislative and executive officers and determining the policy of the country. So that most of the earth's population have little interest in a world "safe for democracy": what they are interested in is a world safe for the under-dog, who has no vote and a poor chance of getting hold of a shot gun.

With most of us phrases happily compensate for our lack of ability to think, and we echoed with that emotion which somehow makes common sense seem despicable—"safe for democracy." We had an idea that it meant something very noble and choice: and that it was a kind of shibboleth which meant that we personally would have all the comforts and none of the privations of life. But if we are forced to think, we will all beyond question vote that the vast populations of the earth, in all continents, are not yet ripe for democracy; they must be taken care of, must obey laws not of their own making, defer to and obey governors, or mock-presidents, or kings, or emperors, in whose selection they had no voice: and this is true of Asia and Africa and of much of Europe and America. It is a question of intelligence, of advancement, of evolution in the human race—whether you belong to the advanced type that achieves self-government, or to the more primitive type that for its own good has to do what it is told—and no back-talk.

Graduating From the Unfit to the Fit Class

IF WE BELIEVE in human progress and evolution, the bright side of it is that there is theoretically a progressive graduation from the class of the under-dogs to the class of freemen with suffrage—the right to vote. And this leads us to consider the requirements for graduation. An examination is the regulation theory in scholastic circles: and the recent official report concerning the Philippines provided for tests somewhat of that nature, after which the candidate was remanded for further training before coming up again. Yet there is some doubt about this examination system: and a suspicion that in many cases the candidate is slated beforehand to remain an undergraduate, in a world where it is very convenient for the more advanced races to have a strong background of under-dogs which would justify them in taking up the White Man's Burden, and spreading learning, sewing machines, gin, the Gospel, and the ability to curse in English.

So slow, indeed, has the regulation process of graduation often proved, that a practice has arisen whereby the candidate, nation or people takes matters in its own hands and graduates itself. Sad to contemplate, except in very few cases, bloodshed and the lack of human pity generally accompany these self-bestowed degrees of competency, before those rendered "safe for democracy" are allowed to strut around peaceably with them.

The American Colonies were not fit for democracy, in the opinion of George III, that self-satisfied Teuton: but muskets, Bunker Hill, and Valley Forge established the fact that three of a kind and a six shooter beats a full house. Ireland has never become fit for democracy, according to the experienced and competent judgment of the English: but the heavy shillalah and the willingness to starve have finally justified English respect at the coming-out party of the Irish Free State.

Russia was not fit for democracy, in the opinion of the Romanoffs and the aristocracy—and events have proved them in the right: but nevertheless, through terrible disaster, famine, assassination, and freezing, the right to a forcible graduation into the class of the self-governed has been proclaimed and followed.

Are Americans Fit for Democracy?

OF COURSE, it is all different in this country. The simple compact signed in the cabin of the "Mayflower" has set a permanent standard of equal right, equal opportunity, and equal voice. The early government of the New England Colonies, from the town meeting to the more orderly Assembly, was a form where each citizen met each other, with equal voice, and elected officers and settled policies, each by his own vote, as heavy as the next man's. And a century and a half afterward, when the independence of the Colonies was proclaimed, the watchword "No taxation without representation" was a sufficient and unanswerable argument to justify the indignation of the people rising to the point of smiting.

The American Revolution stands half way between the landing of the Pilgrims and today. Another century and a half has elapsed since Bunker Hill, when the Americans renewed the claim that they were fit for democracy, as the settlers had impressively assumed without argument, in the log-cabin meeting house at

Plymouth. After another century and a half, are we still fit for democracy? It is hardly fair to assume it without inquiry. We know that the stern free days of the Roman republic gave way to the submissive and degenerate days of the empire.

The Unfitness of the Mining Engineer

LET US START at home and examine ourselves as mining engineers. That engineers and other educated men take little part in public affairs has for some time been a recognized fact. We are the indolent and timorous intellectual aristocracy: we will not go to the bat with the small merchants and the foreign-born laborers and assert robustly our equal voice in all that pertains to self-government. Political rings and organized propaganda ride over us to their ends, while we weakly and cynically make cutting remarks about them to each other. The engineer, especially during these last few years, has felt his fitness for public affairs, his capacity for self-government, his ripeness, after a period of forgetfulness, for democracy. But he finds himself extraordinarily timid and awkward: criticism, even, he feels it bad taste to voice. Somehow or other he might injure his precious pocket-book. He is not, as a rule, long established in any settled community. He works for a company, and takes orders from a superior and gives orders to an inferior. The habit of obedience, of unquestioningly minding his own business, is trained in him by the modern system of individual efficient organization, where each man knows his place in the scale and sticks to it.

The Institute Form of Government

OUTSIDE OF THE COMPANY in which the mining engineer is placed, the organization with which he is most closely connected is the American Institute of Mining and Metallurgical Engineers. Here is a voluntary association of his peers—educated and thoughtful men, among the intellectual aristocracy of our civilization—where he might learn that individual assertion and claim that inherent right of equal voice, in which he is given, in our days, little experience elsewhere. Does he? No—and for two reasons: he never thinks of demanding or expecting it; and no thought ever arises that it would be safe to give it to him. Here, least of all, is he judged by his brother engineers who are in the saddle to be fit for democracy or to have a voice which must be represented. At least he can cast a vote for Harding as against Cox, or Smith as against Miller, and take thereafter a pride in saying that he helped elect the President, or a regret that his candidate for Governor did not win; but among his own kind they hold that his judgment is not yet ripe enough to allow him to vote. The Board of Directors sends him a single ticket to sign—one man for president and so on down the line. Is it possible that a member is witless enough to mail back this slate or ballot, and waste a good postage stamp in idiotically voting for what is already decided without consulting his opinion? Human folly may even go to this point—past carelessness and recklessness to hypnotic docility.

As a mining engineer does in his own organization of mining engineers, so will he do in his capacity of a presumptive freeman and citizen of his city, state, or society. Count him as a negligible factor: simply send him the rules which he must observe. And if this is a satisfactory condition in his own engineering organization, then we have arrived at the end of our query, and know that by his own self-examination, and the judgment of those who secure by force of character political domination, is he no longer fit for democracy. And if that is true of this highly bred group, who shall say that the lesser informed and more poorly trained Americans are fit for democracy, and do exercise that fitness? And so we can take a long look ahead.

We have been curious as students of the origin of the Institute government, typical of so many other technical and scientific organizations, and so opposed to advertised American ideals. There was, some time back, what we may fairly call a dictatorship; and, to be sure, it was fairly well liked; but later it developed into a rule of the few Elder Statesmen, who sit as a group, re-elect themselves, and select new additions to their board, and also select the president and other officers. This appears to be the form of government practiced in various bygone epochs and known as the oligarchy, or the rule of the few, and exemplified in such governments as that of medieval Venice. It is the rule of the barons instead of the rule of the king.

Who selects the officers of the Institute? A nominating committee whose choice must be confirmed by the directors. Without being close enough to know surely, we venture to surmise that four or five of the directors and ex-presidents, whose terms of office and influence run back for years, in effect select the president, and that in many cases they could tell you whom they have selected not only for this year but for the year after. It is a fact that the "next president" has been introduced before the so-called ballot has been sent to the members.

Some Self-Governing Societies

O TEMPORA; O MORES! And yet the times and customs are not without hope. While the Institute members are not fit for democracy, in the judgment of the Elder Statesmen, the members of the Mining and Metallurgical Society of America are fit for democracy, and so observe it in the election of officers and in deciding all other questions. It is a small body, but who shall tell whether from it may not go out a rebirth of freedom?

The Society of Economic Geologists is fit for democracy, in the judgment of its founders and its own members, and does exercise its rights of self-government: while in the Geological Society of America, a larger and older organization, the members are not fit for the privilege of suffrage, as the ruling statesmen frankly state, and the system of government is quite like that of the Institute. The Geological Society of America also solemnly sends out a ballot, and asks you to vote for one out of one: and, incredible as it might seem to an American of 1776 or 1620, we have no doubt that there is here and there an American of Colonial ancestry who signs on the dotted line and wastes a postage stamp.

Give Us the Ballot

THE REMEDY? We have no complaint of the official personnel which results from the method of running the oligarchistic societies. They are devoted men, loyal, to whom we indolent ones are satisfied to leave the hard work and glad to escape it. But the disaster lies in what results to our spirits for this convenient arrangement. And the careful observer can satisfy himself that this is true. They give us good officers and good administration: but we would rather determine our own, even if they were bad. We appeal to these able and thoughtful men—our friends—for universal suffrage, and on the deep-lying principles which we have set forth. Thereafter, perhaps, we may go out and take our places in a great democratic nation. We wish to graduate from the under-dogs and take up the White Man's Burden.

The Dual Standard for Copper Trading

A KEEN EUROPEAN OBSERVER of the metal market here and abroad notes that the present system of selling copper to American and foreign consumers, whereby export trade is tackled collectively, probably results in exacting a higher price from the domestic purchaser, as large quantities are earmarked for export and so withdrawn from competition in the local market. No doubt there is justification for this view. In general, foreign consumers of American copper have not been highly enthusiastic over organizations for export trade permitted by the legislation passed in the latter part of 1918 and known as the Webb-Pomerene Act. This law allowed copper companies to do that which for many years had been forbidden by the Sherman Anti-trust Act—i.e., to combine for the purpose of realizing the best possible prices for exportable products and facilitating the capture of export markets in which competition is usually sharp. Copper producers were quick to see the advantage accruing to them under this liberalizing of the law, and accordingly formed an export association, which now handles almost all of the export business of the trade. Consequently a peculiar situation has arisen—a dual standard of business conduct is countenanced by our laws. Combination to obtain the maximum benefit from foreign trade, which means exacting the highest toll the traffic will bear, is accepted as legally proper and moral, but similar combinations in domestic business are frowned upon.

Some competent students hold that the Sherman Act has been more of a detriment to the industrial growth and efficient development of our country's resources than to its benefit, basing this reasoning upon the advantages which unification of effort and consolidation of industrial groups, as exemplified by European practices, would give. On the other hand, it has been contended that business conditions and methods in this country are different enough to require a Sherman Act.

Copper producers have doubtless been able to obtain somewhat higher prices from foreign than from domestic consumers, but that there should be a difference between the two markets is nothing novel. The reader may recall stories he has heard of American watches and other manufactured goods selling for lower prices abroad than in the United States, a trading method ostensibly used to stimulate foreign consumption and to meet competition. It is unnecessary to use such a system in disposing of copper, for competition is not as keen in that metal as in some manufactures.

In general, consumers abroad are charged a fair and reasonable price for American copper, and surely they can have no objection to the cost of the metal to them during the last year. Nor do we believe that the domestic consumer is complaining. There is enough diversity of interests in the world's copper-producing units to make it impossible to maintain an artificial level of prices by any one group.

WHAT OTHERS THINK

Thoughts on Mining Education

T. T. Read's interesting discussion of Mr. Young's article on "College of Mining—University of California" certainly starts many trains of thought. It is startling to read that "Many mining schools . . . just grow," without consideration of what is demanded of the mining engineer. It is doubtless true of some institutions, but to an "old grad" of the Massachusetts Institute of Technology, frequently bombarded by Dr. Richards, Dr. Hoffman, and Dr. Warren with questions as to what his training lacked, it seems almost unkind. There, at meetings of the Alumni Council, a representative alumni body, have often appeared in the past the president, the dean, and various members of the faculty, to discuss the courses of instruction, and advisable changes. Professor Peele, of Columbia, in discussing the report of the Mining and Metallurgical Society Committee on Technical Education, says, "The schedule of today in the best schools is the result of many years of evolution. Teachers have given anxious thought and conscientious effort to the problem."

Doubtless the courses are not perfect; they will be improved, as will also the method of teaching. But, after all, are not the colleges, with their varied curricula, offering just those variations necessary to produce the different types of men needed? The M. & M. S. committee, in agreement with Mr. Read, concludes that the colleges should concentrate on the fundamentals, or general principles, and suggests that 40 per cent of the time should be given to mathematics, physics, chemistry, and mechanical drawing. From a table which the committee prepared it appears that these subjects receive attention in various mining courses as follows:

	Per Cent of Total Time
Texas State School of Mines	28
Missouri School of Mines	32.7
Colorado School of Mines	33
University of Nevada	36.8
Montana University	37
University of California	40.9
Massachusetts Institute of Technology	41.8
Sheffield Scientific School	42.8

The study of English, economics, and history also receives more time at Sheffield and Technology than at any other school. The committee does not include Columbia, which gives a broad course requiring six years.

Certainly schools close to the mines, like those at Butte and Golden, where the students get time for frequent visits or underground work, can fit their men to assume more quickly the position of timberman, shift boss, or foreman. They undoubtedly give better training for the "Main Street jobs," or what Mr. Read calls "the major work of the industry." And the man who has within him the sparks of genius and vision, who will work and study and think, can, on this foundation, become a captain of industry.

The state schools are certainly less hampered by political conditions than formerly, although unfortunately not always free from them. Obviously, it is fair that in a school supported by Michigan taxpayers more attention should be given to the preparation of men for mining copper and iron, whereas in Missouri work on lead and zinc should be stressed.

Unquestionably, a graduate from most institutions is only prepared to become an engineer, and it is for his superiors and the companies which employ him to give him the opportunity and to guide him. But, on the whole, is it not to the schools giving the stronger courses in fundamentals, and which devote more time to English, history and economics, that we must look for the majority of our men of broad vision, able to solve new problems, to explain them to those supplying the funds, and to handle the forces, physical, human and economic, with success? Mr. Read intimates the schools are trying to make too many of these. Did he ever try to find a man competent to handle an unusual type of ore deposit, for which the most applicable mining method must be developed, located in a foreign country where political and labor conditions must have consideration? GEORGE A. PACKARD.

Boston, Mass.

Another Plea for American Magnesite

With the passing of Barnum it was my opinion that statements such as "the world's largest," "the world's tiniest," "the world's fattest, "the world's thinnest," "the world's purest," and so on, had passed into disuse, except among those who were endeavoring to emulate the late Mr. Barnum. For this reason Mr. Boydell's superlative statement about Grecian magnesite taxed my deglutition to such an extent that a protest was written. Judging from Mr. Boydell's answer to this protest as printed in your issue of Jan. 14, he is somewhat intransigent. To mollify this it is becoming to me as a California magnesite producer to state that Greece undoubtedly produces high-grade magnesite, but to say she excels all others is a statement that may be admitted by the Greeks, but certainly not by the producers in India, British Columbia, Venezuela, or South Africa.

The Grecian analysis as quoted in Mr. Boydell's article would not be published by our umpire chemists in California. The magnesium-carbonate content quoted in the two sample analyses is on a calculated basis, which the buyers in the United States at the present will not accept. Take, for example, the analysis on the lot of 1,500 tons, to wit: The silica is 1.54 per cent, the oxides of iron and alumina are 0.33 per cent, and the lime amounts to 1.21 per cent; this makes the total impurities 3.08 per cent. Subtracting this amount from 100 per cent would leave a remainder of 96.92 per cent, which would be the maximum magnesium carbonate possible on this basis. Now, we know that most of the lime must exist in the form of calcium carbonate, and therefore the calcium-carbonate content would be about 2.16 per cent. This would bring the total impurities to 4.03 per cent, leaving an undetermined portion of 95.97 per cent, which could be assumed as practically all magnesium carbonate. The analysis by Mr. Zalacostos shows the magnesium-carbonate content equivalent to 97.39 per cent. Perhaps the Greeks get their reputed pure magnesite in this way through their laboratories. Perhaps, also, this is the reason that the Grecian analyses are not acceptable to buyers in the United States, who insist on umpire analyses being made at point of destination.

The inference about my unbusinesslike method of purchasing Grecian magnesite may be correct, but a much stronger emphasis can be placed upon the Grecian (would it be proper to say Greecey?) business methods of shipping magnesite to this country upon a guaranteed minimum of 93 per cent magnesium carbonate which is found upon arrival to contain but 88 to 90 per cent magnesium carbonate. Is it for the reason that there was not a better quality in Greece to ship, or was it because their sampling and analytical methods were at fault? Mr. Boydell can be easily referred to several umpire analytical firms in this country who have conducted tests on the imported material and found it less than the minimum guaranteed.

As a comparison to Mr. Boydell's quoted analysis, I am choosing analyses of ten different carloads of magnesite shipped by me from Livermore, Cal. These carloads average 45 to 50 tons each, and were calcined magnesite. The total impurities, consisting of lime, silica, and oxides of iron and alumina, average 3.945 per cent. This is in the calcined state and on a rough calculation would give a little less than 2 per cent total impurities in the crude state. These analyses were made by the Eaton Laboratories, of San Francisco, and if Mr. Boydell wants conclusive proof I shall give him the laboratory certificate numbers and let him take the matter up directly with the laboratory. This lot of ten carloads is approximately equal to a thousand tons of crude magnesite. The laboratory mentioned is an umpire laboratory and has acted in that capacity for some of the largest buyers of magnesite in the United States.

It may some day be Mr. Boydell's pleasure to visit California. Should this occur, I will consider it a pleasure to show him personally over a magnesite property I am operating on which he can put a tape line and see that we have veins of magnesite that measure so much in excess of thirty feet in width—Mr. Phalen's statements to the contrary notwithstanding—that I am afraid to state the figures in fear of Mr. Boydell's incredulity.

Furthermore, in these drear, dry days of the present, we shall try to give Mr. Boydell a taste of California wine, which we hope will not taste so execrable as the Grecian he so humorously described. We might be able to persuade him to admit, at least to us, that our California wine is superior to the Grecian. It will not be tendered him with the intent to have him view the California magnesite too favorably, but merely to take the Grecian taste out of his mouth.

Mr. Boydell's reference to the "Hewet" magnesite in California is probably meant for the Hemet mine. This deposit is well known as one of the low-grade properties of California, and was operated during the war by a New York firm, which, incidentally, has been a large importer of Grecian magnesite, and I understand is at present bringing in Grecian material. The Hemet deposit was practically depleted, operations were abandoned, and the equipment was sold. The Hemet deposit is as far removed from the biggest producing magnesite mine in California as Eubœa is from the Gulf of Taranto. The purity of the Hemet magnesite, as compared to the high grade produced elsewhere in California, is also relatively as far removed.

Hoping to take Mr. Boydell's partiality away from the Ægean Sea and bring it to this, our own, our native land, I am C. S. MALTBY.

San Francisco.

THE GRIESEMER MILL, AT ASHLAND, ALABAMA

The Graphite Industry of Alabama

Overexpansion During the War and Difficulty in Meeting Foreign Competition Have Caused Most Properties to Shut Down—Government Research Improving Technology—Author Advocates a Reasonable Protective Tariff

By George Huntington Clark

Written for *Engineering and Mining Journal*

As has been frequently stated officially, and from reliable sources, 90 per cent of the crystalline flake graphite ore reserves of the United States are carried within a comparatively small area in Alabama, closely bodied, and remarkably well located with respect to all the essential conditions for economic development and recovery. The graphite is all of the higher or crystalline variety, in flake form, and may be reasonably and conservatively stated to be found there in sufficient amounts to meet the needs of the entire United States, on its present basis of consumption, for an indefinite period, provided it can be so recovered and reliably brought up to standard specifications as to meet and satisfy competitively domestic requirements.

Prior to the World War, the entire investment in Alabama graphite mining and milling hardly exceeded $150,000, representing a possible total annual production of not to exceed 1,300 to 1,500 tons of all grades, an output, however, never attained under prevailing market limitations. The close of the war found the industry in the state, by reason of inducements held out from time to time by consumers, and more especially because of patriotic appeals from governmental agencies, expanded to the point where the total mine and plant investment approximated $4,000,000, with the possibility of an annual output approaching 15,000 tons.

Under the then prevailing and clearly understood formative, even experimental, stage of graphite milling methods, as specially to be adapted to the ores of the district, Alabama operators would assuredly have hesitated to make these rapid and enormous increases in mine and mill investment had they not been called to Washington to confer with war boards, and the strongest appeal made to them to increase production to the limit, under assurances, said to have been extended, that prices would at all times be made or stabilized commensurate with costs and on such basis as to admit of investment amortization in a three- to five-year period.

In further reassuring support of this governmental attitude, the Mineral Control Act (S. 4885) was passed by Congress, containing a provision guaranteeing adequate protection to graphite producers for two years after peace should be signed, the evident purpose and intent of this bill being to protect operators from almost certain loss on accumulated stocks, and to offer at least a chance for readjustment to normal conditions.

As a matter of fact these assurances were not realized, and the above-named Mineral Control Bill never became operative. On the contrary, the hitherto declared embargo against foreign graphite was in January, 1919, removed, allowing the unlimited entrance of foreign stocks produced by 20c.-per-day foreign labor, resulting naturally and immediately in heavy foreign shipments of graphite, made at possibly one-third the cost of Alabama production.

As a result, Alabama mills, carrying at the time large stocks of manufactured graphite made at peak war costs, were absolutely ruined, whether they attempted to meet this competition after sacrificing their stocks or shut down, holding these stocks indefinitely. At present such of the stocks as have not been so sacrificed are still on hand, and not a single mill of the forty plants in the district is in operation, or has been for the last twelve months or more. With the rapid deterioration that is taking place in all of these idle mills, the graphite industry of Alabama may therefore be said to be in a condition of absolute demoralization. That this condition, however, is not by any means hopeless may be convincingly shown by a conservatively fair and impartial study of all the facts relative to existing mineral conditions; the progress and development of the successful milling and flotation methods worked out, and the actual character of the flake product now possible of recovery under known and fairly well-perfected methods for flake extraction.

The main efforts of producers have recently been and are now directed solely toward securing an import tariff on graphite sufficient to reduce foreign competition to the point where some market at least would be produced for domestic flake, it being stated that there has been no market whatever at any price during the current year. Given a fair and impartial entrance without discrimination into such a reopened or expanded market, some of the most competent Alabama operators do not now hesitate to say that they are fully prepared to enter this market competitively, under any ruling prices which may prevail, and to start up their plants again immediately, with no fear of results under known perfection of refining and concentrating methods, firmly believing also that graphite crucible manufacturers can be shown that domestic flake may now be so prepared as to be in no way inferior to Ceylon lump.

DIXIE CONSOLIDATED GRAPHITE CO.

GOVERNMENT INVESTIGATIONS ENCOURAGING

From the results of a series of tests made by Dr. Stull, of the U. S. Bureau of Mines, during the war, at the request of the Alabama operators, there is decided encouragement in support of these contentions, although the matter is hardly yet to be considered as convincingly settled without more comprehensive research and experimentation.

The contention of some crucible makers that Alabama flake graphite is unsuitable by itself for crucible purposes, and that only a small percentage of it is permissible in proper crucible mixtures, also did not hold good in certain lines of experimentation undertaken during the war, and graphite operators assert that the price of the flake always seemed to determine the question of its suitability or unsuitability as a crucible-making material. It is possibly also a fact that no Alabama mill has ever named a price on graphite, producers simply accepting what was offered.

The general practice of the mills has been to produce three or four regular grades of graphite—No. 1 flake, No. 2 flake, and one or two grades of dust, the distinction between No. 1 and No. 2 flake being entirely one of fineness, there being little or no difference in carbon content, which ranged from 80 to 94 per cent, according to operative mill conditions. A fair average of the district would probably be 85 to 88 per cent.

Anything under 125 mesh is classed as dust, possibly 10 per cent of which dust, carrying over 45 per cent carbon, would grade as No. 1; the remainder, averaging around 30 per cent carbon, could be used only for foundry facings, and has found a somewhat limited market. No. 1 dust has been used only for paint stock. Widely variable relative percentages of No. 1 and No. 2 flake have been made, ranging for No. 2 from one-fifth to practically full capacity output in second grade.

HIGH STANDARDS DEMANDED

The chief objection made by manufacturers to Alabama flake as a crucible-making material has been the undoubtedly true and important fact that few producers have been able to maintain anything like the favored uniform standard of 90 per cent plus in carbon. This has been in large measure a natural consequence of the enormous and rapid expansion of the industry, as yet in a purely formative stage, under the stress of war demands, and is not in any sense to be considered as a reasonably probable permanent condition.

In addition to a standardized 90 per cent plus carbon flake, crucible makers much prefer flake only a small amount of which shall be coarser than 50 mesh, which conditions, according to some consumers, have been not reliably satisfied as yet by Alabama flake. Though this doubtless was true of the product of certain of the Alabama mines and mills, during the exceptional war period, it is distinctly untrue of others, and cannot be correctly stated to be a district characteristic not now susceptible to correction.

Recommendations made during the war as the result of impartial official investigations called for a screen analysis of No. 1 flake as showing 3 per cent over 35 mesh, 50 per cent over 65 mesh, and 100 per cent over 100 mesh.

IMPURITIES DIFFICULT TO HANDLE

In the matter of the variable percentages of graphitic carbon in the flake proper, one concentration problem is common to all crystalline flake deposits—viz., the difficult elimination of interlaminated impurities in the graphite crystals themselves, entirely inclosed by graphite, which may amount, it is stated, to as high as from 5 to 10 per cent by weight of otherwise high-grade flake. The separation of these inclosed foreign and deleterious materials, feldspar, mica, and quartz, from the body of the flake itself, which may be effected only by dividing the flake into thin pieces by some process of grinding the concentrate, is a most difficult reduction, and must be done with a minimum of loss in dust by pulverization.

Efforts to produce the most suitable and therefore salable grade of flake for crucible purposes have developed widely variable milling practices, most operators, however, having had mainly in mind the recovery of as great a percentage as possible of large flake, frequently irrespective of heavy loss in the tailing. Certain special operators, as for example those using the Huff electrostatic machines with modifications, with which high-grade concentrates have been uniformly and regularly made, prefer to specialize in a high-carbon concentrate absolutely free of all foreign impurities except those occurring between the laminæ of the flakes. As a result, the only mill in the district using this electrostatic process, which has uniformly and reliably standardized its product at 90 per cent plus, has had little difficulty in disposing of its graphite during its entire period of operation, under favorable and unfavorable market conditions, at remunerative prices.

SMALL DIFFERENCE IN SPECIFIC GRAVITY OF GRAPHITE AND ASSOCIATED MINERALS

The problems involved in the separation of flake graphite from its mineral associations, with a minimum of loss in the character and amount of the recovered flake, are extremely troublesome and are complicated by three main difficulties: First, the necessary reversal of ordinary processes of milling (the mineral of lowest specific gravity being the one to be recovered); second, the almost imperceptible difference in specific gravity between graphite and the impurities, quartz, feldspar, mica, and calcite; and, finally, the complication, in any of the grinding or disintegrating processes, resulting from the fact that the objectionable associated minerals are themselves natural abrasives, harder than the flake to be set free and recovered with a minimum of loss.

The dual problem of the removal of the two classes of impurities—those loosely associated, and those intimately associated with, or forming part of, the flake—necessitates two-stage methods, the first stage, or concentration process, being concerned with the loosely adherent impurities for the formation of a so-called "concentrate," and the second stage, or "refining" process, directed at the cleaning and transformation of the graphite by finer crushing and screening into the resultant product styled "refined graphite."

Concentration processes, beginning with the original and crude method of simple water flotation, have covered a wide experimental range of variations and additions, resulting in and leading up to the present and final generally approved and comparatively successful flow sheet of the mill.

FLOTATION METHODS USED

Oil flotation methods originating with the use as licensees of the patented machinery of the Minerals Separation Co. have followed various stages of special adaptation and experimentation, using Callow cells, K. & K. flotation, and the Simplex process, the basic principle of Simplex being automatically regulated hydraulic agitation. The Sutton, Steele, and Smith dry process, installed by a number of mills and subsequently taken out, did not prove successful as applied to Alabama ores. Pneumatic processes have to some extent been found a useful auxiliary method in combination mills, mainly for preliminary rough separation.

The electrostatic process, using the Huff electrostatic machines with certain modifications worked out by E. R. Taber in the Chilton County mill of the Flaketown Graphite Co., has been used with gratifying success on the ore of that locality, the principle involved being the difference in electroconductivity between graphite and its associated impurities, preliminary rough concentration being effected, as in the other mills, by water flotation. On other ores of the district, which are in some degree complicated by the associated presence of iron, this process has not as yet been adapted successfully.

DEPOSITS OF SHALLOW DEPTH

The character of the graphite beds worked varies somewhat widely, being not infrequently continuously flake-bearing along the strike, but in other localities characterized by marked changes and alterations within short distances. The origin of the deposits is assumed to be sedimentary, the carbonaceous material being metamorphosed into graphite of the flake variety, largely crystalline. Mining has been altogether by the open-cut method.

The width of the beds varies widely, ranging from a few feet to as wide as 100 ft. or more. Occasionally, closely parallel beds form belts or zones of ore having a combined or total width of 200 ft. or more, separated by intervening partings of non-graphite or barren schists. It is a generally observed fact that in the widest beds the lower half of the deposit carries a flake concentration running much above 50 per cent of the total recoverable values.

What has been thus far called the working depth of the deposits—that is to say, the softer ores, within the range of comparative surface alteration and decomposition—probably has a general variation of from 60 to 100 ft. At greater depths, approaching water level, the harder and unaltered ores, although equally flake-bearing, are more expensive to mine and crush and may present some concentration complications resulting from pyrite and other mineral associations. Flake values in the ore range as high as 5 per cent, but the district average would probably be not to exceed 2½ or 3 per cent.

The facts above set forth are a conservatively correct analysis of the status and actual value and importance of the Alabama graphite industry today; a history of its war-enforced and unduly rapid development, and of the specific causes leading up to its present demoralization. The status and future of the industry should be a subject for serious reflection—whether or not this district is to be left in its present deplorable condition, or reasonable remediable measures taken to preserve it as an active and invaluable national asset in the general industrial recovery which is commonly accepted as a not far distant future contingency.

In the reconstruction of the district to a basis of successful permanent operation, a considerable percentage of present mill investment in wrongly constructed plants, in many instances rushed to completion on improperly tested and practically valueless property, will admittedly be scrapped. Generally speaking, however, a large amount of this plant investment may become, with well-understood modifications, a seemingly sound and reasonably profitable investment under a fair prospect of available markets. As an admittedly essential raw material of the utmost value nationally, for which there has been found in certain of its uses no acceptable substitute, and as an essential war material, rated among the most important, the status of Alabama flake graphite making, and its claims upon a reasonable measure of protection and industrial preservation, should certainly command and receive attention.

Increasing Efficiency of Mine Labor*

Extensions in Industrial Productivity Largely Dependent on Advances in Living Conditions—Comparative Considerations of Contract Work, Piece Work, and Premium Systems Point to Decided Advantages in the Acceptance of the Latter

BY B. F. TILLSON

Written for *Engineering and Mining Journal*

IT IS GENERALLY REALIZED in industry that the standards of living for the laborer have properly advanced because of industrial activity during wartime conditions, and that factors now enter into his life as necessities which were formerly considered luxuries. In fact, large industries, such as the manufacture of automobiles and their accessories, have been established because of this natural evolution and have a widespread effect upon the economic life of our nation. The problem is how to permit the advance in earnings which these higher standards require without depreciating the purchasing power of our unit of currency. The solution is to increase the productivity of a unit of labor. The introduction of machinery to replace common labor helps to attain this end, but at the same time increases the amount and proportion of skilled labor required by industry.

LIVING CONDITIONS AFFECT INDUSTRIAL EFFICIENCY

It is therefore of vital importance that we seek means for encouraging the development of skilled labor. The most potent inducement is to arrange for an increase in earning power for labor as it becomes more skilled. But money alone does not entirely fill the needs of the situation, for beyond a certain limit it loses its appeal. This limit varies with the habits of living and the desires of individuals. For instance, it has been observed during the unusually sudden wage increases of the last few years that miners did not wish to accept promotion from the occupation of mucker to that of drill runner, although a substantial wage advance was offered, nor were the majority interested in attractive premium systems permitting increased earnings of 50 per cent at the expenditure of a greater but reasonable amount of productive energy and interest.

To what may this condition be ascribed? It is probable that ordinary basic wages supplied all the luxuries to which the workers had been accustomed and educated, and as they had not been taught the value of thrift, the acquirement of more money than they wished to spend held no attractions to them; for as they had not learned the value of investments or banking, the protection of a surplus over ordinary needs proved a worrying embarrassment. For what real enjoyment does money in itself bring to the normal person unless it permits the fulfillment of many desires which must be stimulated by other agencies? It is evident that increases in industrial efficiency are dependent largely upon so-called advances in living conditions, which produce added complexities in our lives, and in turn must parallel increased earnings for units of labor.

Of course, other attributes, such as rivalry, greed, envy, hate, ambition, and the like, all play a potent influence in stimulating greater productivity from labor, but all are developed with the increasing complexities of advanced standards of living.

The installation of advanced types of mechanical devices to increase the productivity of labor is foolish unless we arrange our operations so that the labor will co-operate in making them give an adequate increased return. We have seen that under certain conditions a most potent influence is to permit an increased earning power for labor. In general, three different methods are employed, and these have their advantages and disadvantages. They are contract work, piece work, and premium systems.

The installation of a contract system might theoretically seem an ideal solution of the industrial problem. It has the advantage that an operating company can accurately estimate its cost of production in advance and can market its production at a lower base price with an assured definite profit.

Such a system should also permit the contracting labor to reap a greater return from its energy, skill, and thought. But in practice such results are obtained only from an unusually high grade of labor; in fact, from individuals whose ability and ambition soon take them out of the labor group. The contract system then changes to an organization where the contractor becomes a middleman, and in turn hires the labor, and so greatly differs from the ideal and is not likely to develop marked advantages.

DISADVANTAGES OF CONTRACT SYSTEM

The following disadvantages have been noted in contracts with labor, even where there is perfectly good faith between the contracting parties: The ignorance and financial instability of the labor require the contract to be set at a high rate so as to assure labor that it will suffer no financial loss should unforeseen hard luck develop or conditions change. The company loses supervisory control of the working methods, and the tendency of the labor is to play safe by employing only the systems or processes developed by experience and not hazard a loss through the trial of improved methods. Labor cannot afford to finance such experiments, and improved efficiency is thus deterred. Also, under the contract system, a company does not possess the incentive to invest money for new equipment to increase the productivity of contracting labor, for the labor will resent a reduction in the contract rates and will make light of the contribution of the company toward its work. Furthermore, the company does not have even a normal incentive to alter the nature of its other operations, which link with the contract work, so as to improve the efficiency of the latter. These tendencies are so thoroughly human that there can be little hope of dissipating them.

Piece work is subject to the same opportunities for misunderstandings between contracting parties when an improvement in machinery makes a lower base rate

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*This article is a continuation of Mr. Tillson's paper, "Promoting Efficiency in Drilling Ore and Rock," which appeared in the Jan. 21, 1922, issue of *Engineering and Mining Journal*.

proper, or when the depreciation in the purchasing power of a unit of currency makes a higher rate necessary, that exist under the contract system; but where the operations required to produce a piece of work are simple, and are not greatly influenced by unforeseen and widely variable contributing conditions, it is possible, under the piece-work system, to create so sound a condition of mutual good faith and trust as strongly to warrant the establishment of this incentive for increasing the productivity of labor, reducing costs, and increasing equivalent wage rates.

The Completion Factor a Deterrent in Piece Work

Although piece work has been and can be applied with success to many types of manufacturing industries, there are others in which it gives small assurance of successful results. It requires completing one or more definite tasks per unit of labor in each shift worked by an individual, so that he may feel assured of his wage rate and may, if necessary, draw upon his earnings before the regular paying period. The tendency is also to fix an unwarrantably high piece rate, so as to assure a living wage to the considerable number of inexperienced or inefficient workers.

The field of application of piece-work systems to underground mining conditions is therefore limited, for there is great difficulty in standardizing operations to the degree which is necessary to make such a system successful. It is used in some mines, and undoubtedly is responsible for increased efficiency, but it seems that even better results might be obtained from a "premium system" of piece work.

Premium systems are based upon the principle that a certain minimum wage shall be guaranteed to labor; also establishing a basic return in production for such wage. Increased productivity from a individual above such a base rate then increases his earning power. Considerable care and forethought should be used in establishing such a system, for it is desirable not to have to change base rates after labor has been interested in supporting this incentive for increasing labor efficiency, or distrust and failure are likely to follow, no matter how just and well-intentioned the changes may be. Of course, base rates may be revised in favor of the laborer without the same bad results as a reduction in rates, but any changes in either direction cause an unnecessary amount of discussion, which is likely to produce some dissatisfaction as to the nature or the amount of the change.

Establishing a Rate Basis

It may seem to some that the base rate should be the average productivity of labor at the time the premium system is initiated, but further consideration will indicate the unsoundness of this view. In the first place, the company must lose money if it pays a premium for all work in excess of an average and guarantees a minimum wage, for if no change is made in the productivity of the labor it is paying a greater total sum for the same amount of work. In the second place, temporary industrial or local conditions may cause the present operations to be an unfair index of the productivity which might normally be expected of labor. These conditions should be removed before establishing a premium system. It may be that the nature or quantity of supervision should be changed or that operating methods and equipment should be revised. If so, all such improvements may well be instituted before the establishment of base rates.

The base rates should be established at a point which permits ready attainment by the industrious, but yet indicates an honest shift's work by an experienced man. I believe the nature of the premium should be in terms of hours of labor instead of in money, as my experience has emphasized in a striking manner the fluctuating value of our currency when considered in terms of purchasing power. By expressing the base rates and premiums in terms of hours of labor, the system is elastic in conforming to the changes in general wage scales throughout the country, without begetting distrust and creating dissatisfaction on the part of the laborer.

A simple way for deciding the premium rate is to make it a certain percentage of the base rate. For example, if two men can be expected to drill and blast a drift heading round of 5⅓ ft. in a shift of eight hours, the base rate is one-third of a foot per hour of labor, or three hours per foot. If the premium were established on a 50 per cent basis, one and one-half hours' extra time would be given jointly to the two men for every foot they increased the depth of any round which they broke of a depth greater than 5⅓ ft. Or if the premium were fixed on the basis that the company shared one-third of the gain and labor two-thirds, the men would jointly receive two hours extra per foot increase, or one hour each.

As it is desirable to make the incentive as attractive as possible, the last-named premium might be preferable, but the company should receive a substantial share, so that it will have sufficient incentive in taking every possible step to increase the efficiency of the labor. This involves continual investment on its part in renewing obsolete and worn drilling equipment, keeping the drill steel in the most perfect condition, maintaining good air pressures at the drills, maintaining a convenient supply of drilling water (often piping it to the machines), and in many other ways making particular effort to arrange the mining operations so as to facilitate the earning of premiums.

Premium Rate Most Understandable

Of course, the company also profits in a general reduction of overhead expenses by the greater productivity of a given force of men. Usually it is difficult to figure such savings definitely, and they should not be overemphasized, and the company should be assured a definite and a reasonable proportionate return on the productive labor.

There are, of course, arguments in favor of making the premium rate a variable quantity. As it is more difficult to gain an extra foot on a long round than on a short one, it would seem just that the premium rate should increase proportionately with the length of the round. But it should be borne in mind that only a limited amount of premium is available and that the initial premium rate might therefore necessarily have to be so small as to prove only the slightest incentive to the majority of the men. On the other hand, it is often so hard to awaken the interest of men in such a system that there is reason for advocating a substantial premium for the initial increase in footage beyond the base round, and then the available increase is slight. On the whole, an average premium rate throughout would seem the most practicable, and simplest for the laborer to understand.

There are two different ways of applying such a system, and each has its advantages. If the premium hours are credited in the time books at the conclusion of each daily task, the men readily and accurately realize their earnings, but they may have to accept a loss under the following conditions: Suppose the premiums apply to 1-ft. increments in the length of rounds. Then for yesterday's round, which was 1 ft. 9 in. longer than the base round, they would receive a premium for 1 ft., and if today's round were 1 ft. 3 in. long they would also receive a premium for 1 ft., or in total a premium for 2 ft., although the advance made in the two working days is increased 3 ft.

On the other hand, it would be possible to avoid such an accumulated loss if the men were given the task of driving, say, 53⅓ ft. of drift and were credited with a certain amount of time for doing so. At the above-mentioned base rate, ten shifts would be allotted for such a task, or 160 hours. If they completed this task in eight shifts they would be credited with an average progress of 6⅔ ft. per shift, or an excess of 1⅓ ft. per round. At a premium rate of two hours per foot, the premium time would amount to two and two-thirds hours per round, or a total of twenty-one and one-third hours, so that each man would receive a total pay of about seventy-four and one-half hours for eight days' work. This method of averaging offers a fair proposition for labor, as it eliminates the total loss of time and discouragement from unforeseen difficult conditions or break-downs which might result in short rounds. It also encourages the men to use any spare time left from a completed task before the end of the working day in the attempt to get a head start on future tasks. The only objection to it is that they may not have a definite idea of their earnings to date at any time, and the premium incentive is therefore not so strong for the man of limited intelligence as under an arrangement providing for a daily premium record.

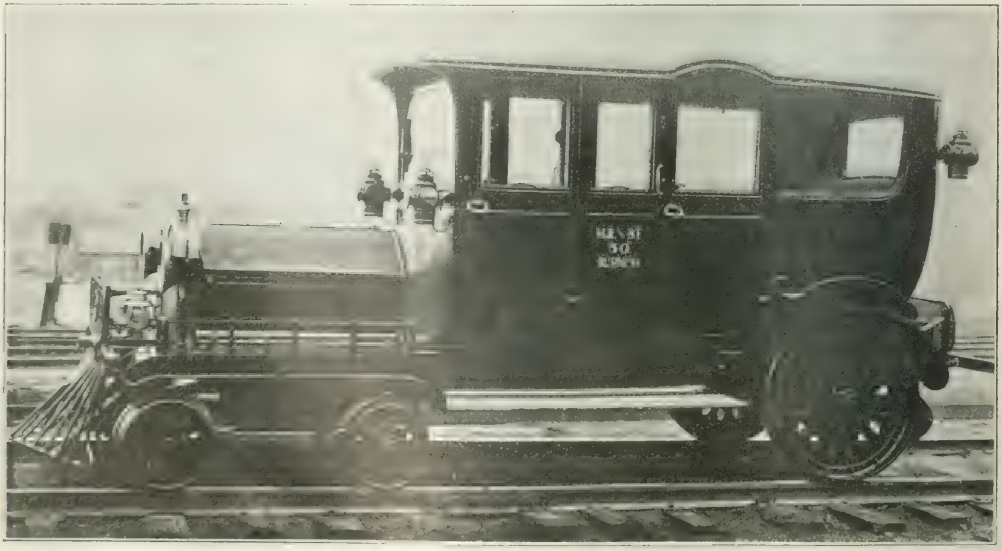
Feldspar Output Declined in 1921

Feldspar production was increasing at an encouraging rate as 1921 came to a close. When the year began it was declining rapidly from the feverish activity of 1920. Before the year was many months old the industry had slumped into a no-market condition, and many of the country's feldspar mills were closed. Those that were able to continue production did so on a part-time basis. Late in the summer conditions began to improve, and there has been a steady increase in production since that time; but the situation was far from normal at the end of the year.

The total production and sales in 1921 were estimated by one large producer at about a third less than in 1920. Final figures are not yet available for the 1920 production of feldspar, but it is known that output in that year established a new record in the industry. The estimate made by the U. S. Geological Survey places that year's output from properties in the United States at 131,006 tons. To this, however, must be added the Canadian production of 36,856 tons, all of which was sold in the United States. Prices during 1921 were largely nominal. One of the largest producer's figure varied from $21 per ton f.o.b. shipping point for No. 1 ground at the beginning of the year to a quotation of approximately $18 at the close.

Carbon-Monoxide Poisoning Investigated

The Department of Labor has issued a report on carbon-monoxide poisoning based on investigations in the copper regions of Arizona and Montana. A careful search in metal-mining towns fails to confirm statements of foreign authorities as to serious after-effects from gassing accidents, as only rare instances of such a character were discovered. The report recommends a more thorough study of this aspect of industrial poisoning.



TRANSPORTATION IN THE SOUTHEAST MISSOURI LEAD DISTRICT

One of the inspection cars of the Mississippi River & Bonne Terre Ry. (subsidiary of St. Joseph Lead Co.) operated by a gasoline engine and having a pony truck forward.

A PORTION OF TOP OF MINE. COOLIES CUTTING OVERBURDEN AND LOADING IT INTO TRAIN

The Gariajore Manganese Mine, in Gangpur State, India

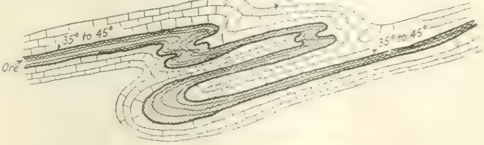
An Open-Cut Property Worked on Contract by Coolie Labor—Principal Deposit of Manganese in the Region—Ore Runs From 46 To 52 Per Cent of Mn.—Boulder Ore a Peculiar Characteristic

BY JOHN F. SPEDDING
Written for *Engineering and Mining Journal*

IN THE GANGPUR native state, Province of Orissa, India, manganese ores are found for a distance of about six miles along a well-defined line, and one of these occurrences, known as the Gariajore deposit, forms quartzites, and gray dolomites. The manganese ores, consisting principally of psilomelane, with a small quantity of braunite, wad, and pyrolusite, are associated with the Dharwar rocks, which include mica-schists, mica-slates, quartzites, and gray dolomites. The manganese ores are interbedded with the schists and quartzites.

The Gariajore deposit is the chief deposit of manganese ore in the state, and was first worked in 1908, since which year it has produced continuously, with the exception of the period from August, 1914, to December, 1916. The ore occurs in the form of a reef, varying in thickness from 8 ft. to 16 ft., with a strike north-northeast to south-southwest, and a dip of from 35 deg. to 45 deg. to the south-southeast. The reef is much folded, and is difficult to follow, but so far as can be seen at present, the form is as shown in the sketch.

The quartzite is a reddish to grayish fine-grained vitreous rock, and is often impregnated with, and partly replaced by, manganese oxide, in which circumstance it is black in color and sometimes difficult to distinguish from the ore. Iron often occurs in the middle of the deposit, and is difficult to distinguish from the manganese. The reef ore contains from 46 to 52 per cent Mn., with an average of about 49 per cent, whereas the float ore, or "boulder," as it is usually called, contains from 43 to 48 per cent Mn., with an average of about 46 per cent.



SKETCH OF FOLDED REEF

The deposits are being worked by open-cast methods. The waste on the hanging-wall side of the deposits is mostly soft, decomposed schist, and is cut away in benches, loaded into 20 cu.ft. side-tipping tubs of 2 ft. gage, and hauled to the dumps, about 200 yd. away. The harder rocks and the ore have to be blasted, for which gelignite or gun powder is used. Owing to the large amount of waste interbedded with the ores, much sorting is necessary, and this is done in the mine, by women. The waste from the bed, and also the interbedded rocks in the bottom of the pit, are hauled out of the mine by means of an incline.

Work is all done on petty contract, under which system a coolie will take a small portion of the mine to work from say 10 ft. x 10 ft. to 30 ft. x 30 ft., according to the number of men and women he means to employ. All measurements are made fortnightly, and the coolies are paid in full each fortnight, but take an advance at the end of the week, on work done. Saturday is "measurement day," and Sunday is "bazaar day," when there is no work, and the coolies, having received their money, all congregate in the bazaar (market), which is held under a large peepul tree.

The wages prevailing in the district are: Men, 4 annas per day; women, 2½ annas, and children, 1½ to 2½ annas. Even on such wages as these, the people are able to get along quite well by working only five days a week, as they subsist principally on rice, the bazaar rate for which is 1 anna per lb.

CLEANING AND SORTING MANGANESE ORE

The labor problem is often difficult, as a coolie usually wants an "advance" of from 1 rupee to 20 rupees before he will come to work. Having received the cash, it is no unusual thing for him to elect to stay at home for some time, rather than come to work at once. The advances are recovered by the company a little at a time, often only 2 annas or 4 annas at one time being repaid, and this entails considerable bookkeeping.

During the dry weather, only about 4,000 gal. of water an hour has to be pumped out, but in the monsoon this increases to an average of 15,000 to 20,000 gal. A horizontal duplex steam pump 14 in. x 8 in. x 10 in. is used to lift the water, and it gives efficient service. Steam for this pump, and for the 20-hp. engine for the incline, is supplied from a 30-hp. horizontal semi-portable locomotive-type boiler.

A peculiar feature of the orebody, which is common to most Indian manganese deposits, is the presence of "boulder ore." This class of ore usually occurs behind the reef, on the foot-wall side (though in some parts considerable deposits are found on the hanging-wall side), and is a product of the reef; it appears as though at some period the reef was greatly weathered and broken, forming rounded pieces of all sizes, which became mixed with stones and earth and then covered with a layer of soil. At Gariajore there is usually a layer of 3 ft. to 6 ft. of earth, covering a layer of 1 ft. to 3 ft. of mixed ore, stones and earth.

THE BOTTOM OF THE PIT ON A NORMAL WORKING DAY

In working, the earth covering is all removed in sections, and the boulders below are then dug out, the ore being carefully hand-sorted and dressed. The boulder ore practically always contains less phosphorus than the reef from which it was formed.

The mines are connected with the Bengal-Nagpur railway by a tramway of 2-ft. gage, six miles long, and the ore is carried in trains of twelve wagons, each of three tons' capacity. The locomotives are of 40 hp. and 50 hp. Rails are 20-lb. section, laid on wooden ties. One bad river has to be crossed, the bed of which is about 450 ft. wide. In the dry season this is usually a stream from 20 ft. to 30 ft. wide, and about 6 in. deep, but I have known eight hours' rain to change it from a stream this size to a torrent 450 ft. wide, and 10 ft. deep. On account of the large trees which are carried down by the floods, it has been found impossible to build a bridge which would stand, at a reasonable cost, so now a sand bank is built each year after the rains, and the small stream is bridged. Just before the rains break, the bridge is dismantled, the rails are taken up, and the sand bank is washed away when the rains come. The bridge stands from about the end of October to the end of May or the middle of June, and during that time

ORE IN FOREGROUND; IN BACKGROUND MICA-SCHIST

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[1] The anna is equivalent to one-sixteenth of a rupee and at present rates of exchange is worth about 1¾c.

all ore has to be railed from the mine, and supplies of coal and other necessaries for the operation of the property brought in.

From November to the end of February is the "cold season," with a maximum temperature of about 70 to 75 deg. and a minimum of about 40 to 45 deg. Then it begins to get warmer, and heats up steadily to the middle of June, when the rains begin. By this time the shade temperature is 110 to 115 deg., and it gives one little consolation to remember that, as the "Cousin Jack" said, "One doesn't have to stay in the shade." The rainy season is from the middle of June to the end of September or mid-October, and at the close of the rains there is a great deal of malaria, which must be countered by taking quinine. A dispensary is provided by the company, and a doctor is employed, but the coolies do not as a rule favor English medicines, and much prefer the extracts of leaves and roots which they make from plants found in the jungle.

General wages are about as follows: Clerks, Rs. 30 to 125 per month; surveyors, Rs. 75 to 150; mechanics, Rs. 30 to 60; engine drivers, Rs. 18 to 30; firemen, Rs. 10 to 18; coolies, 3½ to 5 annas per day; women, 2 to 3 annas; children, 1½ to 2½ annas. The mines manager is European, and the rest of the staff and labor are natives of the country.

"BOULDER PITS." CUTTING THE EARTH LYING OVER THE ORE. IN THE LOWER RIGHT HAND CORNER A LAYER OF ORE HAS BEEN REACHED

For part of the description of the geology of the deposit, and description of minerals found therein, I am indebted to "Notes on the Manganese Ore Deposits of Gangpur State, Bengal," by L. Leigh Fermor, A.R.S.M., D.Sc., F.G.S.

Another Reason for Standardizing Drill Steel

Mine operators in the Tonopah, Nev., district are having considerable trouble with drill steels, according to the U. S. Bureau of Mines, as the various lots received require different heat treatment in tempering. At one mine the steel does not stand up well in hard ground when used in the stopers with the outside water spray. At two different times in one mine the drill bits, after being used five or ten minutes, were red hot when drawn from the holes. The problem is being studied by the Bureau of Mines in the course of its general investigation of the effects of various types of rock and different treatment upon drill steels.

Procedure at the New Gold and Silver Refinery on the Rand

A brief description of the process used at the new Rand gold refinery near India Junction, Germiston, is given in *The South African Mining and Engineering Journal*. After the weight and assay have been determined, the bullion is made up into lots of 700 oz. each. Each lot is melted in a two-quart clay crucible, standing in a plumbago guard crucible, using borax as a flux. When the bullion is melted, a clay pipe stem is introduced into the molten metal and chlorine and air are passed through the molten mass. The chlorine converts the silver and base metals into chlorides, part of the base metal chlorides volatilize, and the remainder, with the silver chloride, rise to the surface of the gold and are bailed off by means of a small clay crucible and poured into a mold placed on the furnace top. The passage of the chlorine is continued until a color test of the issuing fumes with a cold pipe stem shows that no chlorides are being formed. A light brown or yellow color is obtained. The bulk of the chlorides is then removed by bailing, and the remainder is removed by absorption with bone ash. The fine gold is stirred, remelted in large tilting furnaces, sampled, and cast.

The chlorides of silver and base metals removed by bailing contain small quantities of gold. To remove the gold the chloride is made up into lots of 300 oz. each, melted in plumbago crucibles with bicarbonate of soda and borax. This operation reduces a portion of the silver chloride, which produces silver, and this, falling to the bottom of the crucible, carries the gold with it. The crucible, with contents, is then removed from the furnace and allowed to cool till the metal at the bottom of the crucible has solidified. The chlorides, being still liquid, are poured off, cast into chloride cakes about 1 in. thick, and are gold-free. The metallic button so obtained is again refined with chlorine.

All pots, ashes, and pipe stems used in the refinery go to the grinding room. They are ground in ball mills to pass through a 60- to 80-mesh screen. Large metallics remain in the ball mill and are removed. All metallics recovered are returned to the refinery for treatment with chlorine. The tailings are treated in lead and cupellation furnaces for further extraction of precious metals, and the residues from this operation are exported.

The chloride cakes produced in the refinery are crushed in a rock crusher to about 1-in. cubes. About 600 lb. of this crushed chloride is placed in a barrel with a capacity of about 60 Imperial gallons, and treated with a hot saturated salt solution. This treatment removes the base-metal chlorides by solution in the brine. When these are removed, the solid-silver chloride is taken out of the barrels, placed in a reducing vat between iron plates, covered with a dilute solution of sulphuric acid, and heated with steam. This operation transfers the chlorine from the silver to the iron and produces sponge metallic silver. This sponge silver is returned to the barrels, and washed with hot dilute sulphuric acid and water to remove soluble iron chloride. The sponge silver is dried, melted, and cast into ingots of about 1,000 oz., or it may be necessary to melt and stir potassium nitrate into it so as to remove impurities. Gold-free silver is thus obtained. All solutions produced in the wet reduction of the silver chloride are passed over scrap iron to precipitate the silver and copper contents. This residue is dried, sampled, and shipped.

BY THE WAY

Photos From the Field

"Been noticin' for some time past in tha *h'Engineerin' an' Minin' Journal*," said Cap'n Dick, "that there 'as been considerable discushon baout this 'ere statue, 'Tha h'Engineer,' that wuz made by Missus 'Arry W'itney, w'ich remin's me that directly I'm goin' to write h'in sumthin' m'sel' an' tell those chaps 'oo's 'oo in tha matter. Not that I be h'afer those there Chiclets—w'otever they be—for I'd rather 'ave a 'alf a poun' o' Peerless h'any day. But I do believe in properly labellin' a thing w'ot it be, no matter 'ow h'it came or w'ere h'it came from. One thing h'always struck me baout tha *Journal*, an' that is that I've seen pictures from mos' h'every portion o' tha globe on tha pages. Pictures o' minin', o' smeltin', an' h'every sort o' h'operation that tha minin' man does; tha 'ouses h'in w'ich 'ee lives, an' w'ot 'ee wears, an' naow an' h'again w'ot 'ee h'eats. But, m'son, never did I see a picture o' tha Cornishman's staff o' life—tha pasty. So, dam-me, I'm sending' h'in one, an' I 'ope t'will show some o' tha chaps w'ot one o' they looks like. H'interestin' thing baout this 'ere picture too—chap daown in Peru sent h'it to me, an', min' you, tha blessed card was marked 'Truro' h'on tha margin. W'ot's think o' that? Lot o' fellows won't naw w're Truro be, but we chaps from back long we naws bloody well. To get back to tha firs' part o' this 'ere tell, baout proper labellin', there's no mistakin' w'ot a pasty be—least w'en one o' we chaps see un. I believe m'sel' I could tell one blindfolded, and w'en I 'ad one set in front o' me I'd 'ardly 'ave to 'ave h'anyone say, ' 'Ere, stuff thyself.' "

TO PLEASE CAP'N DICK

Aiding the Cause

A new use has been discovered in Ontario for peat, of which the province possesses large deposits. An order for a considerable quantity was recently received by the Peat Resources Committee from an Ontario distiller, who will, it is understood, use it to give a Scotch flavor to Ontario whisky.

He Paints With Words

A correspondent of the Geological Survey, who terms himself "one of the many misfortuners of oil frauding," refers in his letter to the company from which he has bought oil stock in these words: "The company is incorupted at $2,000,000."

While the Muse Is With Us

Some of the limericks perpetrated at the A.I.M.E. smoker two weeks ago were fair. One of the fairest was the following:

There was an old buck from the west,
Who said, as he pulled on his vest,
My clothes are spun copper
Which style is most proper
To strengthen a metal depressed.

Here is a case where it would never do to substitute zinc for copper, though Mr. Seguine, whose passionate appeal follows, probably wont agree.

Copper Versus Zinc

Written for *Engineering and Mining Journal*

Dear Editor, the undersigned
Has read enough to raise his dander
In praise of copper. Stay supine
I won't, while you with propaganda
Your journal pages intersperse.
Don't you know ZINC needs succor worse?

To copper's good points I'm awake
And nothing of disparagement 'll
Cause me to think it doesn't make
A shingle highly ornamental.
It's beauty, though, soon waxes less
In air containing H_2S.

Bartholdi's famous Liberty
Acquired exquisite patina
While gazing calmly out to sea
With salty zephyrs battin' her
For many years. But would she wear
So green a robe in Pittsburgh's air?

Now, Eddie, is it your desire
To really boost for conservation?
Then advocate that brass and wire
Be guaranteed their future ration.
From other markets copper keep,
Boost ZINC instead, its twice as cheap.

—WILLIAM SEGUINE, JR.

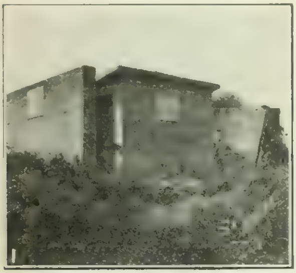
HANDY KNOWLEDGE

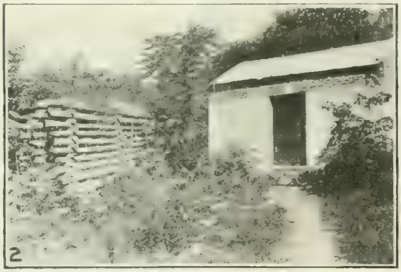
Surface Explosives Magazines

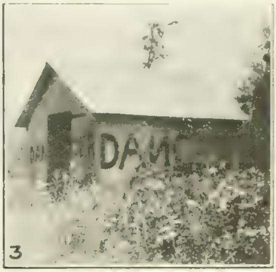
By Robert W. Jones

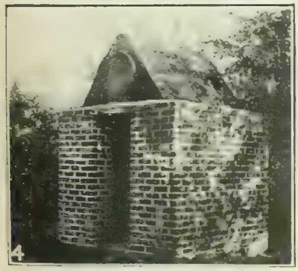
Written for Engineering and Mining Journal

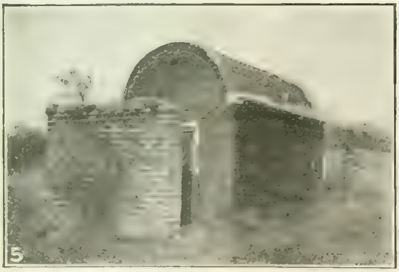
The general legislative requirements for explosives magazines are fire-proofing, bullet-proofing, and ventilation. To these should be added moisture-proofing and protection against theft. For the safety of the adjoining country the construction should be such as to secure adjacent property against the result of an explosion. There are, therefore, legislative regulations in some states as to the proper distance from magazine to the nearest house, railway, and highway. Complete fire-proofing means construction without wood, and this is usually impossible, as the containers are generally made of wood. Metal, concrete, or burned clay products are the ideal construction materials.

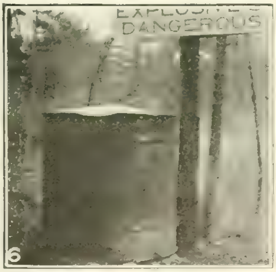












EXPLOSIVES MAGAZINES SHOWING VARIOUS TYPES OF CONSTRUCTION USED IN MINE AND QUARRY WORK

Fig. 1. Quarry magazine, of large capacity, built of solid concrete. Fig. 2. Quarry magazine of large capacity and of heavy concrete and brick construction. Fig. 3. Quarry magazine of large capacity, built of corrugated iron, with double wall and sand fill. Fig. 4. Quarry magazine, of small capacity and built of brick. Fig. 5. Quarry magazine, of small capacity, built of brick and in need of repair. Fig. 6. Quarry magazine, of small capacity, which is so constructed as to be readily available for moving.

In mine and quarry work, in which two magazines are customarily used, one for main storage and a smaller one for daily supply, the choice of construction materials for the smaller is somewhat restricted. The necessity for moving the smaller magazine frequently requires that it shall be of light weight though of proper construction. Figs. 1 and 2 show a type of permanent mine or quarry magazine, both of heavy construction and complying with all requirements for safety. Fig. 3 also illustrates a type of magazine for such work, well constructed of corrugated iron with an inner wall so spaced as to permit a sand-filled compartment all around the magazine, thereby making it bullet-proof though of a light and cheap construction.

A type of small magazine for mine and quarry is illustrated by Fig. 4. It will be noted that the roof is of a somewhat novel construction. In considering brick magazines it is to be remembered that the material in which the bricks have been set may disintegrate, leaving a construction of doubtful value for storing explosives, especially if near working places. Fig. 5 illustrates such a condition. A type of small well-built magazine for mine and quarry use is illustrated in Fig. 6, as a contrast with the more heavily constructed type. It is easily moved, well protected, and of a capacity almost equal to that shown in Fig. 4. In contrast to Fig. 6 is Fig. 7, a magazine for storing small quantities of explosives, which is constructed of wood and covered with tin.

The trouble with some magazines is that little attempt is paid to determining the proper distances between the location and habitations, railways, and highways. Magazines may be of excellent construction, but the legal requirements may so reduce the capacity that they are of little value. My experience is that in building a magazine the owner should not start until all legal requirements are understood, and then if construction is attempted extra safety should not be sought by too heavy construction. A magazine may be perfectly safe and satisfy all legal requirements if of light weight, with a double wall and a sand-filled compartment, and with corrugated iron for walls. The cost of construction will certainly be less than if it is of concrete or brick. Thus constructed, if a home or factory is erected within the legal distance, the magazine may be emptied of sand and easily moved. Such a magazine may be built to carry readily 2,000 lb. of explosives with comparative safety.

In ventilating magazines care must be taken that the method adopted shall not allow the entrance of sparks from field fires. A natural movement of air is all that is necessary, so that approximately the same condition of temperature will be maintained inside the magazine as that which will be found to exist outside the structure. Moisture proofing depends upon the location. Have the ground around the magazine well drained, naturally, if possible. Moisture conditions, with the extreme heat of summer have caused a great loss of explosives.

WOODEN BOX COVERED WITH TIN AND CALLED A "MAGAZINE"

For protection against theft, common sense should be used. I have seen magazines with heavy, expensive locks opened with the greatest ease. Of what use is such a lock when the door frame is in such a condition that it is unnecessary to pick the lock? I have in mind, on the other hand, two magazines that had often been broken into, now apparently locked with common twenty-five-cent locks but actually locked by using a little ingenuity, so that for years no one has succeeded in entering.

Drafting-Room Window Shade

Written for *Engineering and Mining Journal*

Many drafting rooms are improperly designed as to lighting, or they may be so crowded that some tables are forced into bad positions. Frequently a table will be so placed that the draftsman must either sit with his back to the light and work in his own shadow, or face the sun streaming through a window. In the latter position there is usually insufficient light when the shade is drawn.

To cut off the bright sunlight and yet allow sufficient illumination to enter, a shade of tracing cloth serves admirably. This is made by simply removing the regular shade from its roller and substituting for it a piece of tracing cloth of the same dimensions. When not required, this shade can be raised the same as any other window shade.

Rack for Heavy Materials

By W. F. SCHAPHORST

Written for *Engineering and Mining Journal*

A good rack for holding heavy materials, such as pipe, bars, and angles, and even lumber, may be made as follows: Bore holes in as many posts as desired at an angle that will be found to be convenient; insert short pieces of pipe of suitable length in the holes thus made; and fasten the vertical timbers both at the top and bottom. This will give a good serviceable rack. By boring holes from opposite sides and having "shelves" on both sides, it is evident that the rack will be better balanced than where one side only is used.

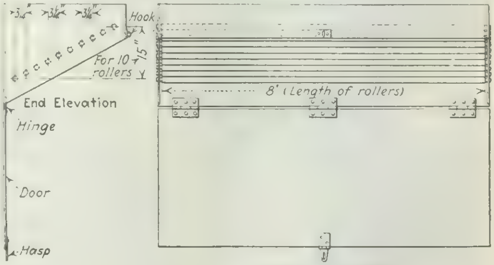
Mounting Large Maps

By ROY H. POSTON

Written for *Engineering and Mining Journal*

The Hartshorn Roller Co., of Newark, N. J., has a roller known as the "new groove tin roller" that will be found useful for mounting maps for hanging in engineering offices. It works on the same principle as the ordinary window-shade roller. It is made in a convenient length of about 8 ft. with a special groove that, together with a small tin strip, forms the method of securing the tracing, map, or drawing to the roller. A wooden strip of convenient size fastened to the lower end of the map with thumbtacks completes the mounting.

The accompanying sketch shows a typical mounting of a group of ten maps in a wooden case that in addition to providing a support for the rollers makes it possible to lock up the maps, if desired. If properly constructed, the case will also prove valuable in excluding water from the fire-fighters' hose should an interior fire occur. The case should be constructed of well-seasoned wood, closely joined together and given two or three coats of good paint, shellac, or varnish.



CASE FOR MOUNTED MAPS

Pressure of Fluid in Drill Hole

Written for *Engineering and Mining Journal*

In rotary drilling the hole is full of mud fluid, and in much cable tool drilling the hole is almost full to the top with water, so that when encountering an oil-bearing sand, the head of fluid exerts so great a pressure that the oil or gas does not come into the hole, but the fluid in the hole actually goes into the sand. Thus, the driller may get no oil showing and decide the sand does not contain oil or gas and drill deeper. The disadvantage of the core drill is that it drills a small-sized hole, which may prove unsuitable for production purposes, but it deserves careful consideration for test work.

THE PETROLEUM INDUSTRY

The Ciervo Anticlinal Bow Oil Field of California

BY WALTER STALDER

Written for Engineering and Mining Journal

IN THE CIERVO ANTICLINE definite oil indications were found in 1916 at a geologic horizon not previously suspected as oil bearing. This discovery led to a subsequent study of the field, and as a result more favorable conclusions than those set forth previously and different interpretations than generally accepted in the past are now possible. The district invites and is being given closer attention, the results of which will be put forth as present development work proceeds.

The prospective field is situated on the west side of the San Joaquin Valley at the foot and along the east flank of the Diablo Range between Tumey Gulch and Cantua Creek, Fresno County, Cal. From the center of the structure the city of Fresno lies forty miles northeast; Mendota, a station on the Southern Pacific R.R., fifteen miles north, and the town of Coalinga twenty-three miles due south.

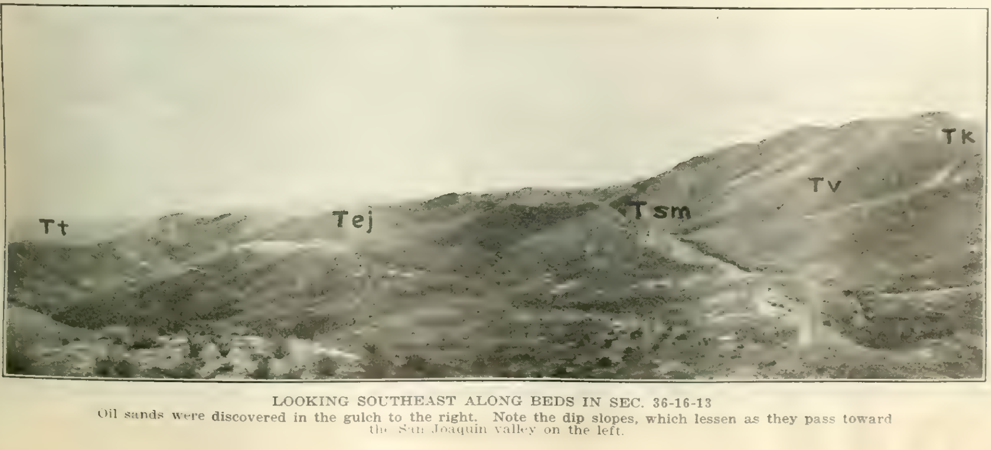
This same district, a large part of which was designated as Monocline Ridge, has been mapped by Robert Anderson and Robert W. Pack, of the U. S. Geological Survey, as a portion of a much more extended survey. Their description of geology and their conclusions, together with a map, were presented in 1915 in Bulletin 603 of that organization.

In prospecting and further studying the district I used this map to excellent advantage. The work of these two writers was much appreciated, particularly when the limited time at their disposal to cover such a wide expanse of territory as that described in the above-mentioned bulletin is considered. To certain parts of their map additions and different interpretations have been made as a natural outcome of prospecting. Outside of the area particularly under consideration, their mapping, where taken, has not been carefully reviewed and has been used in the present paper with a few additions.

The general surface character of the district is partly indicated in the accompanying photographs. It involves the edge of the plain and the first perceptible slopes from the San Joaquin Valley toward the higher outer flanks of the Ciervo hills themselves.

As this paper is preliminary to one which will follow later, and as Anderson and Pack have fully described the formations involved, the reader is referred to the previously mentioned bulletin, if more detailed information is desired. For brevity, reference is made to the legend on the accompanying map where the character of the formations is outlined. These have been taken from the Anderson and Pack map and modified. Attention is drawn to the fact that certain additions have been made to the map and that the formation which the Survey designates as the "Vaqueros" is herein called the "Temblor." This later designation is in conformity with the original name given by F. M. Anderson,[1] modifications by J. P. Smith[2] and the later work of Bruce L. Clark.[3] The name "Temblor" is being gradually accepted among geologists and paleontologists on the Pacific Coast and is used to avoid confusion with the true Vaqueros of the South San Joaquin and the Salinas valleys, which is older than the Temblor.

To harmonize with the mapping of Bulletin 698 of the U. S. Geolgoical Survey, Anderson and Pack state that they have mapped the "Big Blue" with the overlying Santa Margarita and that these beds terminate near



LOOKING SOUTHEAST ALONG BEDS IN SEC. 36-16-13
Oil sands were discovered in the gulch to the right. Note the dip slopes, which lessen as they pass toward the San Joaquin valley on the left.

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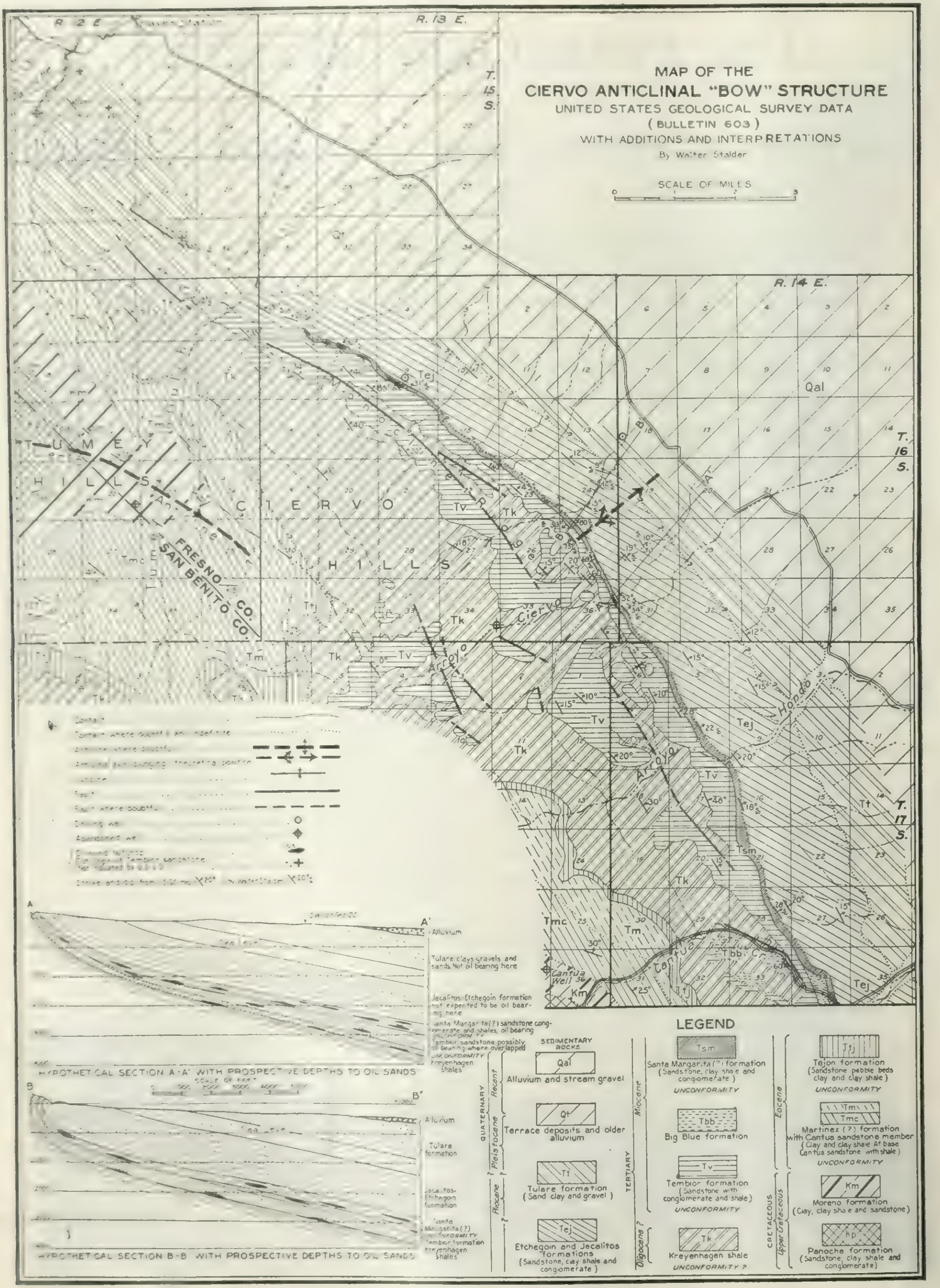
[1] *Proceedings*, California Academy of Science, 3d Series Geology Vol. 2, No. 2, 1905.

[2] *Journal of Geology*, Vol. 18, No. 3; pp. 216-227.

[3] *Journal of Geology*, Vol. 24, p. 596.


MAP OF THE
CIERVO ANTICLINAL "BOW" STRUCTURE
UNITED STATES GEOLOGICAL SURVEY DATA
(BULLETIN 603)
WITH ADDITIONS AND INTERPRETATIONS
By Walter Stalder
SCALE OF MILES
0
3
R. 13 E.
R. 14 E.
T. 15 S.
T. 16 S.
T. 17 S.
TUMEY HILLS
CIERVO HILLS
FRESNO CO.
SAN BENITO CO.
Ciervo
Arroyo
Hondo
Cantua Cr.
Cantua Well
Qal
Qt
Tk
Tv
Tm
Tmc
Tej
Tsm
Tbb
Tt
Ttj
Km
A
A'
B
B'
Contact
Fault
Fault where doubtful
Drilling well
Abandoned well
A
A'
Alluvium
Tulare clays gravels and sands. Not oil bearing here
Jacalitos Etchegoin formation not expected to be oil bearing here
Santa Margarita (?) sandstone conglomerate and shales, oil bearing
UNCONFORMITY
Temblor sandstone possibly oil bearing where overlapped
UNCONFORMITY
Kreyenhagen shales
HYPOTHETICAL SECTION A-A' WITH PROSPECTIVE DEPTHS TO OIL SANDS
SCALE OF FEET
B
B'
Alluvium
Tulare formation
Jacalitos-Etchegoin formation
Santa Margarita (?)
UNCONFORMITY
Temblor formation
Kreyenhagen shales
HYPOTHETICAL SECTION B-B' WITH PROSPECTIVE DEPTHS TO OIL SANDS
LEGEND
SEDIMENTARY ROCKS
QUATERNARY
Recent
Qal
Alluvium and stream gravel
Pleistocene
Qt
Terrace deposits and older alluvium
TERTIARY
Pliocene
Tt
Tulare formation (Sand clay and gravel)
Tej
Etchegoin and Jacalitos formations (Sandstone, clay shale and conglomerate)
Miocene
Tsm
Santa Margarita (?) formation (Sandstone, clay shale and conglomerate)
UNCONFORMITY
Tbb
Big Blue formation
Tv
Temblor formation (Sandstone with conglomerate and shale)
UNCONFORMITY
Oligocene ?
Tk
Kreyenhagen shale
UNCONFORMITY ?
Eocene
Ttj
Tejon formation (Sandstone pebble beds clay and clay shale)
UNCONFORMITY
Tm
Tmc
Martinez (?) formation with Cantua sandstone member (Clay and clay shale. At base Cantua sandstone with shale)
UNCONFORMITY
CRETACEOUS
Upper Cretaceous
Km
Moreno formation (Clay, clay shale and sandstone)
Kp
Panoche formation (Sandstone, clay shale and conglomerate)

Arroyo Ciervo. An examination of the accompanying map indicates that I have traced the same beds which these writers mapped as Santa Margarita still further northwestward to within one mile of Tumey Gulch. They have been found to have the same characteristics at their northern extremity that they have near Arroyo Ciervo where Anderson and Pack terminate them. Evidence at the surface and from the log of the first well drilled to encounter oil in them indicates that they are probably unconformable with the Temblor sandstones. This condition is to be studied further in connection with mapping and other contemplated field developments. It is important, because the beds which Anderson and Pack regard as the Big Blue near Arroyo Ciervo, mapped with the Santa Margarita and believed to be a part of the Vaqueros (so-called), are possibly unconformable with and not related to that formation, as previous evidence might indicate. These beds have a close relation to the oil possibilities of the district.

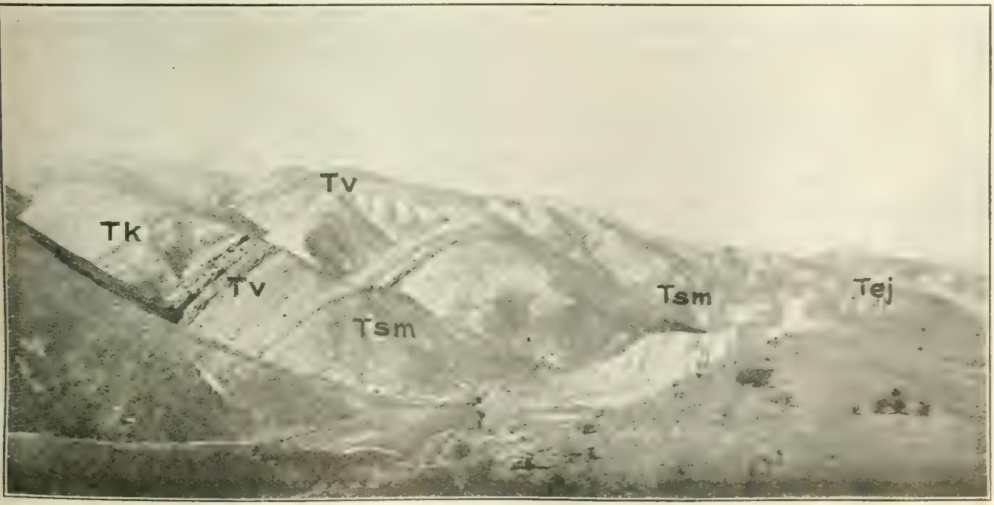
In following the outcrop of beds mapped as the Santa Margarita formation, I recorded the strike of those easterly dipping beds immediately to the north of Cantua Creek as north 20 deg. west. At Arroyo Ciervo their strike is north 30 deg. west. One mile further north the strike varies from north 35 deg. west to north 45 deg. west, and the beds are overturned and have a westerly dip. In Secs. 8 and 9, T. 16 S., R. 13 E., they have a northerly dip and vary in strike from north 65 deg. west to north 80 deg. west. The change in strike of these beds from Cantua Creek northwesterly to Tumey Gulch is therefore between 45 and 60 deg. and indicates a distinct bowing of the later Tertiary formations about what has been designated Monocline Ridge.

Though the beds mapped as Santa Margarita have not been identified to the north between Tumey Gulch and Panoche Creek, search has revealed outcrops of Temblor standstones as far north as the later stream. The strike of these outcrops is north 30 deg. west. As this strike of the beds is at great variance with those strikes noted to the southwest of Tumey Gulch, it indicates the termination of the bowing at Tumey Gulch.

OIL SAND OUTCROP, SEC. 36-16-13

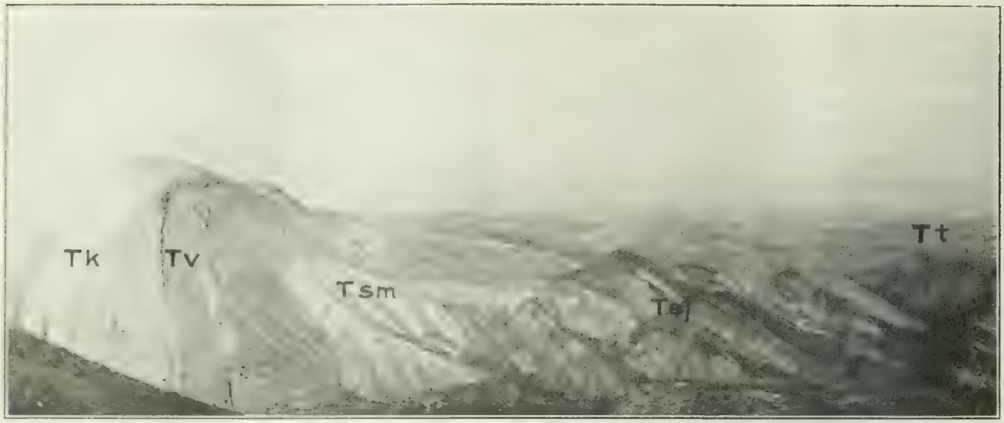
If on the map one end of a scale be placed at the south end of the bow—that is, at the contact of the Temblor sandstone and Santa Margarita formations immediately north and east of Cantua Creek—and another part at the nothern limit of the bow at the corresponding Temblor sandstone contact near Tumey Gulch, it will be observed that the distance between these two points is approximately fourteen and one-half miles. If the outer horizon of the Temblor sandstone be now followed on the map, it will be further observed that a large curve or bow is formed and that the maximum displacement of this bow from a straight line between the two ends of the scale is nearly two miles at its crest just north of Arroyo Ciervo. The significance of this bowing will appear later.

The Temblor sandstones and Kreyenhagen shales are involved in some steep tilting and overturning, first immediately to the south of Arroyo Ciervo and again one-half mile northwest of that depression and continuing northwesterly first with steepening easterly dips and then with marked westerly dips for a distance of one and one-half miles. In these westerly dips the beds mapped as Santa Margarita are also involved. This overturning, as indicated in one of the accompanying photographs, shows that though in a large way



A VIEW NORTHWESTERLY FROM SEC. 25-16-13 AT THE CREST OF THE "BOW"

The strata in the face of Monocline Ridge on the left are overturned and dip to the southwest instead of the northeast, as they should to fulfil the definition of a monocline. Because of this overturning Monocline Ridge is technically not a monocline along its entire course.



NORTHWEST OF THE OVERTURNED AREA MONOCLINE RIDGE AGAIN ASSUMES MONOCLINAL FORM
Note the [illegible] of the beds to the northeast in the direction of the plains

Monocline Ridge can be considered of monoclinal nature, technically it does not really fulfill that definition, as the beds do not dip in one direction throughout its extent.

It is important to note that the greatest disturbance of the strata along their course is at and near the crest of the bow, where such irregularities would naturally be expected. In the light of the foregoing conditions and from a technical standpoint bowing appears to have destroyed what originally was a monocline. It is therefore referred to as the Ciervo Anticlinal Bow. Pack and Anderson have mentioned a slight outward bending of the strike and bowing of the hills north of Cantua Creek, but state that the change of strike is too slight to be treated as a fold or to have any effect of economic importance (Bulletin 603, p. 162). With these conclusions I believe my findings afford reason for a difference of opinion.

In addition to bowing about Monocline Ridge, the younger formations from the basal Santa Margarita to the upper part of the Tulare formation flatten quite rapidly as they pass outward toward the valley, and drilling records to date indicate the same for the Temblor formation.

It was the expectation of the Government investigators that any oil sands to be found should be in the Temblor sandstones overlying the Kreyenhagen shale, in a position analogous to that of the oil sands in the Coalinga field.[4] This conclusion is in conformity with the theory of Ralph Arnold and Robert Anderson[5] for the origin of oil in the Coalinga field, where they state that the oil comes from the shales of the Tejon (Eocene) or Kreyenhagen of Robert Anderson and Robert Pack. Previous investigators have not noted any oil-stained sands at this horizon in the present district, and my searches at that horizon were just as discouraging.

After examining the Temblor sandstones, younger formations away from the contact of the Kreyenhagen shales were also given attention. During this search many exposed sandstones were examined and tested with chloroform. By this method of procedure some discolored sand, exposed near the base of the Santa Margarita formation north of Arroyo Ciervo, as shown on the map, was found to contain asphalt residues, and the first oil sand outcrop of the vicinity was recognized. This sand exposure is also indicated on one of the accompanying photographs. It has been dug into and is now revealed as a black outcrop. It smells of asphalt and gives a decided test for that material. This oil-stained bed, like the beds of the Midway and other districts of California, is not continuous in outcrop. When the strata associated with the oil sands were followed at intervals where exposed in the field, oil residues, in sands, were again observed outcropping in Secs. 6, 8 and 9; T. 16 S.; R. 13 E. These later beds are light chocolate brown in color and not as dark in exposure as those immediately to the north of Arroyo Ciervo.

It is also a significant fact that the oil sands are closely associated with the "Bow" structure. The first test well drilled to encounter the petroliferous sands in Sec. 9-16-13 was put down only 1,400 ft. from the outcrop, and at this location found tar in these beds and also a greater thickness and greater number of tar sands than there are of oil-stained sands on the surface. At the outcrop the Santa Margarita formation which contains the oil-stained sands dips from 31 to 35 deg. northeast, whereas the adjacent underlying Temblor sandstone was measured with a dip of 69 deg. northeast. This difference in dip and increase in thickness and number of sands above the Temblor as indicated in the well log and as previously mentioned suggests an unconformable relationship between the oil sands and the underlying Temblor formation. Not one sign of oil was noted in the well at this location in passing through the Temblor sandstones.

The discovery of outcropping oil sands, more particular associated with the "Bow," naturally emphasizes the possible commercial importance of that structure and awakens interest in drilling tests on and about it. The occurrence of these sands at a higher geologic horizon than previously expected also requires some explanation, more particularly because these oil-impregnated members are separated from the supposed source of oil by the Temblor sandstones.

As the oil sands are not found where expected according to the theory followed by the Geological Survey[6] it seems possible that some different reason may be offered in explanation of their present occurrence. In this relation F. M. Anderson[7] early advanced some conclusions for the Coalinga oil field that appeal to me as being of considerable importance, both for their scientific interest and for practical application, with slight modification, to the present district and to certain other San Joaquin Valley oil fields, both prospective and proved. He pointed out that although certain oil in the Mount Diablo Range undoubtedly originated from the Eocene (Kreyenhagen) shales, it was illogical and unnecessary to conclude that all of the oil found in overlying later Tertiary rocks had its source in these shales, as suggested for the Coalinga district by Ralph Arnold and Robert Anderson.[8] He expressed the view that beds which are sandy near the old shore lines of the interior depression, or Temblor basin, would naturally become finer and more certainly contain diatoms and other organisms as off-shore deposits in deeper waters. The result would be that sandy outcrops would be represented largely by organic shales further out under the depression. He reasoned that the oil has not come from older underlying (Eocene) shales, but that its origin is more logically from beds of organic shales contemporaneous with the coarse near-shore deposits in which the oil is at present indicated. In practice he drew attention to the Kern River oil fields, where all of the conditions apparently support his theory that oil has migrated laterally from off-shore organic shales rather than coming through impervious strata from any underlying older organic shales, because such shales are absent in the Kern River district.

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[4] U. S. Geological Survey Bulletin 603, p. 163.

[5] U. S. Geological Survey Bulletin 357, p. 73

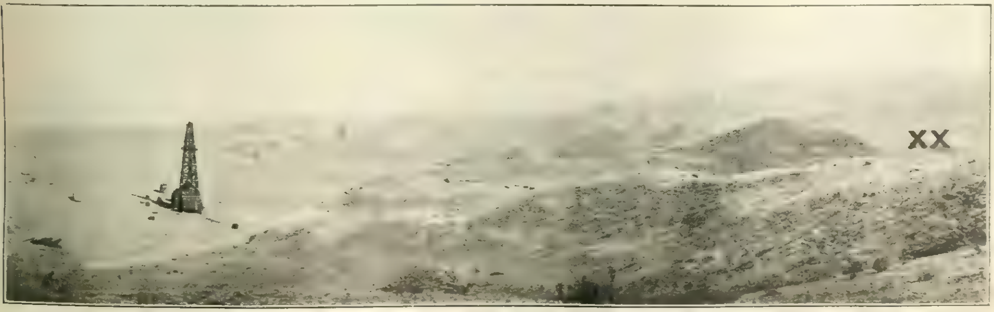
[6] Bulletin 603, p. 87 and p. 163.

Later evidence supporting these conclusions appears in the fact that the horizon of the Kreyenhagen shales when followed southward from Coalinga loses its highly organic nature and becomes more sandy,[9] and the Santa Margarita formation, which is sandy and gravelly near Coalinga, becomes organic in nature south of that town,[10] being sufficiently so to be a source of oil in the southwestern San Joaquin Valley oil fields.[11] As along their outcrops about the San Joaquin Valley these formations change from clastic organic sediments, the conclusion that similar horizons are at least in part organic beneath the trough of the Temblor basin has an excellent foundation.

In regard to the Ciervo Bow district, it seems strange that if the oil residues found in the Santa Margarita sands had their origin in the Kreyenhagen shales some oil-stained residues are not found in the porous Temblor sandstones which occur between those shales and the Santa Margarita beds. According to the theory of the Survey, this horizon is the most logical place for such oil sands. According to the theory of F. M. Anderson, oil would not necessarily be expected in the Temblor sandstones and could logically be looked for in the Santa Margarita formation.

In the present area the opinion of F. M. Anderson, as previously stated, appears to me to be of more practical value than that of the Survey for prospecting and for explaining the occurrence, in outcrop, of the oil-stained sands. By following the theory of the former any prospector would naturally search the Santa Margarita horizon as well as the Temblor for oil indications. In following the theory of the Survey, the tendency is to confine prospecting to the Temblor sandstones, as was actually done in the Ciervo Anticlinal Bow district by the Government geologists and later by myself, although I afterward branched out on a different basis of search that was within the scope of F. M. Anderson's conclusions. According to these the outcropping Santa Margarita sandstones would be represented beneath the Temblor basin by organic shales and the oil from those shales would migrate laterally to the outcropping porous members. With this principle, and for reasons previously mentioned, I am in accord, but I believe it also possible that a certain older organic shale formation (Monterey), that is usually unconformably and immediately beneath the Santa Margarita formation and is younger than the Kreyenhagen shales, may exist out under the Temblor basin. If present, this formation might give rise to oil which could collect in the contiguous Santa Margarita sand members and pass laterally to the outcrops along Monocline Ridge. The drill is apparently the only means of determining this. In any event the present findings give support to the theories of lateral migration as well as of a higher source for the oil than the Kreyenhagen shales.

Whether the present structure is sufficiently bowed to cause the commercial accumulation of petroleum about its arc will be determined in a practical way by the tests under consideration or now in progress. The outcropping oil sands encourage the belief that there is oil somewhere about the structure. Developments will be watched with interest both for the value of the findings and conclusions in relation to the present structure and the broader application of the same principles to other districts.



THE FIRST WELL TO TEST THE SANDS WHICH OUTCROP AT XX ON THE PHOTOGRAPH ENCOUNTERED THESE SANDS AND OTHERS UNDERLYING THEM BETWEEN THE DEPTHS of 900 AND 1,000 FT.

At this location they contain tar. Deeper wells further from the outcrop should yield a more liquid product.

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[7] *Proceedings*, California Academy of Science, 4th Series, Vol. 3, pp. 116 and 117, 1911.

[8] U. S. Geological Survey Bulletin 357, p. 731.

[9] U. S. Geological Survey Bulletin 406, p. 39.

[10] U. S. Geological Survey Bulletin 406, p. 63.

[11] R. W. Pack, U. S. Geological Survey, Professional Paper 116, p. 43.

Technical Papers

Metallurgy of Tungsten—Bulletin 182 of the U. S. Bureau of Mines, Washington, D. C., seventy-nine pages, is entitled "Treatment of the Tungsten Ores of Boulder County, Col." This paper deals largely with the local ore-dressing methods, including the methods of assaying ores, concentrates, ferro-tungsten, and tungsten metal powder. Data of economic interest on producers, costs, and markets are included. Ferberite is the chief tungsten-bearing mineral of this district. It is concentrated to 60 per cent tungstic oxide or more by the use of jigs and tables treating carefully sized material. The book may be obtained for a limited time free of charge from the Bureau, or for 25c. from the Superintendent of Documents, Washington, D. C.

Ontario Mining—A general index to all the reports published by the Ontario Bureau of Mines from 1891 to 1916 has been issued by the Bureau as an 871-page bound book, obtainable on request from the Ontario Department of Mines, Toronto, Canada.

Alaskan Mineral Resources—The U. S. Geological Survey, Washington, D. C., has recently issued Bulletin 722-B, forty pages, "Water-Power Investigations in Southeastern Alaska"; Bulletin 722-C, twenty-three pages, "Ore Deposits of the Salmon River District, Portland Canal Region, Alaska"; Bulletin 722-D, seven pages, "Geology of the Vicinity of Tuxedni Bay, Cook Inlet, Alaska"; and Bulletin 722-E, twelve pages, "Gold Lodes in the Upper Kuskokwim Region, Alaska." Any of these may be obtained free from the Survey.

Petroleum—Vol. 65 of the *Transactions* of the American Institute of Mining and Metallurgical Engineers (29 W. 39 St., New York) has just been issued. It contains papers and discussions on petroleum and gas that were presented at the Chicago meeting, September, 1919, the Lake Superior and St. Louis meetings, August and September, 1920, the New York meetings of 1920 and 1921, and the Wilkes-Barre meeting, September, 1921. The book contains 592 pages and sells, to non-members, for $5 in paper covers, or $6.50 bound in the standard binding.

Metallurgical Handbook—The "Metallurgical Bulletin" recently published by the General Engineering Co., Salt Lake City, Utah, is much more valuable than the ordinary advertising pamphlet. It contains flow sheets of representative mills; metal statistics; costs of ore treatment, power, and plant erection; data on electrical power generators, transmission, and motors; milling data; machinery capacities; timber strengths; and descriptive tables of the principal economic minerals. This eighty-page book is well worth writing for, and will be found valuable for reference.

Waste Zinc Recovery—The zinc used to precipitate the gold in the cyanide process is dissolved in sulphuric acid or acid sodium sulphate and allowed to go to waste to the extent of about 5,000,000 lb. per year in the mines of the Witwatersrand. The major portion of this can be reclaimed by the Kominsky process, described in a two-page article in the *South African Journal of Industries* for December. (Department of Industries, Market St., Pretoria; price, 6d.) The process is in use for the manufacture of paint pigments at Germiston.

Fatigue of Metals—"An Investigation of the Fatigue of Metals," 185 pages, has been published as Bulletin No. 124 by the Illinois Engineering Experiment Station, Urbana, Ill. A bibliography giving 132 references is appended. Obtainable for 95c.

New Power Maps of the Eastern States—A new map of Vermont and New Hampshire on a scale of 1:500,000 showing the location of the power stations and transmission lines used in public service and the names of the public-utility companies has just been issued by the U. S. Geological Survey, Washington, D. C., and may be obtained for 50c. Similar maps are also now available for Maryland, District of Columbia, Delaware, New York, Pennsylvania, New Jersey, Massachusetts, Rhode Island and Connecticut.

Caving Methods—"Caving Systems of Mining," by J. Parke Channing, occupies four pages in the January number of *Mining and Metallurgy* (29 West 39 St., New York, N. Y.; price $1). The article describes the methods in simple terms, with their advantages and disadvantages.

Institute Administration—G. C. Mackenzie, secretary of the Canadian Institute of Mining and Metallurgy, has something to say about what a mining institute, and more particularly the Canadian Institute, should do and how it should do it, in a twelve-page paper in the January issue of the *Bulletin* of the C.I.M.M. (Drummond Building, Montreal, P. Q.).

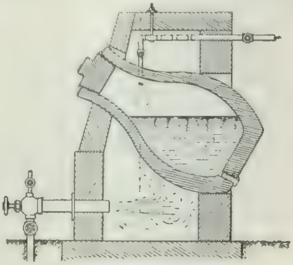
Placer Mining Methods—A general summary of the methods used in handling gravel in placer mining operations is outlined in *Reports of Investigations*, No. 2,315, by U. S. Bureau of Mines. It includes material which has already appeared in the technical press, together with a few general notes on the subject.

High Pressures—More of the interesting information about pressures up to 500,000 lb. per sq.in. mention of which was recently made in these columns, is given in *Compressed Air Magazine* for January. (11 Broadway, New York; price, 35c.)

Electrical Machinery — The Allgemeine Elektricitats-Gesellschaft, Berlin, Germany, has issued a 240-page illustrated book, with paper covers, describing the use of electrical apparatus of all kinds in iron and steel works. The book, which is printed in German, may presumably be obtained upon application.

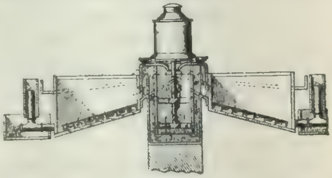
Recent Patents

Reducing Easily Volatilized Metals—No. 1,403,349. H. M. Shimer, Philadelphia. Easily volatilized metallic compounds are mixed with a reducer and necessary flux, heated to the molten condition, and the metal is tapped separately from the slag, in the apparatus shown in the illustration. Air is kept away from the surface of the charge by the admission of a suitable gas.

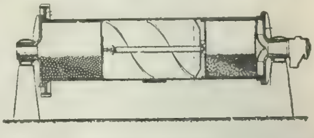


Feldspar — No. 1,402,831. C. M. Brown, Toronto, Canada. Potash and aluminum are recovered from feldspar by subjecting the finely ground feldspar to the action of hot sulphurous gases and air, thus oxidizing the potassium and aluminum compounds to sulphates, leaching the product in water, and evaporating to recover the desired salts.

Flotation Machine—No. 1,402,099. J. T. Shimmin and C. E. Bushnell, Butte, Mont. A mechanically agitated flotation machine of the type shown in the illustration.



Tube Mill—No. 1,399,982. R. C. Newhouse, Milwaukee, assignor to Allis-Chalmers Manufacturing Co., Milwaukee. Increasing the capacity of a tube mill by confining the grinding charge to those portions of the mill near the bearings, using the central portion of the mill only for the transportation of the partially ground material from one section to the next.



Jig—No. 1,402,303. E. M. Daugherty, Webb City, Mo., assignor of one-half to A. J. Poynor, Joplin, Mo. A jig, comprising a tank, screen, baffles, and launders of improved design.

ECHOES FROM THE FRATERNITY

Canadian Institute of Mining and Metallurgy Meets at Ottawa

Technical Papers Generally Reached High Standard of Merit, and a Large Attendance Was Present—Many Outside Attractions Also Provided in Canada's Capital City

By Edward H. Robie

PROFITABLE AND EXPANDING operations by the gold producers and a satisfactory year for the silver-mining industry helped materially to support the general feeling of optimism which pervaded the twenty-fourth annual meeting of the Canadian Institute of Mining and Metallurgy, held at Ottawa on March 1 to 4 inclusive. Markedly increased amounts of gold, lead and zinc were produced in Canada during 1921, as compared with 1920, silver being approximately the same. Copper and nickel and some of the non-metallic minerals were dull, but it was generally agreed that conditions were getting better in practically all fields. Many interesting papers were read and discussed, those of chief technical interest being descriptions of mining and milling at the Hollinger and McIntyre gold mines, and an exposition, chiefly by motion pictures, of what goes on in a ball mill.

For possibly the first time in the history of the Canadian Institute, the convivial features of the meeting were somewhat in eclipse. Ontario laws seem to be more effective, if slightly less stringent, than those in New York, and as a result the smoker and banquet had little resemblance to the gatherings of bygone days. For the first time ladies were invited to the banquet, and the consensus of opinion seemed to be, as Captain Ross said, that hereafter their presence would always be welcome at all meetings held south of the Ottawa River. Though the social features of the program were disadvantageously affected in the minds of some, the technical sessions profited correspondingly, and on Friday, with the convention two days old, the morning session was called to order at 9:40, with a good attendance. This is believed to be a record.

Unfortunately, we arrived in Ottawa two or three hours late for the opening session. Instead our time was occupied in listening to discussions on the conventional Pullman smoking compartment topic—to wit, the evils and advantages of prohibition and the bootlegging industry, with sidelights and personal experiences as to the possibility of bringing liquid refreshment across the border, and observations on the astuteness of the customs officials. The general opinion seemed to be that some are and some are not; you pay your $4.30 per and take your chances.

On Wednesday morning, we understand however, the usual reports on mineral statistics for 1921 were made, and C. V. Corless, the retiring president, delivered the annual president's address. Canada's chief mining industries in 1921 were, in the order of value of product, coal, gold, silver, copper, nickel, natural gas, asbestos, lead, zinc, gypsum and salt. The nickel and asbestos industries were particularly depressed during the year. The aggregate value of economic minerals produced reached a total of $172,327,580 (Canadian funds), compared with $237,422,857 in 1920.

In his presidential address, Mr. Corless took for his topic, "The Mining Industry: Its Future Place in the Development of Canada." He showed the importance of mining to modern scientific civilization and declared it to be the basic industry of progress, as agriculture is of subsistence. He gave fundamental reasons why "the demand for minerals per unit of population will not diminish as civilization progresses, but will rather increase, probably beyond what we now conceive, even as this demand during the past century has surpassed the utmost dreams of a century ago." Mr. Corless contended that mining in Canada was only in its infancy. He dwelt on "the importance of Canada's enormous pre-Cambrian area, nearly surrounding Hudson Bay, occupying more than half of the entire surface of our country, the greatest single exposure (greater, indeed, than all others in the world added together), of our mother earth's basement, wherein, as we are recently finding, her richest treasures are stored for future use." This area has scarcely been scratched. That small portion of it which projects into the United States in the vicinity of Lake Superior is one of the richest mining districts in the world.

Canada's coal reserves also are enormous, the latest estimate being 1,234,000,000,000 tons. This is nearly 60 per cent greater than the estimated reserves of Europe, nearly equal to those of Asia, and one-sixth of those of the entire world. In concluding, Mr. Corless invited the attention of the Dominion and Provincial governments to the future relative importance of mining and agriculture, and asked whether mining was receiving its relatively fair share of government assistance. His address was widely and favorably commented upon and was considered the outstanding non-technical paper of the meeting.

In the afternoon, Dr. Adam Shortt, of Ottawa, presented a paper on "The Economic Relations of Canadian Gold Production." Dr. Shortt is considered the leading authority in Canada on subjects of this nature, and his extemporaneous discussion of the matter as well as his written paper attracted much interest. Charles Camsell, Deputy Minister of Mines, spoke on "The Relationships of the Mining Industry to the Canadian Railway Problem." He pointed out the importance of mining to the railways, as evidenced by the fact that in 1919 coal and coke contributed about 24 per cent of the total railway tonnage; other mining industries, 20 per cent; agriculture, 17 per cent; forests, 18 per cent; and the animal industry, 4.5 per cent. Mr. Camsell's paper was discussed by J. A. Dresser, C. Price-Green, and G. C. Mackenzie.

THE HOLLINGER MINE AND MILL

One of the most important technical papers presented at the meeting was that prepared by the staff of the Hollinger Consolidated Gold Mines, Ltd., on the mining and milling methods in use at that plant.

Extensive diamond drilling is done by contract at prices ranging from $1.10 to 80c. per foot, depending upon the nature of the rock and the percentage of core recovered. During 1921 the average paid was $1.04 per foot and core recovery 88 per cent. Carbon consumption is 0.21 carats per 100 ft. All core is examined every day, and the particulars are plotted with the assay results. Sludge samples are saved and used for check.

As the ore is in more or less continuous lenses, standing almost vertical and with usually good walls and roof, flat back shrinkage stoping was adopted. Incline raises at 45 deg. are carried through to the level above, for use as pipeways, manways, and for ventilation. Breasts are carried from 40 to 50 ft. apart and are usually 7 ft. high. In a vein 20 ft. wide, two rows of holes would be driven 8 ft. deep and 4 ft. apart. About one blockholer is employed for each four machines. Average production in the stope is 27 tons per machine shift; average holes drilled, 9.8 per shift; and powder used, 1.3 lb. per ton. Machine men do their own scaling. A system of sand filling is being devised.

All levels below 425 ft. are equipped with trolley locomotives, and the rock is hauled direct to the shaft. Side-tipping cars of 20- and 26-cu.ft. capacity are used. All crosscuts have 35-lb. rails, with ties at 2-ft. centers. Drifts have 20-lb. rails. Locomotives are 18-in. gage, two-motor type, with 1,500-lb.

draw bar pull and a speed of six miles an hour. They can haul trains of 50 cars to the dump, but the average number is 25. On the levels below the shaft the gage is being increased to [illegible], with three-ton cars, which will be dumped on tipples. From the loading chute, a crew of three men draw the cars as a shift's work. From the stope chutes they average 32 tons per man shift.

ELECTRIC ASSAY FURNACES USED

In stopes, 80 per cent of the breasts are sampled. Samples average 4 in. wide and yield 1 lb. per foot. Samplers take ten 4-ft. samples in crosscuts per shift, but fewer in stopes. About 300 samples are turned in daily. Seven electric furnaces are now used for general assaying. They are adaptations of the heat-treating furnaces used in the automobile industry, and are proving entirely satisfactory.

Blasting is practically all done on the 11 p.m. to 7 a.m. shift. Blasters go in pairs and each team blasts an average of 80 holes in stopes and development faces. In stopes, 1.3 lb. of 40 per cent Forcite is used per ton; in drifts, 2.26 lb. per ton. The equivalent of 16.46 lb. of 50 per cent Forcite is used per foot of crosscut.

Hexagon hollow steel, 1¼ in., is used almost exclusively, although some 1⅜-in. octagon is still in service for the small amount of dry stoper work now done. All steel is X-bit, with straight 14-deg. taper and cutting edges 90 per cent. The run is 14 in., with ⅜-in. change. In sharpening 1¼-in. steel of 14-deg. pitch, round, wet dollies are used in pneumatic sharpening machines. Steel are heated by high-pressure burners which consume 19 U. S. gal. of kerosene per shift. An average of 60 steel are sharpened per gallon of oil consumed. A steel sharpener and helper will dress and temper an average of four hundred steel per shift of eight hours. During 1921 one steel was sharpened for each ton of rock broken.

All hoisting is done in one shaft, with a double cylindrical drum electric hoist. Drums are 10 ft. in diameter. The hoisting speed is 1,200 ft. per min. with 500 hp. slip-ring motor, using rheostatic control. Two five-ton Kimberley skips, operating in balance, hoist a maximum of 5,200 tons of ore per day. The cable used is 1⅜ in. diameter, 6-strand, 19 wire, Lang's lay, plow steel. The last one installed ran 529 days and hoisted 559,000 tons. The hoist is equipped with a Johnson recorder, which is a most important aid in localizing trouble. A feature of the hoisting signal system was illustrated. The pointer is geared, as usual, to the hoist shaft, and contact can be made only in the bell circuit when the cage is at one of the levels—an important safeguard.

Coarse crushing is done with three No. 7½ gyratories, four No. 5 gyratories and one set of 40 x 20-in. rolls. Full details of this equipment and its operation were given. The ore is reduced through ⅜-in. mesh screens in a ball mill and 200 stamps, and finished to 70 per cent through a 200-mesh screen in twenty-two tube mills. The ball mill is 7 x 6 ft. inside the shell, runs at 25 r.p.m. and takes 145 hp. The feed contains 20 per cent moisture. The ball load is kept at the center line of the mill and weighs between eleven and twelve tons. Four 6-in. chrome-steel balls are fed per shift.

The description of the cyanidation equipment was complete and readers are referred to the original paper for details. A recent addition was a 14-ft. diam. by 16-ft. long drum filter. Four months of operation has demonstrated that a net saving of 7c. per ton may be made by filtering the decantation plant tailing. The saving in cyanide will pay for the operation of the filter. It is understood that several more filters have been ordered.

Milling costs per ton were given as follows:

Coarse crushing	$0.10
Fine grinding: Stamps and tubes....	.41
Fine grinding: Ball mill and tubes...	.26
Agitation	.03
Concentration and re-treatment......	.05
Decantation	.03
Filtration: Leaf filter............	.12
Filtration: Drum filter...........	.05
Filtration: (Estimated for 3,000-ton plant)	
Clarification, Precipitation, and Refining, per ton of solution precipitated.	.04

The above costs include all labor with the exception of that of the mill foremen. Filtration costs include repulping of tailings and pumping to tailing launder.

A reel of motion pictures was also thrown on the screen to illustrate the Hollinger operations.

MCINTYRE ALSO DESCRIBED

In addition to the complete description of the Hollinger plant, only a brief excerpt of which is given above, the mining method and equipment at the McIntyre property was described in detail in a paper presented by Mr. Robinson, of the McIntyre staff. The mine is adjacent to the Hollinger and the mining method differs only in details. André Dorfman, metallurgist of the McIntyre company, explained the trouble which has been caused by carbonaceous (graphitic) ore and the method which has been devised to circumvent it. This graphitic matter caused immediate reprecipitation of the gold dissolved in cyanide solution, and unless a solution could be found, threatened to make large bodies of McIntyre ore unsuitable for treatment, as has been the case in one or two other places in the world. Chemical reagents were tried with no good effect. Vacuum treatment was used, in an effort to remove occluded gases, to no avail. Heating the ore, short of a complete roast, was unsuccessful in preventing precipitation. Then flotation was tried, in an effort to remove the graphitic matter in a flotation concentrate. This was only partially successful, for the immediate result desired, but the significant fact noted was that the flotation residue, even though it contained graphitic matter, was amenable to cyanide treatment without reprecipitation. This led to the discovery that the addition of a small amount of flotation oil would virtually inhibit the deleterious action.

In a mill test the ore was crushed and ground in water and a mixture of crude, fuel, and gas oil added directly to the ball- and tube-mill scoops. The test was somewhat rough, but $12.60 was dissolved out of $13.60 ore by the usual method of cyanide treatment, thus obviating practically all of the troubles formerly encountered. Further work to determine the details of treatment is now being done, and a 250-ton mill unit, adopted to the process, will be completed in a few months. Mr. Dorfman, in the discussion, suggested the advisability of co-operation with the universities on problems of a like nature.

MOVING PICTURES SHOW BALL-MILL OPERATION

To most of the Institute members present, the motion pictures showing the action of balls in a ball mill was the most eye-opening feature of the meeting. For two or three years, Prof. H. E. T. Haultain, of the University of Toronto, assisted by selected students, has been studying the action of a ball mill. Recently the ultra-speed moving picture camera was tried in the work, and some remarkable effects were obtained. A small glass model of a mill was constructed, balls of a special composition were devised, and the mill was rotated at varying speeds before the camera. The result was a slow-motion picture of a type with which many are familiar, which showed in a clear manner the slippage, surging, manner of fall and other peculiarities of balls in a mill. We hope to discuss Prof Haultain's most interesting work editorially in a later issue.

Many other papers on a variety of subjects were scheduled. These included "Gold Dredging Possibilities in the Barkerville Area, Cariboo District, B. C.," by W. A. Johnson; "Institute Policy," by G. C. Mackenzie; "Recovery of Precious Metals From Sudbury Nickel Ores," by R. L. Peek; "Ontario Gold Deposits; Their Character, Distribution and Productiveness," by P. E. Hopkins; "Drop Shaft Sinking," by A. A. MacKay; "Prospecting Conditions in Northern Manitoba," by Dr. R. C. Wallace; "Feldspar in the Ottawa District," by N. B. Davis; and "The Possibility of the use of Seaplanes in Preliminary Mapping of Pre-Cambrian Area," by E. L. Bruce. In the discussion of the last-mentioned paper, the author showed that an airplane survey was often not as expensive as when surveying was made by more conventional methods and gave a brief report of the cost of the work already done.

Ottawa proved a suitable place in which to hold the meeting from many points of view. The new parliament building, on which about $12,000,000 has so far been spent, is a work of art, and almost entirely a product of Canadian industry, with the exception of a small amount of Vermont marble. The Royal Mint interested many, as did the other government departments, all of which were thrown open to the visitors. The Victoria Museum, at which the meetings were held, contained much of interest. It was unfortunate that the lecture room possesses such poor acoustic properties, for some of the speaking was virtually unintelligible.

Two excursions to plants outside of Ottawa attracted many of the visitors, especially the one to the refinery of the British America Nickel Co. at Deschenes, Que., about twenty minutes' ride by electric car from the city. The refinery is no longer in operation, but it is hoped to resume activities there when the demand for nickel improves. The Hybinette electrolytic process is used, in which the platinum-group metals are recovered. The plant is an extensive one, costing over $3,000,000 and is being heated and maintained through the winter.

On Saturday a small proportion of the members took a special train to the Kingdon Mining, Smelting & Manufacturing Co.'s plant at Galetta, Ont. This is a galena mine, the ore occurring with calcite in a fault plane. Very little zinc is present. The mine has been developed by a three-compartment shaft to a depth of over 400 feet. The mill consists of Mitchell screens, rolls, James jigs and tables, a Hardinge mill, Richards classifiers, and a Callow cone. The smelter consists essentially of a Newnam ore hearth, refining being done by poling in a kettle. Over 3,000,000 lb. of lead was produced from this property during 1921, and sold in Canada. The plant has recently been enlarged. The visitors returned to Ottawa late in the afternoon, enjoying lunch as the guests of the Kingdon management.

The paper mills of the E. B. Eddy Co., Ltd., and J. R. Booth, Ltd., were also thrown open to the visitors.

The smoker and banquet were both held at the beautiful Chateau Laurier, and were generally attended by the members present. The banquet was a most successful one, despite or because of prohibition regulations, as one cares to look at it. The after-dinner speeches were particularly appreciated; everyone told a story, and no one spoke for more than five minutes.

A peculiarly appropriate souvenir was distributed by the Mond Nickel Co. It consisted of the first mintage of the new Canadian pure nickel five-cent piece, of a size similar to the United States variety. One coin in a velvet-lined box was placed at each place. The opportunity was also taken to distribute samples of feldspar from the deposits at Buckingham, Que.

An attractive program of entertainment was also offered the ladies, twenty or thirty of whom were in attendance. This included afternoon teas, luncheons, sleigh rides and bridge parties. Many elected to see the numerous motion pictures which were shown at the Victoria Museum, and some took the longer excursions out of town.

San Francisco Section, A.I.M.E. Considers Proposed Mining Law

William E. Colby, speaking before the San Francisco Section of the A.I.M.E. on Feb. 14, stated that a mistake was made when the proposed mining law was drawn up by mining engineers. He made clear the importance of assistance from lawyers in the drafting of a code which would not only incorporate fundamental ideas but would also be free from legal objections. Mr. Colby then briefly considered the proposed revision by taking up its various provisions, and his remarks are abstracted under each as follows:

Section 5 A—Conformity of location to legal subdivisions. Mineral deposits do not lend themselves to location by legal subdivisions. B—Discovery not necessary. Discovery is a time-honored principle of the mining laws of the world. Courts have held that if a man is in possession of a claim and working he has the right of possession. This provision would be unnecessary if there existed a codification of existing law as it has been interpreted by the courts. D—Location on land of non-mineral character. This provision assumes that the land is going to be classified, and there exists, in the light of experience, a reasonable doubt as to the accuracy of land classification. Changing classification of land will lead to confusion. E—One discovery supporting four claims aggregating 160 acres. This is all right. F—Applies solely to Alaska. G—Final entry limited to seven years. I don't know whether this provision is a good one or not. Passing this provision may create more business for the lawyer. H—Discovery prior to patent. The difficulty here is the leaving of a long period of time open in which possession is held.

Section 6 A—Marking claim on ground. This is a good provision. A codification of various state requirements on this provision would be useful. Recording in the Land Office may be a good provision, but it should be done in the county records also. B—Annual labor $5 per acre and alternative of direct payment to Land Office. The labor requirement on an acre basis is more equitable, but I am not sure that the alternative of paying into the Land Office is a good feature. Wealthy owners could hold claims indefinitely. The fundamental idea of assessment work is to get the land developed. The abuses which have arisen under existing law are not the fault of the law but of the way in which it is administered. It is best to inforce the existing law. C—Forfeiture by reason of failure to comply with provisions. This is a wise provision. D—Co-owners responsible. This is a good provision. E—Annual work within calendar year. This is all right.

Section 7—Extralateral right. It is not necessarily a bad idea to abolish the extralateral right. Most of the successful mining laws of the world are based on the severance of mineral title from the surface title. The United States has applied this principle to some extent. If the proposed law is to be logical, its proponents should go a step further and, if they abolish the extralateral right, they should sever mineral from surface rights. The agriculturist should take his title subject to the rights of the miner to pass under his land.

Section 8—This section deals with formalities. Section 9—This section also deals with procedure. Section 10—This is of minor importance and may be all right. Sections 11 and 12—No comment. Section 13—Location of adjacent ground. This is a wise provision, as it enlarges the scope of the present law, which is often inadequate in respect to large properties. Section 14—Mineral development fund. This is salutary. Sections 15 and 16—This is a recodification of old enactments. Section 17—Additional land districts. This is necessary. Section 18—Location upon tide lands. This is of little interest.

Mr. Colby commented on the serious menace caused by the filing upon land for stock-raising purposes, as it gives complete title to the claim and of 640 acres, and thus stops prospecting.

In the discussion that followed, Albert Burch stated that countries not burdened by the extralateral law have less litigation. If the extralateral right is abolished, the requirement of discovery must also be abolished. We do not know now what a miner can do under an agricultural patent, said Mr. Burch. The important thing is to prevent expensive litigation that has accompanied the exercise of the extralateral right. Legal subdivisions, in Mr. Burch's opinion, are not practicable.

A general discussion followed, in which R. H. Elliott, T. A. Rickard, F. Sizer, and C. M. Eye joined.

Minnesota M. C. M. Alumni Elect Officers

At a meeting of the Minnesota alumni of the Michigan College of Mines at Hibbing on Feb. 22 the following officers were elected: President, W. R. Van Slyke; vice-president, W. A. McCurdy, and secretary-treasurer, J. A. MacKillican. Resolutions were adopted whereby the Minnesota alumni indorsed the proposal of Donald B. Gillies, president of the M. C. M. Alumni, to make a survey of conditions at the college and offer recommendations for any improvements. Also to assist the college in securing sufficient funds from the Michigan Legislature to carry on the school work.

Expectations of Capital

At the recent meeting of the British Columbia division of the Canadian Institute of Mining and Metallurgy, Dr. George Hanson stated that the Dolly Varden mine had shipped 1,304,411 oz. of silver, and that the ore had yielded as high as 1,200 oz. to the ton. He expressed the opinion that the ore might be classified as a "secondary," and he drew attention to the large number of metallic minerals the ore contains. The address was purely of a technical character, although the impression was left that from an economic standpoint it could have been more [illegible].

It was the opinion of S. S. Fowler, who occupied the chair, that the Dolly Varden experience drove home the fact that capital when invested in a mine must not expect values to continue indefinitely. He also spoke of the "spectacular" manner in which the mine had come in. Dr. S. J. Schofield and J. D. McKenzie took part in the discussion. All the speakers admitted that different opinions are held regarding the outlook for this property.

California Mine Safety Organization Holds Banquet

The Empire Mines Safety Bear Club was first organized in 1916 as one of several Safety Bear clubs in California. Most of the clubs died after their first year of existence, and at present the Empire organization is the only one in existence. It boasts of an active membership of fifty; it meets weekly to practice first aid and for discussion of general safety questions. The Empire Mines Co. pays the hall rental and also the time of the members of the club spent at the meetings.

In addition to the president, R. W. Rodda, and to Secretary H. Crouch, there is a first aid instructor, Thomas Evely. To be a member of the club one must be an employee of the Empire Mines Co., hold a Bureau of Mines first aid certificate and be actively interested in the prevention of accidents. He must also be elected to membership in the club. In addition to the weekly meetings an annual banquet and meeting of the club is held.

At a banquet at Bret Harte Inn, Grass Valley, on Feb. 18, R. W. Rodda, the president, presided. In addition to B. O. Pickard, of the U. S. Bureau of Mines, G. Chester Brown, chief mining engineer of the Industrial Accident Commission, State Senator Thomas Ingram and F. W. Nobs, manager of the Empire Mines, were present and answered to toasts.

A discussion of first aid and prevention of accidents followed the dinner.

Jerome Celebrates Ben Williams' Birthday

A celebration was held in Jerome, Ariz., Feb. 24 to celebrate the sixty-ninth birthday of Ben Williams, for many years manager of the Copper Queen mines, at Bisbee, and regarded as one of the leaders in the adoption of modern mining and smelting methods. Mr. Williams was the guest of his grand-nephew, Louis Douglas, and included in the party were James S. Douglas, of Douglas, Ariz., father of the host, and Mrs. J. S. Douglas, niece of Mr. Williams, and daughter of his brother Lewis Williams, whose affectionate designation, "Don Luis," is borne by a suburb of Bisbee. The Williams brothers left Bisbee in 1901, to take up residence in Los Angeles, where Lewis Williams died a few years ago. They were succeeded in Bisbee by Walter Douglas, now head of the entire Phelps Dodge interests.

MEN YOU SHOULD KNOW ABOUT

H. R. Robbins has joined the staff of the American Cyanamid Co.

Kirby Thomas has returned to New York from an examination of limestone deposits in Butler County, Pa.

L. F. S. Holland is examining mines in Sinaloa, and expects to return to Hollywood, Cal., about March 21.

Robert T. Hill has temporarily closed his Dallas office. His present address is 623 North Central Ave., Glendale, Cal.

Charles E. Knox, president and manager of the Montana Tonopah mine, is in Tonopah, having come from Berkeley.

Frank H. Sistermans has returned to New York after a seven months' absence in Mexico, where he had been examining mines.

A. D. Miles, formerly president of the International Nickel Co. of Canada, is in England in the interests of an exploration project.

W. Lee Heidenreich has gone to northern Manitoba to take charge of development work at Copper Lake for the Nipissing Mining Co.

George J. Young addressed the Geological and Mining Society of Stanford University on Feb. 23, on the subject, "How Should a Student Use His Time?"

P. A. Simon, president and general manager of the Simon Silver-Lead Mines Co., has returned to the mine after a business trip to San Francisco.

Charles Stewart, Canadian Minister of the Interior and of Mines, has been elected to the House of Commons by acclamation, for the constituency of Argenteuil, Que.

E. H. Robie, metallurgical editor of *Engineering and Mining Journal*, attended the meeting of the Canadian Institute of Mining and Metallurgy at Ottawa last week.

F. E. Scobey, of San Antonio, Tex., has been nominated by President Harding to be Director of the Mint in place of Raymond T. Baker, of Nevada, whose term expires on March 19.

B. Marcuse has relinquished his interest in the Asbestos and Mineral Corporation, and is now president of the Asbestos Crude and Fibre Corporation, Ltd., at 342 Madison Ave., New York City.

L. K. Armstrong, secretary of the Columbia Section A. I. M. E., is expected to return to Spokane the middle of March from an extended business trip to New York, Washington, and other Eastern points.

L. D. Davenport, formerly chief engineer of the Oliver Iron Mining Co. in the Hibbing, Minn., district, has accepted a position with the South Manchurian Ry. Co. He will sail in the near future for Manchuria, where he will have charge of the mining of a large tonnage of coal by open-pit methods.

T. W. Vaughan, who has been a member of the geologic staff of the U. S. Geological Survey for many years, retired from most of his active duties on March 1. He was succeeded as chief of the coastal plains section by **L. W. Stephenson**, and as chief of the West Indian geological surveys by **W. T. Woodring.**

Dr. Henry M. Payne left New York this week to engage in professional work in Idaho. He will also spend a few days in the California oil fields. En route he will fill his annual engagements as non-resident lecturer at several of the mining schools and universities, including Cornell, Houghton, Moscow, Pullman, Corvallis, Reno, Golden, Lawrence, and Rolla, returning to New York about April 1.

Mining and metallurgical engineers visiting New York City last week included: Glenville A. Collins, Vancouver, B. C.; **Fletcher G. Downs**, Chatham, N. J.; **J. M. Frankel**, Clifton, Ariz.; **D. A. Lyon**, Washington, D. C.; **Donald G. Miller**, Tyrone, N. M.; **J. H. Herron**, Cleveland, Ohio; **A. E. White**, Ann Arbor, Mich.; **E. R. Crutcher**, Great Falls, Mont.; and **Henry B. Smith**, Meriden, Conn.

SOCIETY MEETINGS ANNOUNCED

The twenty-fifth annual convention of the **American Mining Congress** will be held in Cleveland, Ohio, Oct. 9-14, 1922. The national exposition of mines and mining equipment will again be a significant and special feature of this great industrial gathering.

The New York Section of the **American Institute of Mining and Metallurgical Engineers** will hold a joint meeting with the other three Founder Societies on March 15 at the Engineering Societies Building. The subject for discussion is "The Port of New York," E. H. Outerbridge and B. F. Cresson, Jr., will be the principal speakers.

OBITUARY

Nicholas P. Theo died on Feb. 22 at San Diego, Cal., at the age of fifty-seven. Mr. Theo conducted mining operations in Alaska and Goldfield, Nev.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

Blue-sky legislation is receiving more consideration at Washington than it has in the past. A new bill introduced by Representative Denison is on the House calendar.

The new income tax regulations have been issued by the Bureau of Internal Revenue embodying certain changes required by the amended law.

Wages have been raised at Bingham Canyon, Utah, thereby canceling the reduction made on Jan. 16. Similar action was recently taken in the Tintic district, following a brief strike there.

Australian news of interest from Peter G. Tait, our Melbourne correspondent, appears on another page. Among other matters, tests on Read-Rosebery sulphide ores are said to have given satisfactory results. The Electrolytic Zinc Co. is producing steadily.

Zinc Never To Be on Free List, Says Tuthill

Secretary of Zinc Institute Takes Exception to Statement Recently Published

Stephen S. Tuthill, secretary of the American Zinc Institute, referring to the item headed "Free List for Zinc Approved by Some in Washington," which was published on p. 377 of the *Engineering and Mining Journal* of March 4, said recently:

"There are only two ways 'to alter the character of the zinc industry' of the United States at this time: the one is to kill it with free-trade theories and heresies; the other is to protect it by law in line with the recommendations of the men who are vitally interested in its conservation and development and whose knowledge of the necessities of their own business is based upon intimate contact with the industry for many years.

"The 'metal-mining specialists in Washington' apparently have a great deal to learn if they think there is enough of an analogy between zinc and copper to warrant their conclusions.

"President Humphreys of Stevens Institute recently said that theorists of this class spend most of their time reading each others' theoretical writings, and that such men are unsafe as guides in the practical business world. The zinc men of the United States absolutely agree with President Humphreys' views.

"To my own knowledge, zinc has not been nor will it be placed upon the free list, and such reports as the one under discussion should always be carefully investigated before being published."

West Australian Gold Output Given Out

By Cable From Reuters to "Engineering and Mining Journal"

Perth, March 3—The gold output in West Australia during February was 42,120 oz.

Strike Prevents Announcement of Rand Production

By Cable From Reuters to "Engineering and Mining Journal"

London, March 6—Figures showing the gold output in the Transvaal have not been issued, owing to the strike, since Jan. 10. A shortage of labor will restrict operations when work is resumed.

International Nickel Elects New Officers

R. C. Stanley has been elected president of the International Nickel Co. to take the place of W. A. Bostwick, deceased. James L. Ashley is vice-president and treasurer; and Charles Hayden, of Boston, chairman of the board. Britton Osler, a Toronto lawyer, and J. L. Agnew, general manager of the mining and smelting division, were elected directors.

Planning To Aid Development of Ontario Properties

The Ontario Department of Mines is working out a plan in conjunction with the Temiskaming & Northern Ontario Ry. Commission to assist in the development of mining properties, by providing a market for small lots of ore. The proposed arrangement would not only help the prospector and small company to realize something for the ore, but would also permit them to obtain information as to its character and the treatment necessary. It is proposed that prospectors ship ore to the Temiskaming Testing Laboratories, in Cobalt, where it will be assayed and paid for at once on the basis of the gold and silver, less treatment costs.

When carload lots have been accumulated, arrangements will be made with gold and silver mills to handle the ore. The T. & N. O. Ry. will co-operate by giving a 50 per cent reduction in freight charges on such shipments, and prospectors' free assay coupons will pay for the assays. The necessary changes in the mining act are now being drafted.

Webb City Organization Favors Lower Tariff on Zinc

Attitude Results in Appointment of New Committee—Question of Local Advantage Involved

A new zinc ore tariff committee was named at the meeting of the Webb City, Mo., branch of the Missouri Mine Safety and Sanitation Association, at a meeting held at Webb City, Mo., on March 2. The naming of the new committee was the outcome of an argument brought about when Paul A. Ewert, chairman of the old committee, proposed sending a telegram to President Harding, asking his assistance in preventing the Senate Finance Committee from lowering the proposed rate on the metallic content of zinc ore in the new tariff bill from 1½c. to 1¼c. per lb. The organization opposed such a move, and the discussion finally terminated in the appointment of a new committee and the dismissal of the old committee. The new committee is made up of C. T. Orr, head of the Athletic Smelting & Refining Co.; W. W. Wampler, of the American Zinc, Lead & Smelting Co.; J. J. McLellan, and J. A. Skinner. The last two are independent operators, and Mr. Skinner is president of the Safety and Sanitation Association.

In the course of the debate, Charles Chinn, a Webb City business man, declared that Webb City no longer is in the zinc ore producing business, and as a consumer of zinc rather than a producer favors a low tariff on zinc ore. He said that Webb City does not expect to profit from ore production for the next fifty years.

Eagle-Picher's Joplin Smelter Running at Capacity

The Eagle-Picher Lead Co. resumed operations at full capacity at its Joplin smelter on March 1, it being the first time the plant has been operated thus in over a year. Late in 1920 all but a part of the office employees were laid off. The company's venture in manufacturing plumbing supplies has been successful, it is said.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Blue-Sky Legislation Getting Consideration

Denison's Latest Bill Now on House Calendar — Another Measure Introduced by Oklahoma Representative

Proposed blue-sky legislation aimed at mining and other securities is making rapid progress, in fact greater than at any previous session of Congress. Heretofore bills on this subject have not emerged from committee. The House Interstate Commerce Committee has ordered a favorable report on a bill of this nature introduced by Representative Denison, of Illinois, on which hearings were recently held. This is the third bill presented by Mr. Denison, and the bill is now on the House calendar subject to consideration at any time. The bill is H.R. 10,598 and is designed to prevent the use of the mails and other agencies of commerce for transporting and promoting or procuring the sale of securities contrary to the laws of the states in which offered.

Another blue-sky bill was introduced by Representative McClintic, of Oklahoma, which provides for control of security, stock, and bond issues by the Federal Trade Commission. This measure requires that persons or companies offering securities for sale in a state other than that of the main office of the corporation should file a complete statement of the venture with the commission, and if that body finds that the offer is a reasonable safe investment it will issue a certificate at a reasonable fee. Companies offering securities would be required under the bill to submit annual reports to the commission on Jan. 10 of each year.

To Mint Grant Memorial Coins

Under a bill passed by Congress and approved by the President the Director of the Mint will have struck off at the mint a special coinage of gold dollars and silver half dollars for issue in connection with the celebration in Ohio in April of the 100th anniversary of the birth of General Grant.

Engineers Report on Colorado River Project

The mining industry of Arizona and Nevada appear first on the list of enterprises which will use power in the plans for development of the waters of the Colorado River which has been reported to Congress by the Interior Department. It is estimated by engineers that 700,000 hp. can be developed through the Government construction of a reservoir at or near Boulder Canyon on the lower Colorado River.

The department recommends that the cost of the dam be met from receipts of lease of power so developed. It is recommended that a high line canal be constructed from Lagoona Dam to the Imperial Valley.

Lack of Funds Keeps Helium Plant Down

During consideration by the House of the deficiency bill, Representative Lanham, of Texas, sought an appropriation of $150,000 for experiments, conservation, and production of helium at Fort Worth, Tex., where the Government plant, he said, had been closed since November on account of lack of funds. Chairman Madden, of the Appropriations Committee, said the matter was being considered in connection with preparation of the Army bill. Representative Stafford, of Wisconsin, said that it was not a deficiency, as the Army had stored 2,500,000 cu.ft. of helium.

Mining Machinery Exports Drop in January

Regarding the exports of machinery for January, 1922, as compared with those of January, 1921, the Bureau of Foreign and Domestic Commerce shows that mining machinery to the value of $328,518 was exported in January, 1922, as compared with mining machinery to the value of $1,302,705 in January, 1921.

No oil well machinery was reported as having been exported in January, 1922, whereas machinery of this character to the value of $1,449,013 was exported in January, 1921. Pumps and pumping machinery exports also show a decided falling off in January of this year. The value of this class of machinery for January, 1922, was $170,063, as compared with $2,634,414 for January of 1921.

Utah Consolidated Denied Rehearing

The U. S. Supreme Court has declined to review the decision of the lower court in the so-called Yampa case brought by the Utah Consolidated Mining Co. against the Utah Apex Mining Co., involving rights to certain orebodies.

An appeal in the Highland Boy case, which was taken by the Utah Consolidated, is pending.

Government's Silver Purchases

Purchases of silver by the Bureau of the Mint during the week ended March 4 amounted to 1,392,000 fine ounces. This brings the total purchases under the Pittman Act to 95,743,628 oz.

New Income Tax Regulations Issued

Bureau of Internal Revenue Makes Important Changes Required by Amended Law

Important changes in the regulations under the income tax law as recently amended by Congress are embodied in new regulations promulgated by the Internal Revenue Bureau. These regulations are embraced in Regulations No. 62, and cover several changes made necessary by the amended tax law as to depletion of mines and oil and gas wells.

Regulations, in addition to those heretofore issued covering depletion, valuation and other points, are as follows:

"(Depletion)—Depletion or depreciation sustained: (1) In arriving at the amount returnable through depletion or depreciation, means (except in cases where a discovery has been established, as to which, see below), depletion or depreciation actually sustained based on the value as at the basic date; (2) in arriving at profit or loss from sale, means depletion or depreciation allowed based on value as at basic date except where value as at basic date is a discovery value, in which case the depletion sustained is that based on value as of March 1, 1913, or cost if acquired after that date; (3) in arriving at invested capital, means depletion and depreciation actually sustained based on cost.

"Depletion allowance in case of discovery: The deduction for depletion in case of a discovery cannot exceed the net income computed without allowance for depletion, from the property upon which the discovery is made, except where and to the extent that such net income so computed is less than the depletion allowance based on cost or fair market value as of March 1, 1913. Net income is the gross income from the sale of all mineral products and any other income incidental to the operation of the property for the production of the mineral products, less operating expenses, including depreciation on equipment and taxes, but excluding any allowances for depletion. If the mineral products are not sold as raw material but are manufactured or converted into a refined product, then the gross income shall be assumed to be equivalent to the market or field price of the raw material before conversion. Operating expenses, depreciation, and taxes on the property upon which the discovery is made, should be applied against the gross income from the same property on the basis of actual expenditures, but if the records for the year 1921 are in any case inadequate, allocation of such expenditures for that year may be made on the basis of the ratio of (1) the number of wells operated on the property on which the discovery is made to (2) the total number of wells operated in the operating division in which the discovery is included.

"(Valuation)—Valuations by analytic appraisal methods, such as the present value method, are not entitled to great weight: (1) If the value of a mineral deposit can be determined upon the basis of cost or replacement value, (2) if the knowledge of the presence of the mineral has not greatly enhanced the value of the mineral property, (3) if the removal of the mineral does not materially reduce the value of the property from which it is taken, or (4) if the profits arising from the exploitation of the mineral deposit are wholly or in great part due to the manufacturing or marketing ability of the taxpayer, or to extrinsic causes other than the possession of the mineral itself. Where the fair market value must be ascertained as of a certain date, analytic appraisal methods will not be used if the fair market value can reasonably be determined by any other method.

"The degree of risk is generally lowest in cases where the factors or valuation are fully supported by the operating record of the mineral property prior to the basic date; relatively higher risks attach to appraisals upon any other basis.

"All statements required to be furnished in connection with the returns of taxpayers claiming depletion or depreciation must be under oath and may be included in a single affidavit.

"Allowable capital additions in case of mines.—All expenditures for development, rent, and royalty in excess of net receipts from minerals sold shall be charged to capital account recoverable through depletion, while the mine is in the development stage. Expenditures made in order to maintain the mine at its normal output shall be deducted as an expense in the year in which the expenditure is made or accrues. Any expenditure for extraordinary development and equipment, such as stripping, shaft sinking, tunneling, and other work beyond that necessary to maintain the mine at its normal production or output, should be carried forward and apportioned and deducted as an operating expense in the year to which it is applicable."

NEWS BY MINING DISTRICTS

London Letter

Bullfinch Proprietary Takes Option on Nearby Kalgoorlie Property—Canadian Shares Offered in London

By W. A. Doman

London, Feb. 22—Mining companies die almost as hard as the feline tribe. For this there are various reasons. One—and it is quite sound at present—is that, the company being in existence, no fees are payable, and registration fees, it may be remarked, are decidedly heavy. Another reason is the evident dislike of some boards of directors to distribute the assets, and so give up what is frequently a lucrative living. After what was regarded as a most favorable start, the Bullfinch Proprietary failed, Kalgoorlie proving a disappointment. The directors turned their attention to Nigeria, taking various properties under option. These have been tested, and as reports have been rather unsatisfactory, prospecting is to be undertaken in other areas.

On more than one occasion I have referred to reported gold discoveries in Nigeria, but nothing worthy of note has yet resulted. (Cynically, this may be because the share market is so dull). Now the Bullfinch company is showing renewed signs of life in Kalgoorlie, and has taken an option over a property situated about 6 miles to the east of the original mine. It seems strange that a deposit so close was not noticed at an earlier date. So far, only a little work has been done—only 4 ft. of driving, and this by prospectors. The assays are given thus: From 0 ft. to 1 ft., 2 dwt; from 1 ft. to 2 ft., 1 oz. 8 dwt.; from 2 ft. to 3 ft., 13 dwt.; from 3 ft. to 4 ft., 1 oz. 4 dwt. 12 grains; average 17 dwt. Width at right angles to wall, about 3 ft. At present this is interesting and nothing more, for many assays of this kind can be obtained in the vicinity of Kalgoorlie.

The Esperanza is coming to the front again. The last three cabled reports give information concerning the Descubridora vein, on the 5th level, north drift, thus:

Advanced	Average Width of Vein	Assays Gold Oz.	Assays Silver Oz.
12 ft.	16 in.	2.78	52.53
17 ft.	28 in.	3.10	58.37
31 ft.		0.10	4.21

The first and second of these results are quite satisfactory, following upon 24 ft., giving 2.68 oz. of gold, and 58.31 oz., silver. The market, however, is quite upset by the latest message, more especially as the price of the shares fell previous to the publication of the cable dispatch. Nowadays there are so many interests concerned in a mining company that it is next to impossible to prevent leakage of news.

The Canadian promoter or "share pusher" is pretty active on this side just now. According to him—or, rather, them, for several are here at once,—the wares for sale are first class, and are brought to London because the "share pushers" "do not want Yankee capital, preferring to keep the good things within the Empire." One of these gentry told me quite seriously that the Englishmen love a gamble, and he wanted some of the money!

A. S. & R.'s Test Mill at Leadville Nearing Completion

The experimental mill which is being constructed by the American Smelting & Refining Co., at the portal of the Yak tunnel at Leadville, Col., is nearing completion, and it is expected will be in operation within the next sixty days, treating the low-grade complex ores tributary to the tunnel, by jigging concentration and flotation. Laboratory tests indicate that the mill will bring the saving from about 50 per cent, the best results from former methods of treatment, to about 80 per cent of the values in the ore.

Melbourne Letter

Tests on Read-Rosebery's Sulphides Gives Satisfactory Results — Mount Lyell in Full Swing—Mount Boppy Takes Option on Occidental

By Peter G. Tait

Melbourne, Feb. 1—The Electrolytic Zinc Co.'s experiments on the Read-Rosebery ores at Zeehan, Tasmania, have given satisfactory results. A standard one-box M. S. machine is used and 200 to 300 lb. of ore is worked off in one shift. The charge is fed in by buckets, after having been broken in a crusher and ground in a ball mill. The water is kept at a temperature of 120 deg. F. Sulphuric acid is introduced in sufficient amount to keep the liquid slightly acid, that is, .06 per cent. Wood tar oil with a little eucalyptus oil is fed in intermittently. Sulphur dioxide is introduced through the same pipe as the oil from a small burner, keeping the solution saturated with the gas at a temperature of 120 deg. F. In this stage, a pyrite-galena float is obtained. The sulphur dioxide has the effect of allowing the particles of blende to be wetted, and it sinks with the gangue. When this float is finished, the temperature is raised to 140 deg. F. and the sulphur dioxide turned off. A mixture of coal tar and creosote with a little eucalyptus oil is added and more acid from time to time to keep the liquid at .06 per cent throughout the run. When the sulphur dioxide has been expelled, the zinc sulphide froth rises and overflows.

The feed averages 32 per cent zinc, 10 per cent lead, and 12 per cent iron, and the recovery is 85 per cent.

Operations at the Mount Lyell company's mines and smelters are now in full swing, and at the North Lyell mine ore production has practically regained the 10,000 tons a month mark, which it is the aim of the management to maintain as a minimum.

At the Mount Lyell mine the output of about 6,000 tons of pyrites monthly is being maintained.

At the reduction works one furnace is usually able to treat all the available smelting material, and now that operations are in full swing again it is expected that the output of copper will soon reach 600 tons a month. All the auxiliary plants are running regularly, and fair progress is being made with the erection of the new and larger sintering plant which is needed to deal with the increasing quantity of concentrates produced by the flotation plant.

The Mount Boppy gold mine, at Canbelago, in the Cobar district, New South Wales, closed down at the end of last year. but, as it was felt by Mr. Negus, the general manager, that the valuable plant installed would not realize anything like its value, if sold piecemeal, he has advised the London board to seek a new property. Since 1899 the Mount Boppy mine produced gold valued at £1,812,700 and paid £446,000 in dividends. An option extending over four months after unwatering has now been taken over the Occidental gold mine, at Cobar, a property which has had its ups and downs for a number of years. Recent reports show that a considerable tonnage of ore is proved about the No. 7 level and that the average grade of the stone is approximately 10 dwt. per ton. An all-sliming mill is installed and, if the option is exercised, the plant will doubtless be extended to handle a larger tonnage. Under the terms of the option, the new company will have a capital of £280,000 in 10s. shares, and the Occidental company will receive 40,000 shares and £7,500 cash, besides which £15,000 worth of debentures issued by the Occidental will be taken over by the new company.

Figures of production of the Electrolytic Zinc Co. of Australasia from the beginning of full-scale operation on the first section of the plant show that from Nov. 2 to Dec. 31 (thirty-nine days) 1,118 tons was produced, and from Jan. 1 to Jan. 25 (twenty-five days) 1,200 tons. By the end of February it is estimated that the daily average production will be sixty-eight tons, and as arrangements have been made for a further block of power, over and above the 15,000 hp. now available, it is hoped to reach an output of eighty tons per day within three months. The full power supply of 30,000 hp. under contract from the government will be available in August or September, and the second section of the company's plant will then be put into operation, increasing the output of zinc to 120 tons daily.

Committee Silent on Tariff

During the last week the Senate Finance Committee again considered the metal schedule in its final study of the revised tariff bill, but no details as to action taken were revealed.

CANADA

British Columbia

Quadra Island Ore Thought Radio-Active — J. J. Warren Discusses Consolidated M. & S. Co.'s Plans

Victoria—The claim is made that the ores of the Quadra Island mines, of the Valdez Island Copper Co., (Queen Charlotte Islands), are radio-active and that further development may prove the property to be an important new source of radium. The owners, F. N. D. Rosher and F. H. Rosher, and their associates are reported to have had encouraging results from preliminary examinations carried out at McGill University, Montreal. At present F. H. Rosher is in England with samples.

The holdings of the Valdez Island Copper Co., embrace thirty mineral claims in the vicinity of Gowland Harbor, Quadra Island, the largest of the Valdez group of islands, which forms with Vancouver Island the Seymour Narrows.

Vancouver—The Consolidated Homestake Mining & Development Co. has been developing its property at Alice Arm during the last year. It plans to build a 150-ton mill and to install an hydro-electric plant at Clearwater Creek, one and one-half miles from the proposed mill site, where it is possible to develop 15,000-hp. Two tunnels have been started, one of them now being in 123 ft. and the other 45 ft. The first has cut two veins, running $9.85 and about $50, respectively, the values being principally in gold, with some silver and copper. The company states that the main leads have been traced across the full length of four claims of 6,000 ft. The average width of orebodies taken from the sampling of the outcrop over the entire 6,000 ft. is 49 ft. A composite sample made up from 300 samples assayed gold, .56 oz.; silver, 2.14 oz.; copper, 5.02 per cent; gross value per ton, $24.82. On Homestake claim No. 2 the main lead attains a width of 154 ft, and assays for the entire width $19.11 per ton, irrespective of a high-grade streak on the foot wall.

Nelson—At the regular yearly session of the Associated Boards of Trade of Eastern British Columbia, held here the latter part of February, and which was attended by delegates representative of the mining sections of East and West Kootenay and the Boundary. J. J. Warren, president of the Consolidated Mining & Smelting Co., of Canada, Ltd., stated that his company had succeeded in weathering the current financial depression in good condition, and that as a result it is now in a position to extend further consideration to independent shippers. He said that practically all the accumulated lead surplus of the Consolidated had been disposed of, and that costs of lead- and zinc-smelting operations at the Trail plant had been lessened to such an extent as to make it possible to compete with any other producers. Announcement was made that the Trail plant's lead refinery would be enlarged from a 90-ton to a 150-ton daily capacity, and it was planned to install a custom electrolytic zinc plant to treat the ores of independent shippers, thus avoiding mixing of their ores with material from the company's big Sullivan property.

Trail—Receipts of ore at the Consolidated smelter from Feb. 22 to 28 inclusive totaled 7,086 tons. Shippers were: Bell, Beaverdell, 47 tons; Standard, Silverton, 82; and company mines, Silverton, 6,957.

Ontario

Fight To Get Control of La Rose—Ontario Kirkland and Montreal Kirkland Merge — Porcupine Crown To Reopen—McIntyre Sells Treasury Stock

Cobalt—La Rose Mines, Ltd., has declared a dividend of 10 per cent, payable April 20 to shareholders of record March 24. The annual report of the company shows that during the last year there was produced 637,000 oz. of silver, at a cost of 46c. per oz., from which was realized a profit of $126,000. The results were the best since 1916. A firm of mining brokers and promoters in Toronto is making a fight to obtain control of this company and the treasury, which contains quick assets of $555,000. The directors are making strenuous opposition.

Coniagas expects to have a diamond drill working at the Ruby property before the middle of March. Several holes will be put down to determine the geological conditions.

The annual meeting of the McKinley Darragh will be held March 9. The mine has been closed during the last year, and the cash in the bank has been reduced from $86,371 at the end of 1920 to $8,753 as of Dec. 31, 1921. The company is carrying 260,000 oz. of bullion.

The Nipissing is sending a diamond drill to the Gordon property, in the Copper Lake district of northern Manitoba. This is a gold property on which some high values were found about two years ago. Some diamond drilling was done, which indicated the presence of heavy sulphides at depth. W. Lee Heidenreich is in charge of the work.

The La Rose, with one car of 78,503 lb. of ore, was the only shipper from Cobalt for the week ending Feb. 24.

Kirkland Lake — Amalgamation has been brought about between the Ontario Kirkland and the Montreal Kirkland. A $5,000,000 company will be formed, of which the Ontario will receive 1,500,000 shares and the Montreal Kirkland 1,725,000 shares. The new company assumes the Ontario Kirkland's liabilities of approximately $120,000, and agrees to raise money for further development of the two properties. The Ontario Kirkland is equipped with a 140-ton mill, but mine development was about one year behind the mill, and the company was unable to make headway.

The Argonaut has bought a ball mill from the McKinley-Darragh, of Cobalt, to install on its gold property.

Crown Reserve has shipped four carloads of machinery to a property in Gauthier, which it has under option. A shaft will be sunk 300 ft. before lateral work is undertaken.

Porcupine — As soon as the foreclosure proceedings in connection with the Porcupine Crown and the Thompson-Krist are at an end, it is understood that the Porcupine Crown will be reopened. The annual report showed a surplus of $237,635.

The annual report of the Hollinger, which shows net profits of $5,091,659 from an income of $10,031,050, states that 4,000 tons or more per day can confidently be expected as the average for 1922, which would mean about 1,500,000 tons for the year. The income is 47 per cent in excess of that of 1920, and current cash assets are over $6,000,000.

Mill heads at the Dome are running in the neighborhood of $13. Production for February is reported to have been $302,000.

A deal has been made for the sale of 359,717 shares of $1 par McIntyre treasury stock at $3 per share, which will realize approximately $1,000,000. It has not been announced for what purpose the money will be used, but in all probability the directors consider it advisable to finance the new mill addition in this manner.

The Gold Island company, on Nighthawk Lake, is planing to do a large amount of diamond drilling on its holdings this year.

Recently there has been a great deal of excitement and activity regarding reported placer deposits in Monroe Township, Ontario, lying between Kirkland and Porcupine, and already a block of country embracing approximately fourteen square miles has been staked. This section is almost entirely covered by a heavy deposit of sand, and some interesting results have been obtained. It is not believed, however, that these deposits will be of great importance, as they no doubt represent comparatively small concentrations in the glacial drift, where local conditions have been favorable. The Croesus mine, from which extremely high-grade ore was produced, was in this same neighborhood, and it is probable that the values have come from the glacial erosion of veins corresponding to the Croesus.

WASHINGTON

Chloride Queen Tunnel in Mineralized Ground

Colville — The long tunnel on the Chloride Queen property, thirteen miles north of Colville, cut the main ledge on the property about a month ago, passing through one of the walls and angling across the ledge, which gave increasing signs of mineralization. By the last week in February, the face of the tunnel began showing occasional chunks of galena, with carbonates. This is thought encouraging. The ore occurs as a replacement, with values chiefly in lead.

IDAHO

Armstead Mill Ready for Operation—Idaho Gold & Ruby Completing Installation for Sluicing

Talache — The all-flotation 150-ton mill at the Armstead mine is practically completed and ready for operation. It is situated at the portal of the main adit tunnel, and ore is to be trammed direct to the mill bins. Power is to be taken from an eleven-mile transmission line, connecting with the Mountain States Power Co.'s system at Sagle, which will also be the shipping point. The Armstead mine, formerly known as the Keystone group, was a fairly consistent producer of high-grade silver ores years ago. It has been under development by Major H. H. Armstead and associates for a number of years, and approximately 12,000 ft. of development has been done. Ore reserves are estimated as being sufficient for the new mill for two years.

Twin Falls—The Sawtooth Dredging Co., holding 1,200 acres at the headwaters of the Big Salmon River, is planning to install jigs and other equipment required for saving oxidized gold, silver, and platinum in black sand, which, it is said, can be recovered by reported dredging. The company has a dredge in operation, which is to be saving 56c. gold per cu.yd. About 80 cu. yd. of gravel yields a ton of the black sands.

Bonners Ferry—What is regarded as one of the largest sluicing operations of the west, that of the Idaho Gold & Ruling Company, is in its final stages of preparation near Leonia, not far from Bonners Ferry. Actual sluicing with monitors was begun last fall, but installation of equipment for recovering the gold was started during the winter. Operations were first begun about fifteen years ago. Since then the scope has been widened from time to time, so as to surpass all original estimates. When the concentrator equipment is installed, treatment of "fines" collected as a result of sluicing can be started. A special table for this purpose, known as the Deardoff, has been designed and tested. The values are chiefly in the form of fine gold and black sands, with a considerable quantity of small garnets, which it is believed may be useful as abrasives. The company controls an immense area of ground, all of which is said to show values similar to those found where preliminary operations have been conducted.

Coeur d'Alene District

Federal To Deepen Morning Shaft—Amazon-Dixie Shaft Completed—Rex Consolidated Buys Red Monarch—Powder Cheaper

Wallace — The Federal Mining & Smelting Co. has invited bids for sinking the main shaft of the Morning mine, at Mullan, 200 ft. further. The lowest level now is the 2,250, which is 1,450 ft. below the main working tunnel, the levels being numbered from No. 5 tunnel, 800 ft. above, which was originally the outlet for the mine. The Morning orebody maintains its size and mineral value unimpaired at this depth, and this is expected to prove true also 200 ft. below.

The Amazon-Dixie Mining Co., operating in what is locally known as the East Coeur d'Alene district, in Montana, near the Idaho line, has completed its shaft down to the 1,500 level, 800 ft. below the main tunnel, and is preparing to crosscut to the vein, an estimated distance of 500 ft. This is one of the most remarkable development enterprises ever undertaken in the Coeur d'Alene district. With a showing of lead-silver ore practically on the surface, a tunnel was run to explore the vein 700 ft. below, disclosing a long shoot of low-grade ore, not of commercial grade. A shaft was sunk 400 ft. from this tunnel and the vein crosscut and drifted upon at 200 and 400 ft., each level showing an improvement over the one above. Last summer work started sinking the shaft 400 ft. further, which has now been completed. All equipment of the property and underground work has been carried out on a basis of permanent operation, and in this respect the property is ready for production when the expected orebody is found. Over $400,000 has been spent in equipment and development work on the Amazon-Dixie.

The Rex Consolidated Mining Co., of which L. E. Whicher, of New York, is president, has concluded negotiations through which the Rex company acquires all property of the Red Monarch Mining Co., stock in the Rex being issued in payment. The Rex is situated on Nine Mile canyon, about six miles from Wallace, and the Red Monarch is on Beaver Creek, across the divide from the Rex. A 4,400-ft. tunnel has been run by the Red Monarch to within 2,000 ft. of a point 400 beneath the Rex shaft, which is down 700 ft. The Rex company intends to extend the tunnel and raise to a connection with the shaft, making accessible a large block of ground that is expected to be productive of lead-silver ore. The extension of the Red Monarch tunnel and connection with the shaft will provide ventilation, drainage, and an outlet for Rex within a mile and a quarter of the Beaver Creek railroad. Raymond Guyer, manager of the Rex, announces that financial arrangements have been completed.

A cut of $1.15 per 100 lb. on 40 per cent gelatin powder and $1.65 per 100 lb. on 60 per cent gelatin has been announced by the local distributing agency for mining explosives in the Coeur d'Alene district. The new price makes 40 per cent powder $22 per 100 in ton lots and $22.50 in less than ton lots. The price of 60 per cent is $25 per 100 in ton lots and $25.50 in less than ton lots. Last year there were two reductions in the prices of explosives. The first was June 1 and was $1.75 per 100, and the second was on Aug. 20, 25c. per 100, making a total cut of $2 per 100 during the year.

MONTANA

All Units of Anaconda's Great Falls Plant Running—Operations Outside of Butte District

By A. B. Keith

Butte—Anaconda Copper now has [illegible] all units of its Boston & Montana smelting works at Great Falls in operation, including its copper refinery, and the output of the zinc plant will be enlarged as more zinc concentrates are had from the Black Rock concentrator of the Butte & Superior. The recent address of Cornelius F. Kelley, president of the Anaconda, before the A. I. M. E., has been [illegible] to heighten the optimism [illegible] in local circles. Estimates [illegible] effect that the company will be [illegible] copper at better than 50 [illegible] capacity before the end of the year, and it is considered probable, [illegible]ng that the demand of the metal warrants, that nearer 75 per cent than 50 will be recorded.

The Crystal Copper Company is shipping from five to six cars of ore monthly from the Goldsmith mine, in the Butte district. The last five show the following net smelter returns—$8.910.83, $6,003.04, $2,545.89, $2,566.19, and $1.443.29. Six cars are now at the sampler awaiting assay. The total gross from ore shipments in the last year was $159,000. The best ore is being mined between the 700 and the 600 levels. About forty men are working.

Semi-official reports from the North Butte Mining Co. state that ore of a grade higher than the ordinary run at the Granite Mountain mine has been opened on the 3,600 level of the Edith May ledge, with a width reported to be more than 15 ft. It is said to be the plan of the management to sink the Granite Mountain shaft to open this vein at greater depth.

The Main Range shaft of the Tuolumne company is down below the 1,800 level. Mineralization in the shaft, incident to the cutting of a northwest vein below the 1,700 level, is holding up well. Resumption of production of silver ore is looked for soon. Word from the Washoe smelting works of the Anaconda to begin shipments is awaited. The Tuolumne has a large body of silver ore on this level running up to 2½ per cent in copper.

Wickes—Preparations are under way looking to the financing of a mill for the Mount Washington mine, controlled by Duluth interests. Milling ore indicated is estimated at 500,000 tons. A mill site has been secured and plans have been ordered drawn.

Jefferson — The Asset's new cyanide mill is reported to be ready for operations. This plant is at the old Yellow Jacket mine, which has been developed by a [illegible]t tunnel at a depth of 500 ft.

Marysville—Barnes-King for December produced $39,322 in bullion from its Shannon ores with a tonnage of 3,294 and a value per ton of $11.72. Three tunnels in the Strawn property, in Madison County, are being driven. This is the property which caused much excitement last summer because of the rich surface showing.

Townsend—A body of ore 10 to 15 ft. wide and carrying up to $10 in lead, silver, and gold, has been opened in the Kleinschmidt group of claims, in Weasel Gulch, Broadwater County.

Melrose—The old Glendale silver-lead property is being explored by interests which have organized with a view to systematic development and the construction of a power line.

Neihart — The Block Mining Co. is shipping about 700 tons of ore monthly to the East Helena plant of the American Smelting & Refining Co. About sixty men are working.

Basin—Attention is being given to development work being done by the Lowlands Ruby Mining Co., which is driving a tunnel to open three veins about 400 ft. below the present working levels, which have produced good ore.

Missoula—The retiring board of the Montana-Idaho Mining Co. was reelected at the annual meeting held recently in Spokane. H. F. De Bower, of New York, is president.

Pony—The Clipper mine has resumed, and gold mining in this county (Madison) is showing increased activity.

Lewistown—The Northwest Gypsum Products Co. has started operations at its plant near Heath, employing thirty men. It is estimated that 8,000,000 tons of rock is available. The mill has an initial capacity of 150 tons daily.

UTAH

Wages Raised at Bingham, Restoring Jan. 16 Scale—Deer Trail and Ophir Hill Consolidated Companies Report

Bingham Canyon — Wages at Bingham Canyon, in common with wages in the Tintic district, were increased 50c. a shift Feb. 15, bringing the scale back to that in force before the decrease in wages Jan. 16. Machine men receive $4.25 per shift, muckers $3.75 per shift, and common labor $3 25. Only a few mines are working in Bingham. No definite date has been set for the resumption of operations by the Utah Copper. Wages were not increased by the Salt Lake Valley Smelters. The labor supply is plentiful.

Salt Lake City—Reports to the state Board of Equalization for taxation purposes of two well-known mining companies whose stock is closely held, are as follows: The Deer Trail Mining Co., operating near Marysvale, in Piute County, in the southern part of the state, reports net proceeds for 1921 of $108,864. Production totaled 35,773 tons of ore, for which the company received $567,556. Deductible extraction and reduction costs are reported as $458,692. Valuation for taxation is listed at $411,892. The Ophir Hill Consolidated Mining Co., of Ophir, in Tooele County, gives the value of its plant, machinery, and supplies at $142,793. The gross yield of the property for 1921 is given at $177,340 and the expenses were the same, leaving no net proceeds.

NEVADA

MacNamara Mill Cuts Custom Charges—Virginia Louise Bondholders To Extend Refunding Date

From Our Special Correspondent

Leadville—The shaft of the Leadville Mines Co. has reached the 400 level, and a station and ore pocket are now being cut. Changes in the milling plant are practically completed, and if weather conditions permit production will be resumed about the middle of March.

Virginia City — Despite the heavy snows, construction work on the plant of the United Comstock Mines Co. is about normal. The north and south drifts from the Hale and Norcross tunnel of the Middlemines are out 100 ft. from the tunnel, and excellent progress is being made.

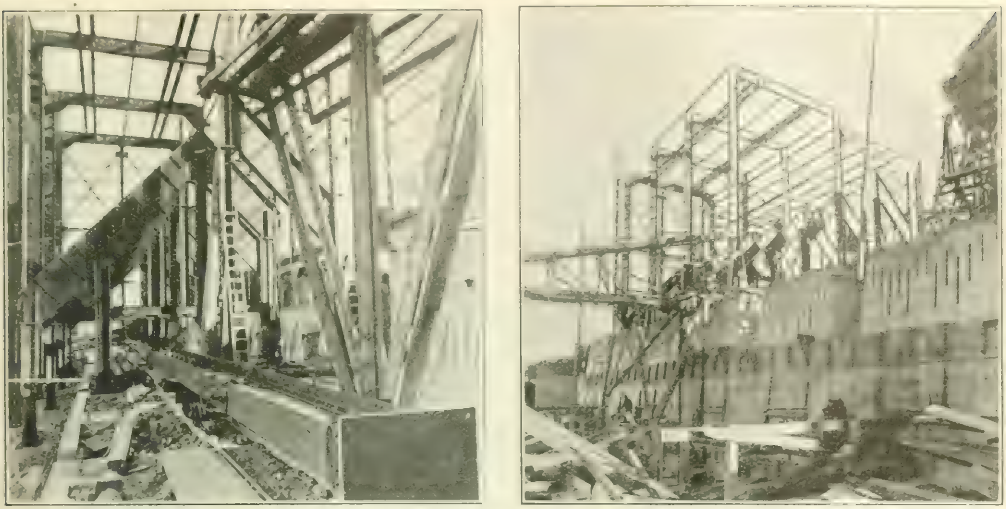
Tonopah—The MacNamara company has reduced ore treatment charges to meet the cut made by the Tonopah Belmont. Rates are now $4.50 per ton on ore up to $20 grade, $5 on ore between $20 and $25 per ton, plus 10 per cent on all ore above $25 per ton.

Bullion shipments reported for the first fifteen days of February are as follows: Tonopah Belmont, $99,000, Tonopah Mining, $40,000, West End, $46,000. No report has been received from the Tonopah Extension or the MacNamara, but operations were normal at both properties. The Tonopah Extension continues development in ore on the 1,880 level from the Victor shaft. The orebody above the 900 level of the Halifax is being developed by drifting and raising, with good results.

Divide—At the Tonopah Divide mine development totaled 95 ft. and ore production 350 tons for the week ended Feb. 24. Development consists of a north crosscut on the 200 level, an east drift on the 1,000 level, and north and south crosscuts on the 1,300 level. No new discoveries or developments out of the ordinary were reported.

Pioche — The annual stockholders' meeting of the Virginia Louise Mining Co. was held in Pioche on Feb. 20, and the following directors were elected: J. D. Thompson, N. S. Berray, W. W. Caldwell, C. A. Thompson, and Charles Lee Horsey. Dissatisfaction among the bondholders which led to the request for a receiver for the company was adjusted, the bondholders agreeing to extend the refunding date, and, there being no other indebtedness, the matter never came into court. The company has a substantial tonnage of developed ore, which it is expected to market in the near future, when smelting conditions warrant the treatment of increase tonnage.

Shipments of ore from the upper levels of the Prince Consolidated mine are now being made. The product assays $5 in gold, 23 oz. in silver and 20 per cent in lead, the ore being mined from the fissures adjacent to the big flux ore beds. With continued winter weather and heavy snows, no substantial increase in shipments is believed to be possible for at least two months.



Photos (also that on front cover) by A. Lease, Lead, S. D

LEFT—STEEL FRAMING OF ORE BINS, HOMESTAKE MINING CO.'S NEW SOUTH MILL, NOW BEING ERECTED AT LEAD, S. D. RIGHT—NORTH BATTERY BLOCKS, SOUTH MILL.

SOUTH DAKOTA

New South Mill of Homestake Company Expected To Be Completed This Year

Lead—The construction of the Homestake Mining Co.'s new South mill is progressing satisfactorily, and it is expected that the building and machinery installations will be completed this year. The steel ore bins have been completed as well as the concrete foundations for the equipment. The new plant will be modern in every respect and will have a daily capacity of 1,800 tons.

Following the preliminary crushing, the ore will be reduced by 120 stamps weighing 1,550 lb. each. These will be followed by rod mills working in closed circuit with Dorr classifiers. Amalgamation and cyaniding will be used for extraction. A more detailed description was given on p. 521 of the *Engineering and Mining Journal* of March 19, 1921.

COLORADO

Tonopah Placers Co.'s Dredge Damaged—Freight Rate on Coal to Cripple Creek Lowered

From Our Special Correspondent

Breckenridge—An accident occurred in the latter part of February which will put the dredge of the Tonopah Placers Co. out of operation until about April 1. The dredge has been operating during the winter, and while it was moving forward, a caving bank tore down the head gantry and partly submerged the dredge. Dredging has been done during the winter for the first time in this district.

Boulder — The Smuggler - Ballerat Mining & Milling Co. has been organized to take over and operate the Smuggler mine, near Jamestown. Tests being conducted at the metallurgical plant of the Colorado School of Mines will determine the type of mill which will be constructed to treat dump ore and stope fillings from the old mine, which is credited with a production of over $2,000,000 between 1877 and 1892.

Cripple Creek—A reduction of practically 50c. per ton in freight rates on steam coal shipped into this district became effective on March 1. Large quantities are used at the mining and milling plants of this district, and with the $1 per 100 lb. reduction in the price for powder this will appreciably reduce production costs here. Increasing activities of lessees and several new finds, together with enlarged operations on company account, have greatly stimulated interest in the Cripple Creek district. The Portland is handling an increased tonnage. The figures for October were 17,000 tons, December 27,600, and January 32,800. Equipment is being installed to bring the tonnage up to 36,000 monthly, where it will be maintained.

Empire—The Empire Consolidated Mining Co. is planning to build a concentrating mill at the portal of its main tunnel at North Empire. Joseph McAuliffe is superintendent.

NEW MEXICO

Lordsburg—Ore shipments have begun to move once more from this district. They consist principally of siliceous copper ores from the Eighty-five mine destined for the C. & A. smelter at Douglas, Ariz.

The Great Eagle Fluorspar Co., which has been working the Great Eagle mine for about a year and a half, has quit, and the property has been turned back to the owners.

ARIZONA

Resumption in Clifton District To Be Deferred — Oatman Camp Active

By JAMES H. MCCLINTOCK

Clifton—No early resumption of extensive operations may be expected in the Clifton district, according to a statement made here by Walter Douglas, of the Phelps Dodge Corporation. Operations are to be continued on the present small scale, including working of the Coronado mine and operation of No. 6 concentrator till the fall, at least. Plans are being drawn for enlarging this concentrator, at a possible cost of $500,000, but whether the work will be started this year or not is to be determined later. Mr. Douglas says that, "In the copper industry it appears to be a game of survival of the fittest, and the Phelps Dodge Corporation is trimming its sails in order to weather the storm." J. P. Hodgson, general manager at Clifton, expressed regret that the new management had been compelled to drop so many tried and true employees, but it became evident that it was impossible to continue an expensive overhead organization under present conditions. Operation of the Morenci Southern narrow-gage from Guthrie has been discontinued, and all traffic is being billed through Clifton, most of it being taken from there to Morenci by trucks.

Douglas — About 800 men are now employed by the local Copper Queen and Calumet & Arizona smelters, and more men are being taken on day by day. The custom ore shipments are becoming a material factor in operations. Ores are being received from the Night Hawk lease, below Bisbee; also from the Patagonia district where a number of well-known copper-silver [illegible] mines are resuming operations, including the [illegible] Eclipse, January, [illegible], Hansell, Black Eagle, Bland, and Paymaster. The last named has been leased by R. R. Richardson to Howard Foley.

Judgment has been given the Circle A Cattle Co. against the Gold Prince Mining Co. of Los Angeles, for $125,000 and 1,250,000 shares of stock.

Tombstone—The big Nordberg compressor at the Bunker Hill company's power house was started March 1. It will furnish air to all leasers in the district for both hoisting and mining. It has been idle since the Douglas smelters closed last year, air being supplied to a few of the larger leasers by a smaller compressor owned by the company. Announcement will be made soon, it is expected, as to the date when the Douglas smelters will accept custom ore. A large tonnage is ready.

Globe—Globe, in common with other Arizona mining camps, is overcrowded with unskilled labor, yet it is said that in nearly all Arizona copper camps work can be found by any decent skilled miner or mechanic. Here a gradual expansion of industry is to be noted. The Inspiration mill has been operating seven sections for over a week. Otherwise there is little change to record. From Hayden comes word that the camp's buildings are being placed in good condition, to be ready for resumption of work in the Ray mill or the smelter, but this is not expected for months.

Asbestos production is confined to small lots, carefully graded by a local Asbestos Clearing House. It is said that the local product is of superior quality, some of the samples having fiber as long as 5⅜-in.

Jerome—The steam-shovel operations at the United Verde have reached a siliceous ore zone of no particular value and will be pushed on into the oxide. Contracts are reported to have been given for 2,000 tons of structural iron for the new crushing plant.

United Verde Extension is reported to have cut a new body of ore sampling around 30 per cent copper on its 1,100 level, only 60 ft. from the Jerome Verde side line. The work is to be pushed onward into Jerome Verde ground. The company at Clemenceau is operating one reverberatory, but will not need ore from the mine for weeks to come at the present rate of consumption. The company is understood to have sold all its bullion. In the annual report statement is made of production during 1921, in four months of operation, of 12,498,000 lb. of copper, from 53,643 dry tons. The production cost was 13.46c. a pound. There was gross revenue of $2,319,259 and gross outgo of $2,282,262.

Verde Central is drifting on the 650 level and is sinking from its new station at that depth, with both workings in ore. Some trouble is being experienced from water and new pumping and hoisting machinery is being installed.

JOPLIN-MIAMI DISTRICT

Missouri-Kansas-Oklahoma

Blizzard Cuts District's Output — Rich Strike Made at Carterville on Ten O'clock Lease

Joplin — The worst blizzard of the year for the Tri-State district came Feb. 28 and resulted in curtailment of production for the week by approximately one-third. However, producers generally look upon this result as helpful rather than anything else, as there has been a definite tendency looking toward increasing the surplus of ore held in the bins.

An excellent lead strike has recently been reported on a part of the old Ten O'clock lease, near Carterville, Mo. Drilling indicated an orebody and a drift from an old shaft proved its existence. Steady production of chunk lead has been made for some time.

MICHIGAN

The Copper Country

Calumet & Hecla Mill Being Made Ready—Proposed State Prison May Benefit Keweenaw Copper Co.

By M. W. Youngs

Houghton — The tables and other equipment in the Calumet mill of the Calumet & Hecla have not been seriously affected by the long suspension, and investigation has disclosed that only minor repairs will be necessary. The work of getting the mill in readiness is proceeding satisfactorily. Probably not more than three heads will be put in operation April 1, and production will probably be comparatively small for the first few months. Vein rock now being hoisted from some of the conglomerate shafts during the progress of shaft repairs will be shipped to the mill as soon as the heads are ready for it.

The State of Michigan is giving consideration to the erection of a new prison, and there is a probability that the site of the institution will be in Keweenaw County. This is of interest to stockholders of the Keweenaw Copper Co., for it is proposed to employ prisoners in the quarrying of trap rock, immense quantities of which are on the Keweenaw Copper Co.'s lands. Aside from the sale of rock to the state, a prison in Keweenaw also would mean the reopening of the Keweenaw Central railroad, owned by Keweenaw Copper. This company also owns thousands of acres of timber, which also would be available to the state for use in a prison manufactory.

Marquette and Menominee Ranges

By William H. Newett

Marquette—The Cleveland-Cliffs Iron Co. has put its charcoal pig-iron furnace in blast at Marquette. This was shut down on June 1, 1921. Three chemical byproduct plants producing alcohol, acetic acid, and gray acetate of lime were started up at the same time the furnace was lighted, as was the company's sawmill. Only the rough wood from the company's forests is used in making charcoal, the better portions of the tree being sent to market. The logs and rough wood are separated in the woods, the rough being sent to the mill at the furnace yards, where it is cut into desired lengths. At present the furnace, mill, and chemical plant is employing 325 men, and more will be added as other departments are put in operation. This plant employs about 440 men in normal times.

J. R. Thompson, a veteran mining man of the Lake Superior iron ore ranges, is now in charge of the Michigan Verde Antique Marble Co.'s quarries and at present is engaged in treating the wastes from this quarry in the old American mine's concentrator, it being converted into grits for roofing purposes. It has a fast green color that architects demand for covering felt shingles. Work of quarrying marble will be resumed some time during the coming spring.

There have been no resumptions of idle mines on the Marquette Range in the new year, and no sales of ore have as yet been reported.

The Chapin and Aragon mines, on the Menominee Range at Iron Mountain and Norway, respectively, are working half-time. One crew is employed for a week and then another takes its place, so that the men are given employment two weeks each month.

The Imperial mine, operated by Henry Ford, is now working half-time, surface construction work having been discontinued until the advent of better weather. A heavy storm made surface work difficult. The wage scale at the Imperial is $6 per day, which is higher than elsewhere in the iron country.

Gogebic Range

Ironwood—The Eureka mine has reopened with two shifts on full time, employing about 200 men.

ALABAMA

Tennessee Company Starts Two New Furnaces—Shannon Mine Resumes

By George Huntington Clark

Birmingham—Increased steel production is responsible for the blowing in of two new iron furnaces during the week ended March 2. These were the No. 4 furnace at Ensley, and the Alice furnace at Birmingham, both of the Tennessee Coal, Iron & Railroad Co.

With the blowing in of these furnaces is associated the lighting of one bank at least of the Fairfield coke ovens, auxiliary to the two new furnaces, which in turn involves the re-employment of about 300 men. Six furnaces of the Tennessee company are now in blast.

Following the recent blowing in of the furnace of the Gulf States Steel Co. at Gadsden, the Shannon mine, belonging to the company, is either now in operation or will be within a few days. This is the deep-mine operation recently described, from which, over a slope 2,816 ft. in length, self-fluxing hematite iron ore is raised from a developed vein 20 ft. thick, the entire 20 ft. being taken out.

The Situation at the Mines in February

Wages Paid in Various Districts Show General Decrease—Conditions Better in Copper Camps—Silver and Gold Operations Most Active

HEALTHIER CONDITIONS prevailed at Butte and in the copper camps in Arizona in February, owing to the resumption of operations in varying degree, this despite a weakening market. By the end of the month, Anaconda had seven mines producing 5,000 to 6,000 tons daily, with 5,500 men employed. An additional 3,000 men were working at Great Falls and Anaconda.

In Arizona, Phelps Dodge, Calumet & Arizona, Inspiration, and Arizona Commercial got under way on a limited scale, none of them, however, mining ore. Clifton-Morenci, Tyrone, and Ray remained quiet; likewise the Utah, Chino, and Nevada Consolidated companies. Western producers of importance, aside from Anaconda, were confined to Miami, New Cornelia, Engels, and Granby.

Calumet & Hecla and three subsidiaries in northern Michigan continued preparing to resume mining. C. & H., with seven furnaces; Copper Range, with three; and Quincy, with one, turned out 8,300,000 lb. of refined copper. The two producers in southeastern Tennessee ran as usual.

Conditions in general in districts throughout the country and in Canada showed little change from January. Wages continued falling here and there, a tentative lower scale being announced in Colorado. By a strike, now a rare occurrence, workmen in the Tintic district, Utah, secured a restoration of the wage scale in effect before Jan. 16, when a cut was made. Day wages, paid or earned, in various districts are given in the accompanying table.

Silver and gold operations continued to have the best of it. In Ontario, Cobalt silver companies made a normal production and Porcupine and Kirkland camps were busy.

In the Pacific Northwest, there was little change in producers or in output. The Premier mine shipped more ore to Tacoma, its tramway having been completed. Tonnage shipped by independents to Trail improved. Silversmith's high-grade went mainly to the Bunker Hill smelter, which has been running two furnaces for some time. Northport remained down. Labor continued plentiful despite an exodus to Butte. In the Coeur d'Alenes, production was confined to three large companies.

Freight rates on all commodities from Reno to southern Nevada points were cut 25 to 40 per cent. The Tonopah district produced normally. Tonopah Belmont cut its custom milling rates. Severe weather handicapped operators.

Bingham, Utah, produced about 15,000 tons of milling lead ores and sulphides for fluxing; Tintic, 27,122 tons of silver-lead ore (both unchanged); and Park City, 9,988 tons, against 8,024 in January. Labor was plentiful.

The Homestake and the Trojan companies, the only gold producers in the Black Hills, ran at capacity. Some smaller operators were active. In Colorado, Cripple Creek mills handled an increased tonnage. The freight on steam coal to this district was cut; also the price of powder. Bad weather caused smaller shipments from the Telluride district. Gold mining in California continued its slow improvement. The Randsburg silver district was busy. Oatman, Ariz., a gold camp, was active.

As for lead and zinc, about seventy-six mills ran in the Joplin-Miami district in February, compared with seventy-two in January and thirty-two in July. Production was about 7,000 tons weekly, against 5,800 tons in 1914.

Production in the Wisconsin district was unchanged from that of the last few months, or about 19 per cent of normal.

Operations in the southeast Missouri lead district were about two-thirds of normal. Those in the Mascot zinc district of Tennessee were about a third of normal.

The Lake Superior iron country was quiet, some of the operations being conducted merely to provide employment. At Birmingham fourteen stacks were in blast, representing 56 per cent of normal pig-iron production. Iron ore mined is estimated at 330,000 tons.

[illegible] METAL-MINING [illegible]

[illegible]	[illegible]	[illegible]	Jan. 1, [illegible]	[illegible]	[illegible]22
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	5.65	4.65	4.00
		[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		[illegible]	5.60	5.60	4.00
	Oatman	Machine men	[illegible]	[illegible]	[illegible]
		Muckers	5.50	5.50	4.50
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Grass Valley	Machine men	4.40	[illegible]	[illegible]–4.75
		Muckers	[illegible]	4.[illegible]	[illegible]–4.25
	Sutter Creek	Machine men	4.[illegible]	4.75	4.[illegible]
		Muckers	4.00	4.25	3.75
	Sheepranch	Machine men	4.25	4.75	4.25
		Muckers	3.75	4.25	3.75
	Randsburg	Machine men	5.00–5.50	5.50–6.50	6.00–6.50
		Muckers	4.50–5.00	5.50	4.00–5.50
	[illegible]	Machine men	4.[illegible]	5.[illegible]	4.[illegible]
		Muckers	4.00	4.50	3.50
	[illegible]	Machine men	4.50	5.[illegible]	4.[illegible]
		Muckers	4.00	4.50	4.00
Colorado	Ouray	Machine men	5.00–5.50	[illegible]	4.50 (a)
		Muckers	4.[illegible]	4.50	4.00 (a)
	Telluride	Machine men	5.00	4.[illegible]	4.[illegible] (a)
		Muckers	4.50	4.00	4.00 (a)
	Cripple Creek	Machine men	4.50	5.00	4.50
		Muckers	3.75	4.25	3.75
	Breckenridge	Machine men	5.00	5.25	5.25 (a)
		Muckers	4.50	4.75	4.75 (a)
	Eureka	Machine men	5.75	5.75	5.25 (a)
		Muckers	4.75	4.75	4.25 (a)
Idaho	Kellogg	Machine men	5.25	4.75	4.25
		Muckers	5.00	4.50	4.00
	Quartzburg	Machine men	....	....	4.75
		Muckers	....	....	4.00
	Wallace	Machine men	5.25–5.75	4.75	4.25
		Muckers	5.25–5.75	4.50	4.00
	Salmon	Machine men	5.00	4.00	4.00
		Muckers	4.50	3.50	3.50
	Portbill	Machine men	5.00	6.00	4.50
		Muckers	4.50	5.50	4.25
Michigan	Copper Ctry.	Machine men	4.80–5.00	3.50–4.[illegible]	3.15
		Muckers	4.60–4.80	3.25–3.50	2.70–2.85
	Iron Country	Machine men			4.60 (b)
		Common labor			[illegible]
Minnesota	Cuyuna range	Miners	6.68 (c)	6.85 (c)	4.00 (c)
		Muckers (hour)	.64	.58	.58
	Mesabi range	Machine men	5.23	5.76	4.31
		Muckers	5.00	5.52	4.13
		Shovel runners	10.50 (e)	11.55 (e)	7.78 (e)
Missouri	S.E. lead dist.	Machine men	4.80	4.00	3.15
		Muckers	3.70	3.95	3.10
	Joplin-Miami	Machine men	4.75–6.00	4.00–4.50	3.00–3.50
		Muckers	.12 car	.08 car	.06 car
Montana	Butte	Machine men	5.25–5.75	4.75–5.75	4.25
		Muckers	4.75–5.75	4.25–5.75	3.75–4.25
	Marysville	Machine men	5.00	4.50	4.00
		Muckers	5.00	4.50	4.00
Nevada	Pioche	Machine men	5.00	4.75	4.50
		Muckers	4.75	4.50	4.25
	Tonopah	Machine men	6.00	6.00	5.25
		Muckers	5.50	5.50	4.75
	Mina	Machine men		5.50	5.00
		Muckers		5.00	4.50
	Round Mtn.	Machine men	5.50	5.50	5.50
		Muckers	5.00	5.00	5.00
New Mexico	Mogollon	Machine men	4.00–4.50	4.00–4.50	3.75–4.25
		Muckers	3.50	3.50	3.25
New York	Gouverneur	Machine men	4[illegible] 9 hr.	45[illegible] 9 hr.	36[illegible] 8 hr.
		Muckers	41[illegible] 9 hr.	40[illegible] 9 hr.	[illegible] 8 hr.
Ontario	Porcupine	Machine men	4.00	5.2[illegible]	4.[illegible]
		Muckers	3.52–4.00	4.72	4.24
	Cobalt	Machine men	5.50	5.25	4.50
		Muckers	4.75	4.50	3.75
Oregon	Cornucopia	Machine men	5.00–5.50	5.50	4.50
		Muckers	4.50–5.00	4.50	4.00
Penn.	Cornwall	Machine men	4.16	4.40	2.80
		Muckers	3.80	4.00	2.30
	French Creek	Machine men	4.8[illegible] 8 hr.		3.36 8 hr.
		Muckers	3.[illegible] 8 hr.		2.80 8 hr.
So. Dakota	Lead	Machine men	4.00	5.00	4.50
		Muckers	3.60	4.25	3.75
	Deadwood	Machine men	4.25	5.00	4.50
		Muckers	4.[illegible]	4.50	4.00
Tennessee	Ducktown district	Machine men	[illegible].42	3.92	2.16–3.28
		Muckers	3.60	3.60	1.92–2.96
	Mascot	Machine men	4.24	3.78	3.06
		Muckers	3.04	3.06	2.43
Utah	Eureka	Machine men	[illegible].25	4.50	4.00
		Muckers	4.75	4.00	3.50
	Lark	Machine men	[illegible]	4.50	3.75
		Muckers	4.50	4.00	3.25
	Bingham Canyon	Machine men	5.[illegible]	5.25 (d)	3.75 (d)
		Muckers	4.5[illegible]	4.75 (d)	3.25 (d)
Wisconsin	Platteville	Machine men	4.00 9 hr.	3.85/9 hr.	3.50/9 hr.
		Muckers	4.50 9 hr.	4.25/9 hr.	3.75/9 hr.
British Columbia	Anyox	Machine men	6.00	5.25	4.00
		Muckers	5.50	4.75	3.70

(a) 50c. decrease announced, subject to approval by Industrial Commission.
(b) Oliver Iron Mining Co.'s scale. Nearly all underground mining on contract.
(c) All contract labor—average wages received.
(d) Rates in effect, though none employed.
(e) Plus bonus.

THE MARKET REPORT

Daily Prices of Metals

Mar.	Copper, N. Y., net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
[illegible]	12.5[illegible]	28.375	29.25	4.70	4.40	4.575
[illegible]	12.50	28.75	[illegible]	4.70	4.375@4.40	4.60
[illegible]	12.50	28.625	[illegible]	4.70	4.375@4.40	4.60
[illegible]	12.50@12.625	28.75	[illegible]	4.70	4.375@4.40	4.625
[illegible]	12.625	28.125	29.00	4.70	4.375@4.40	4.65
[illegible]	[illegible]	28.125	29.00	4.70	4.375@4.40	4.65

*These prices correspond to the following quotations for copper delivered March 2, 12.75c.; 3d, 12.75c.; 4th, 12.75c.; 6th, 12.75@12.875c.; 7th, 12.875c.; 8th, 12.90c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Mar.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
[illegible]	59	59⅞	64	141¾	143¾	20½	20⅜	24¾	25⅛
[illegible]	[illegible]	60¼	64½	143⅜	145⅜	20⅞	20⅝	24⅞	25¼
4									
[illegible]	[illegible]	[illegible]	[illegible]	144¾	[illegible]	20¾	20⅝	25⅛	25⅜
[illegible]	60[illegible]	61[illegible]	65[illegible]	142	144	20⅝	20½	25⅜	25½
[illegible]	61[illegible]	62⅛	[illegible]	142[illegible]	144[illegible]	20¾	20⅝	25⅞	25⅞

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Mar.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	Mar.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
[illegible]	441	99⅝	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	63¼	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	64¼	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	99⅝	63½	[illegible]

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Metal Markets

New York, March 8, 1922

The recovery in the copper and zinc markets which was indicated last week has continued, and producers feel more optimistic than for some time. Tin has been buffeted about by varying London quotations and unsteady sterling exchange rates. Lead continues steady.

Copper

It is still too early to say whether the improved demand of the last ten days is the forerunner of an important buying movement or is to be of much more meager proportions. The character of the buying would indicate that consumers are still cautious, for the sales, though numerous, have been for comparatively small tonnages. The industry would benefit if this condition were to continue and the waves of buying be superseded by a steady demand for small tonnages, as is the condition in the lead market. Copper was in good demand on Thursday and Friday, the bulk of the metal going at 12.75c. delivered, for April shipment, though some small tonnages were sold at ⅛c. above this level, especially where May or June delivery was wanted. By Monday, producers were so encouraged that they generally raised their quotations to 12.875 and 13c., and it was evident that practically all of the 12.75c. copper had been disposed of. This advance somewhat stilled the demand, and only a little copper was sold at the 13c. level, now generally quoted. It was still possible today to get the metal at concessions under this price, and most of the sales were so made. Not a great deal of metal is available under 13c., however, and if demand is good in the next day or so the price will likely advance to that level. Wire-drawers have been the chief buyers.

Export business has been of a satisfactory nature. The tonnages sold have not been large individually, but the demand has come from many different countries and indicates the widening possibilities of the foreign market. The prices now being quoted generally net producers here slightly less than 13c.

Lead

The American Smelting & Refining Co. continues its official contract price of 4.70c. in the New York market. A disposition to meet the current market in the Middle West is indicated by a reduction of the St. Louis price on desilverized lead to 4.50c. which was made effective last Wednesday. Federal lead is quoted 10 points below this.

Demand has not been so great during the last week as in the preceding one, though it continues extremely satisfactory, and producers are well sold up for their current production. Much of the business placed has been for carload lots. Corroders, lead-pipe manufacturers, cartridge, and cable makers continue active. It is on the paint business, however, that many of the producers are depending for continued satisfactory conditions. Corroders are working on a much larger scale than at this time last year, and their product is in demand from dealers. It remains to be seen, though, whether painting will continue this summer on as large a scale as last, and this can hardly be indicated much before the middle of April. Should the consumer demand for paint come up to expectations, lead producers and corroders will rest easy.

The St. Louis market remains practically unchanged, though it has again been possible to pick up lead at 4.375c. This is not significant, however, for those representing one of two or three interests seem to quote at this level for awhile, and then go up to 4.40c., returning to the even fraction when they accumulate a little more lead than they wish to carry. Desilverized lead in St. Louis is worth about 4.50c., and in Chicago, 4.525@4.55c.

Zinc

The market has a strong undertone. An increased demand from consumers and dealers advanced prices steadily, so that today we hear of no zinc offered below 4.65c. per lb. and higher prices have been asked. A feature of the week's trading was the sale yesterday of 250 tons for shipment to Continental

Europe at a price that netted the seller slightly above the domestic quotation. Although mention has frequently been made of the possibility of a European demand for American zinc developing, this is the first sale of that character reported. If the demand abroad continues, it will be favorably reflected in domestic prices. High-grade business is still good, at unchanged prices on the basis of 6c., with freight allowed. Zinc for forward delivery commands a premium of about 5 points per month.

Tin

Tin is again extraordinarily cheap, but no great rush to buy on the part of consumers is reported. Lower quotations on sterling have had a great effect in upsetting the market, but an early recovery seems likely.

Straits tin for June delivery was quoted as follows: March 2d, 29.125c.; 3d, 29.375c.; 4th, 29.5c.; 6th, 29.5c.; 7th, 28.875c.; 8th, 29c.

Arrivals of tin, in long tons: Total for February, 3,290. March 1st, Straits, 1,130; Rotterdam, 25; 6th, Batavia, 50; 7th, Straits, 1,350; China, 50.

Gold

Gold in London: March 2d, 93s. 6d.; 3d, 93s. 6d.; 6th, 94s. 6d.; 7th, 94s. 6d.; 8th, 95s.

Foreign Exchange

Heavy selling of London and European bills has depressed exchanges somewhat. On Tuesday, March 7, francs were 8.95c.; lire, 4.97c.; and marks, 0.38625c. New York funds in Montreal, 4 13/16 per cent premium.

Silver

Heavy buying by the Indian bazaars on March 3 and 7 caused a sharp advance in the London market on those dates. The bazaars have also been sellers, and with China operating on both sides of the market during the last week, conditions have been highly speculative, and it is hard to predict the tendency. Sterling exchange also adds to the uncertainty. The New York market continues at a lower level than the London spot equivalent, and at no time recently has business been on more than a moderate scale. San Francisco reports no business.

Mexican Dollars—March 2d, 48¼; 3d, 49; 4th, 48¾; 6th, 48⅝; 7th, 49¼; 8th, 48¾.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 16@17c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 4.25c.; market dull. W.C.C. brand, 5@5¼c. per lb. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—7@7½c. per lb.

Bismuth—$2@$2.10 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Iridium—Nominal, $170@$190 per oz.

Nickel—Standard market, ingot and shot, 41c.; electrolytic, 44c. Small tonnages, spot, nominal at 32c.

Palladium—Nominal, $55@$60.

Platinum—$85@$90 per oz.

Quicksilver—$50 per 75-lb. flask. San Francisco wires $48. Strong.

The prices of **Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of March 4.

Metallic Ores

The prices of **Bauxite, Chrome, Manganese, Tungsten, Molybdenum, Tantalum, Uranium, Vanadium**, and **Iron Ore, Zircon and Zirkite** are unchanged from the prices in the issue of March 4.

Zinc and Lead Ore Markets

Joplin, Mo., March 4—Zinc blende, per ton, high, $30.35; basis 60 per cent zinc, premium, $27@$26; Prime Western, $25@$24; fines and slimes, $23; average settling price, all zinc ores, $26.39.

Lead, high, $63.85; basis, 80 per cent lead, $60; average settling price, all lead ores, $62.10 per ton.

Shipments for the week: Blende, 5,966; lead, 2,078 tons. Value, all ores the week, $286,480.

A larger tonnage was purchased this week on $25 basis, buyers finding after four weeks' attempt to hammer down prices that producers would market only a limited tonnage at a lower figure. The week opened with a blizzard, the worst of the winter, restricting production about 25 per cent. Shipments were smaller, the storm interfering with loading the ore on cars. The continued high price for lead ore has advanced production from about 1,500 tons last fall to over 2,000 tons per week. Increasing lead production has also increased zinc production, until the latest survey places an estimate at 7,500 tons per week.

Platteville, Wis., March 4—Blende, basis 60 per cent zinc, $26.50 per ton. Lead ore, basis 80 per cent lead, $60 per ton. Shipments for the week: Blende, 137 tons. Shipments for the year: Blende, 1,840; lead ore, 560 tons. Shipped during the week to separating plants, 472 tons blende.

Non-Metallic Minerals

Barytes—Crude, $6@$8 per ton, f.o.b. mines. Ground, white, $17@$23; off-color grades, $13@$21 per ton, f.o.b. mills. Producers in the South report dull market for crude but better business than in 1921.

Fluorspar—Fluxing lump, $20; fluxing gravel, $17.50; No. 1 ground, $50@$55, No. 2 ground $40 per ton, f.o.b. Illinois mines. Market dull.

There are no price changes from those indicated in the market report of the issue of March 4 covering **Asbestos, Borax, Chalk, China Clay, Emery, Feldspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, and Talc.**

Mineral Products

The prices of **Copper Sulphate, Potassium Sulphate, Sodium Nitrate**, and **Sodium Sulphate** are unchanged from the issue of March 4.

Ferro-Alloys

Ferrovanadium—$3.55 per lb. of V contained, according to analyses and quantity.

The prices of **Ferromanganese, Ferrotitanium, Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotungsten** and **Ferro-uranium** are unchanged from the issue of March 4.

Metal Products

The prices of **Copper Sheets, Lead Sheets, Nickel Silver, Yellow Metal, and Zinc Sheets** are unchanged from the issue of March 4.

Refractories

The prices of **Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick**, and **Silica Brick** are unchanged from the issue of March 4.

The Iron Trade

Pittsburgh, March 7, 1922

There seems to have been a slight decrease in the buying of finished-steel products in the past week or two. Steel mill operations, on the whole, have shown no decrease, the rate of steel ingot production being approximately 29,000,000 tons per annum, against rates of under 18,000,000 tons at the end of December and 23,000,000 tons in October and November. The rate is almost up to the average of 1912 and 1913, the two heaviest tonnage years before the war.

Bars, shapes, and plates did not become stabilized at the low price of 1.40c. recently reached, but have sold in many cases at $1 a ton less and in a few cases at slightly lower prices still. Sheets, on the other hand, are stiffly maintained at prices ruling for more than three months. Shading in tubular goods has increased somewhat. Nails are fairly steady at $2.40, a price now made to smaller buyers than a few weeks ago.

Pig Iron—The Snyder averages for February are reported at $19.50 for bessemer and $17.75 for basic, indicating that no Valley basic in 1,000-ton lots sold at above $17.75 in the month, this being therefore the fair market quotation. Foundry remains at $18.75 to $19, Valley, depending on tonnage of the order.

Coke

Connellsville—Furnace, $3.25@$3.50; foundry, $4.25@$4.75.

Western Fluorspar Mines Active

Producers in New Mexico Competing in Eastern Markets With Middle Western Operators

By Alford Roos

[illegible]

THE market for Western fluorspar is improving slowly, with increased demand for fluxing grades. Prices at which the mineral has recently been sold are: Ground, 75 per cent through 100 mesh, minimum 96 per cent CaF_2, $26; gravel lump fluxing, minimum 85 per cent CaF_2, $13.50 per ton, f.o.b. cars, New Mexican shipping points.

Glass works at Muncie, Ind., have been taking practically the entire production of ground acid grade from New Mexico under contracts with the producers. Additional orders and inquiries from other consumers have been refused, the output being insufficient, indicating the demand is greater than the supply at present. Demand for flux from Pacific Coast consumers has fallen off. Eastern steel consumers are making increased inquiries.

Since the recent closing down of the Great Eagle fluorspar mine, in New Mexico, production of fluorspar in the United States has practically ceased, with ample stocks on hand to provide for the present consumption for a period of several months. A noteworthy exception is the operation of the Tortuga Fluorspar Mine, at Mesilla Park, N. M. This property has been a steady producer for more than two years without a day's shutdown. An additional unit to the new mill has been completed and functions perfectly. Simple crushing and jigging raises the mine run from 55 to 96 per cent. The finished concentrate is dry pulverized in a standard ball mill. Electrical power is used throughout.

For the first time, Western fluorspar is able to compete successfully with the old Illinois-Kentucky fields, which heretofore have supplied the greater part of the national consumption. This is a noteworthy turning point in the annals of American fluorspar production, when, notwithstanding the distance from market and attendant higher freight rates, a Western fluorspar mine continues to operate under adverse national economic conditions which have closed down practically every Eastern fluorspar mine in the country. At a market price which means operation at a loss to the Illinois-Kentucky operators, a New Mexican fluorspar mine not only continues to operate, but sells its product and produces at a profit and at the same time carries on development and improvement out of profits.

The reason for this is probably that the depletion of the old Illinois-Kentucky field was greatly hastened by boom war times and high prices. The post-war collapse has found these Eastern mines in a position where cost of production is higher, with the prospect of steadily becoming more so, as greater depth in mining becomes necessary. The cream of these old deposits has long been skimmed, and the water-pumping problem ever becomes more acute. Higher costs, with a market price approximately that of before the war and increased freight rates, have forced the mines to close down. The Western fluorspar mines, though feeling keenly many of these conditions, which have also closed down a number of them, are more advantageously situated in many respects, for an abundance of fluorspar of a good grade in large veins is found without expensive pumping problems, most of them being developed by tunnels rather than shafts, and, in addition, it has not been necessary to go to depth to get ore.

When the steel industry gets back to normal (speed the day!) a consumption of fluxing fluorspar greatly in excess of the pre-war period may be looked for with confidence, due largely to the fact that for the last six years most of the steel-manufacturing expansion has been toward basic open-hearth, rather than acid Bessemer processes.

Where will the additional fluorspar, which is so absolutely necessary to the basic open-hearth process, come from, now that the Eastern fluorspar production has reached its peak? The answer seems to be that more and more the country must look to the West for its fluorspar or make up the difference by foreign importation, upon which a moderate import duty should be imposed.

Ore and Metal Movements for January, 1922

Imports and exports of the more important metals and ores during January, 1922, as reported to the Department of Commerce, and the figures for January, 1921, as finally revised, are as follows:

IMPORTS

In Pounds, Unless Otherwise Stated

	January, 1921	January, 1922
Antimony ore, contents	20,200	....
Antimony matte, regulus or metal	616,080	1,070,781
Copper		
Ore, contents	3,524,293	4,754,304
Concentrates, contents	3,225,568	119,147
Matte and regulus, contents	1,884,345	2,263,525
Imported from		
Spain	....	1,412,679
Canada	331,302	636,857
Mexico	2,784,078	2,211,238
Cuba	1,220,061	....
Chile	608,259	463,499
Peru	677,903	24,834
Unrefined, black and blister	21,456,013	5,178,068
Refined, in bars and plates	9,630,984	13,519
Old, for remanufacture	35,549	551,920
Composition metal, copper chief value	13,440	....
Lead		
Ore, contents	1,627,377	215,189
Bullion, contents	5,561,802	12,651,067
Imported from		
Canada	937,893	61,047
Mexico	6,205,058	12,799,009
Chile	38,845	....
Other countries	7,383	6,200
Pigs, bars and old	905,409	302,871
Manganese ore, long tons	49,699	9,500
Imported from		
Cuba, long tons	(a)	(a)
Brazil, long tons	24,600	9,500
British India, long tons	10,700	.. .
Tungsten ore, long tons	(a)	(a)
Pyrites, long tons	13,699	30,243
Imported from		
Spain, long tons	11,049	30,203
Canada, long tons	....	40
Other countries	2,650	......
Tin ore, long tons	1,441	79
Bars, blocks and pigs	2,584,347	9,102,703
Imported from		
United Kingdom	866,908	3,423,534
British Straits Settlements	1,291,435	5,367,632
Hongkong	213,546	67,377
Australia	156,541	244,160
Zinc		
Ore, contents	946,532	50,000
Imported from		
Canada	84,838	50,000
Mexico	861,694	....
Blocks, or pigs, and old	86	....

(a) No imports in January of either year.

EXPORTS OF COPPER, LEAD AND ZINC

In Pounds	January, 1921	January, 1922
Copper		
Ore, concentrates, matte and regulus (copper content)	131,250	6,035
Unrefined, black and blister	2,247	56,107
Refined, in ingots and bars	50,783,972	50,096,690
Exported to		
Belgium	1,549,487	3,405,727
France	15,011,994	7,985,565
Germany	18,801,672	16,289,741
Italy	129,604	4,428,122
Netherlands	2,223,367	728,831
Spain	559,243	1,199,511
Sweden	880,010	897,029
United Kingdom	8,667,714	2,756,851
Canada	769,063	113,299
Japan	250	9,961,095
Other countries	2,191,471	2,330,919
Old and scrap copper	142,166	796
Composition metal, copper chief value	6,632	2,959
Pipes and tubes	792,985	78,976
Plates and sheets	1,161,162	226,106
Rods	....	2,307,291
Wire	1,922,887	360,935
Lead		
In pigs and bars	3,455,224	12,424,859
From domestic ore	150,517	939,688
From foreign ore	3,304,707	11,485,171
Exported to		
France	....	7,520,495
United Kingdom	2,464,305	1,792,460
Canada	95,295	94,754
Argentina	20,000	224,032
Brazil	2,200	560,084
China	(a)	(a)
Japan	672,000	....
Other countries	201,424	2,233,034
Zinc		
Dross	69,100	911,090
Spelter		
Produced from domestic ore	2,582	1,690,146
Produced from foreign ore	....	85,676
Exported to		
France	....	795,306
Italy	....	78,440
United Kingdom	(a)	(a)
Canada	....	74,002
Mexico	446	89
Argentina	(a)	(a)
Japan	......	112,010
Other countries	2,136	715,975
Rolled in sheets and strips	419,934	385,358
Dust	....	499,729

(a) No exports in January of either year.

COMPANY REPORTS

St. Joseph Lead Co.

A report of operations of the St. Joseph Lead Co. for 1921 states that dividends to the amount of $1,549,363.75 in cash have been paid to stockholders and to minority stockholders in subsidiary companies $235,078.

The changes in surplus in the fiscal year may be commented on briefly as follows: Diamond drilling having disclosed additional ore reserves not included in the Finlay appraisal, of an appraised value of $3,500,000, it was deemed advisable to reflect this fact in the consolidated balance sheet of the company. There was a deficit of $185,011.33 after all charges for depreciation and depletion resulting from the operation for the fiscal year. There was produced 2,266,911 tons of ore, 141,351 tons of concentrates, and 70,948 tons of pig lead. The sales of pig lead for the year amounted to 63,887 tons.

CONSOLIDATED GENERAL BALANCE SHEET, DEC. 31, 1921
ASSETS, ST. JOSEPH LEAD CO.

Capital assets			
Ore reserves and mineral rights	$21,704,454.99		
Less reserve for depletion..	8,221,722.86		
		$13,482,732.13	
Buildings and equipment at mines and smelter....	$7,843,534.19		
Less reserve for depreciation	1,000,554.61		
		6,842,979.58	
Real estate		99,659.28	
Farm lands, buildings, and equipment	$563,662.37		
Less reserve for depreciation	14,172.11		
		549,490.26	
Railroad property and equipment	$4,321,534.48		
Less reserve for depreciation	504,620.15	3,816,914.33	$24,791,775.58
Investment—Missouri-Illinois Railroad Co.			302,800.00
Sinking fund and reserve fund assets—cash and accrued interest			14,334.08
Current assets			
Cash		$1,244,789.98	
Cash in transit		179,946.00	
Liberty Loan bonds, par value $860,000		788,998.01	
Accounts and notes receivable		665,630.77	
Lead on hand and in process		1,877,304.53	
Materials and supplies		1,344,541.90	
Store accounts (net)		39,584.46	6,130,795.65
Deferred debit items			329,154.30
			$31,568,859.61

Montana-Bingham Consolidated Mining Co.

A report of operations of Montana-Bingham Consolidated Mining Co. for 1921 states that a deficit of $50,80[illegible] was incurred, as the following income and profit and loss summary shows:

Ore sales less deductions [illegible] taxes		$140,188.82
Operating expenses, [illegible]	$84,447.51	
General and administrative expenses	1[illegible].14	[illegible]
Profit from operation		$4[illegible].17
Other income received [illegible] royalties [illegible]		1,[illegible].76
Gross income		$43,556.93
Income charges, including depletion		6[illegible].83
Net loss for the period		$24,[illegible]
Prospecting and development expenses charged [illegible]	$24,776.56	
Taxes applicable to 1920 operations	[illegible].07	26,[illegible].63
Net deficit for the period		$5[illegible]

Balance sheet Dec. 31, 1921, shows current assets, $37,396.91; current liabilities of $7,318.50, and surplus account of $759,490.83.

Production in 1921 amounted to 23,146.6 dry tons, of gross value, $192,027.58, smelter returns being $140,188.82. Metal contents were 1,354.9 oz. gold, 42,869 oz. silver, 1,581,857 lb. copper, and 21,402 lb. lead.

Chief Consolidated Mining Co.

A report of operations of the Chief Consolidated Mining Co. for 1921 states that conditions as to the mine and the general work of the company have continued to be extremely satisfactory. Much progress has been made in securing additional property on reasonable terms, and the acquisition of the Grand Central mine "is bound to prove a profitable venture ultimately, though it may be necessary to spend considerable of its earnings in its further development." Metal contents of ore mined was: gold, 4,353 oz.; silver, 3,262,241 oz.; lead, 12,496,433 lb., and copper, 11,563 lb. Average gross value of all ores was $41.89; smelting, freight, and sampling amounted to $18.65 per ton. The net profit after payment of all charges was $336,998.27.

On Dec. 31, 1921, current assets were $280,624.87 and current liabilities, $193,319.65. Surplus on Dec. 31, 1920, was $1,641,710.30; adding profits on operation of $336,998.27, interest on investments, $25,729.76, and subtracting dividends of $176,805.40, leaves surplus on Dec. 31, 1921, of $1,827,632.93.

LIABILITIES, ST. JOSEPH LEAD CO.

Capital stock				
St. Joseph Lead Co.:				
Authorized—2,000,000 shares of $10 each; issued 1,605,744.6 shares			$16,057,446.00	
Less held in treasury, 56,332 shares			563,320.00	
				$15,494,126.00
Subsidiary companies, minority stock held by public				235,640.08
Funded debt				
Mississippi River & Bonne Terre Ry., first mortgage 5 per cent bonds, due 1931			$2,500,000.00	
Less				
Held in sinking fund		$532,000.00		
Held in treasury		597,000.00	$1,129,000.00	1,371,000.00
Current liabilities				715,915.38
Deferred credit items				126,874.14
Reserves				
Profit on lease agreements			$28,715.39	
Premium on bonds to be purchased for sinking fund			23,126.32	
Contingencies (includes unused portion of provision for Federal taxes in prior years)			$1,155,295.10	
				1,207,136.81
Surplus				
Balance, March 1, 1913			$3,925,000.00	
Less amortization distributions therefrom			3,523,665.00	
				$401,335.00
Undistributed profits accumulated March 1, 1913, to Dec. 31, 1920		$10,697,617.31		
Add				
Revaluation of ore reserves and mineral rights due to diamond drilling	$3,500,000.00			
Miscellaneous surplus adjustments (net)	13,122.03	3,513,122.03		
Total		$14,210,739.34		
Deduct				
Adjustments of city, state and Federal taxes (net)	$73,211.14			
Exploration department expenses transferred from ore reserves and mineral rights account	151,242.84	224,453.98		
		$13,986,285.36		
Net income for the year ended Dec. 31, 1921, after providing for depreciation of plant and equipment	$1,096,272.73			
Less provision for depletion of ore reserves and mineral rights	$1,281,284.96	185,011.33(a)		
Total		$13,801,274.03		
Less dividends paid in 1921		1,784,441.75		
Remainder			$12,016,832.28	$12,418,167.28
Total				$31,568,859.61

(a) Deficit for the year.

MINING STOCKS

Week Ended March 4, 1922

Stock	Exch.	High	Low	Last	Last Div.	
			COPPER			
Ahmeek	Boston	68	60	[illegible]	Sept. '20, Q	$0.50
Alaska-Br. Col.	N. Y. Curb	[illegible]	[illegible]	[illegible]		
Allouez	Boston	27	25	[illegible]	Mar. '19	1.00
Anaconda	New York	49¼	48¼	[illegible]	Nov. '20, Q	1.00
Arcadian Consol.	Boston	2¾	2½	2½		
Ariz. Com'l.	Boston	8¼	8	8	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*25	*19	*23		
Bingham Mines	Boston	†13½	†13	13	Sept. '19, Q	0.25
Calumet & Arizona	Boston	58½	57¼	58	Dec. '21, Q	0.50
Calumet & Hecla	Boston	280	276	277	June '20, Q	5.00
Canada Copper	N. Y. Curb	*25	*20	*20		
Centennial	Boston	†12	†10	11	Dec. '18, SA	1.00
Cerro de Pasco	New York	35	32¾	34¼	Mar. '21, Q	0.50
Chile Copper	New York	17¼	16¾	17		
Chino	New York	26¼	25½	26	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	†*31	†*27	*30		
Con. Arizona	N. Y. Curb			*2	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	1⅝	1½	1⅝		
Copper Range	Boston	42½	40½	42¼	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	*57	*54	*55		
Davis-Daly	Boston	7¾	7½	7½	Mar. '20, Q	0.25
East Butte	Boston	11	10½	11	Dec. '19, A	0.50
First National	Boston Curb	*60	*60	*60	Feb. '19, SA	0.15
Franklin	Boston	†2	†1¼	1¾		
Gadsden Copper	Boston Curb	*60	*43	*50		
Granby Consol.	New York	29	27½	29	May '19, Q	1.25
Greene-Cananea	New York	26½	25½	26	Nov. '20, Q	0.50
Hancock	Boston	2¾	2½	2¾		
Howe Sound	N. Y. Curb	3¼	2¾	3¼	Jan. '21, Q	0.05
Inspiration Consol.	New York	39½	38	39½	Oct. '20, Q	1.00
Iron Cap	Boston Curb	†*8	†*7½	*7½	Sept. '20, K	0.25
Isle Royale	Boston	24	22	24	Sept. '19, SA	0.50
Kennecott	New York	28½	27¾	28¼	Dec. '20, Q	0.50
Keweenaw	Boston	1½	1½	1½		....
Lake Copper	Boston	2½	2¼	2½		
La Salle	Boston	2	†1¾	1⅞		
Magma Copper	N. Y. Curb	30¼	28	29½	Jan. '19, Q	0.50
Majestic	Boston Curb	*6	*5	*6		
Mason Valley	Boston	1½	†1½	1½		
Mass Consolidated	Boston	2¾	2	2	Nov. '17, Q	1.00
Miami Copper	New York	27¼	26¼	27½	Feb. '22, Q	0.50
Michigan	Boston	2¼	†1¾	2		
Mohawk	Boston	57	56	57	Feb. '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	8¼	7½	8		
Nevada Consol.	New York	14½	13¾	14¼	Sept. '20, Q	0.25
New Cornelia	Boston	18	17¼	18	Feb. '22, K	0.25
North Butte	Boston	11½	11	11½	Oct. '18, Q	0.25
North Lake	Boston			*25		
Ohio Copper	N. Y. Curb	*10	*7	*9		
Old Dominion	Boston	†25	†23	23	Dec. '18, Q	1.00
Osceola	Boston	33¼	32	33¼	June '20, Q	0.50
Phelps Dodge	Open Mar.	†171	†168		Jan. '22, Q	1.00
Quincy	Boston	44	44	44	Mar. '20, Q	1.00
Ray Consolidated	New York	14½	13¾	14⅛	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*5	*3	*4		..
St. Mary's Min. Ld.	Boston	45	44½	44⅞	Dec. '21, K	1.00
Seneca Copper	Boston	14	11¾	14		
Shannon	Boston	*90	*90	*90	Nov. '17, Q	0.25
Shattuck Arizona	New York	7¼	7	7¼	Jan. '20, Q	0.25
South Lake	Boston	*80	*80	*80		
Superior & Boston	Boston	1⅛	*99	*99		
Tenn. C. & C. cfs.	New York	10¼	10	10¼	May '18, I	1.00
Tuolumne	Boston	*55	*50	*50	May '13,	0.10
United Verde Ex.	Boston Curb	28	27¼	28	Feb. '22, Q	0.25
Utah Consol.	Boston	2¼	2¼	2¼	Sept. '18,	0.25
Utah Copper	New York	63¼	61½	62¼	Dec. '21, Q	0.50
Utah Metal & T.	Boston	1⅛	1	1	Dec. '17,	0.30
Victoria	Boston	2¼	2¼	2¼	......	....
Winona	Boston	†*50	†*40	*40	....	....
Wolverine	Boston	10¼	10¼	10¼	....	....
			NICKEL-COPPER			
Internat. Nickel	New York	13¼	11¾	13½	Mar. '19,	0.50
Internat. Nickel, pfd.	New York	66	65	66	Feb. '22, Q	1.50
			LEAD			
National Lead	New York	90	87	89¼	Dec. '21, Q	1.50
National Lead, pfd.	New York	112	112	112	Dec. '21, Q	1.75
St. Joseph Lead	New York	13¼	13¼	13¼	Dec. '21, Q	0.25
			QUICKSILVER			
New Idria	Boston	*50	*50	*50	.	...
			ZINC			
Am. Z. L. & S.	New York	13¾	12½	13½	Nov. '20,	1.00
Am. Z. L. & S. pfd.	New York	37¼	36½	37½	Nov. '20, Q	1.50
Butte C. & Z.	New York	5¼	5¼	5¼	June '18,	0.50
Butte & Superior	New York	27¼	25¾	27	Sept. '20,	1.25
Callahan Zn.-Ld.	New York	5½	5¼	5½	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	137	136	137	Feb. '22, Q	2.00
Yellow Pine	Los Angeles			*50	Sept. '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce; Colorado Springs, The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.	
			GOLD			
Alaska Gold	New York	¼	¼	⅜	..	
Alaska Juneau	New York	¾	¾	¾	. .	.
Carson Hill	New York	14½	13¾	14		
Cresson Consol. G.	N. Y. Curb	2 13/16	2¾	2 13/16	Jan. '22, Q	$0.10
Dome Extension	Toronto	1.00	1.00	1.00		
Dome Mines	New York	25	24⅝	24⅝	Jan. '22, Q	0.25
Florence Goldfield	N. Y. Curb	*27	*21	*23		
Golden Cycle	Colo. Springs	*77	*73	*75	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb			*4	Dec. '19,	0.05
Hollinger Consol.	Toronto	9.00	8.50	8.9	Feb. '22,	0.05
Homestake Mining	New York	60½	60	60½	Feb. '22, M	0.25
Kirkland Lake	Toronto	*44	*38½	*39½		
Lake Shore	Toronto	1.70	1.55	1.59	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	14.90	14.50	14.65	Jan. '22, K	0.05
Porcupine Crown	Toronto	*26	*23½	*24	July '17,	0.03
Porcupine V. N. T.	Toronto	*27	*25½	*26		...
Portland	Colo. Springs	*38	*38	*38	Oct. '20, Q	0.01
Schumacher	Toronto	*46	*43½	*44	....	...
Silver Pick	N. Y. Curb			*2	....	...
Teck Hughes	Toronto	*40	*38½	*39		
Tom Reed	Los Angeles	.	.	*77	Dec. '19,	0.02
United Eastern	N. Y. Curb	2	1⅞	1 15/16	Jan. '22, Q	0.15
Vindicator Consol.	Colo. Springs	†*21	†*20	*21	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*3	*3	*3	...	
Yukon Gold	N. Y. Curb	1⅛	1⅛	1⅛	June '18,	0.02½
			SILVER			
Batopilas Mining	New York	⅝	½	⅝	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*34	*29½	*30	May '20, K	0.03
Coniagas	Toronto	1	1	1	May '21, Q	0.12½
Crown Reserve	Toronto	*19½	*18	*19	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3¼	3⅛	3¼	Jan. '22, Q	0.12½
La Rose	Toronto	*63½	*51	*52	Apr. '18,	0.02
McKinley-Dar.-Sav.	Toronto	*23	*18	*21	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.12	1.00	1.10	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅜	6⅛	6¼	Jan. '22, Q	0.15
Ontario Silver	New York	5½	5¼	5½	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb			*12	Jan. '12,	0.10
Temiskaming	Toronto	*33	*30	*31	Jan. '20, K	0.04
Trethewey	Toronto	*9	*5	*6	Jan. '19,	0.05
			GOLD AND SILVER			
Boston & Montana	N. Y. Curb	*41	*34	*39	....	....
Cash Boy	N. Y. Curb	*5	*4	*4	....	....
Dolores Esperanza	N. Y. Curb	1	*90	1	....	...
El Salvador	N. Y. Curb	*4	*2	*3	....	....
Jim Butler	N. Y. Curb	*6	*5	*5	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	*3	*3	*3	June '16,	0.05
MacNamara M. & M.	N. Y. Curb	*8	*5	*5	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1 9/16	1½	1 9/16	Jan. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*59	*47	*47		
Tonopah Extension	N. Y. Curb	1¾	1⅝	1⅝	Jan. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1¾	1 9/16	1⅝	Oct. '21, SA	0.05
West End Consol.	N. Y. Curb	*80	*52	*72	Dec. '19, SA	0.05
			SILVER-LEAD			
Caledonia	N. Y. Curb	*5	*4	*4	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	1.02½	1.00	1.00	Dec. '20,	0.15
Chief Consol.	Boston Curb	3½	3⅜	3½	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	19¼	19	19¼	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†3.00	†1.00	.	July '20, Q	0.10
Daly-West	Boston	†3½	†2½	2½	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	2½	2½	2½	Apr. '21, K	0.05
Electric Point	Spokane	*4¾	*4¼	*4½	May '20, SA	0.03
Federal M. & S.	New York	†12	†8	. .	Jan. '09,	1.50
Federal M. & S. pfd.	New York	38	38	38	Dec. '21, Q	1.00
Florence Silver	Spokane	*23	*22	*23	Apr. '19,	0.01½
Grand Central	Salt Lake	*44	*44	*44¶	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	6½	5¾	5⅞	Dec. '21, Q	0.17
Iron Blossom Con.	N. Y. Curb	*19	*16	*16	Dec. '21, Q	0.02½
Judge M. & S.	Salt Lake	†3.10	†2.50	3.00	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*5	*4	*5	June '21, I	0.02
Prince Consol.	Salt Lake	*11½	*9	*11½	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*6½	*6	*6	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*8	*7	*8		
South Hecla	Salt Lake	†*60	†*35	.	Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*15	*15	*15	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*3	*3	*3	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.15	2.00	2.00	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.05	2.02½	2.05	Dec. '21, Q	0.05
Utah Apex	Boston	3⅛	3	3 1/16	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	*2	*2	*2	Nov. '17,	0.01
			VANADIUM			
Vanadium Corp.	New York	37¼	35½	36	Jan. '21, Q	1.00
			ASBESTOS			
Asbestos Corp.	Montreal	50	49	49	Jan. '22, Q	1.50
Asbestos Corp., pfd.	Montreal	.		74	Jan. '22, Q	1.75
			SULPHUR			
Freeport, Texas	New York	17¼	14⅜	17½	Nov. '19, Q	1.00
Texas Gulf	New York	46¼	44⅜	44⅞	Dec. '21, Q	1.00
			MINING, SMELTING AND REFINING			
Amer. Sm. & Ref.	New York	48½	46¼	47⅝	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	90½	90	90½	Mar. '22, Q	1.75
Am. Sm. Sec. pf. A	New York	89½	89½	89½	Jan. '22, Q	1.50
U. S. Sm. R. & M.	New York	34½	33	34½	Jan. '21, Q	0.50
U. S. Sm. R. & M. pf.	New York	43½	43½	43½	Jan. '22, Q	0.87½

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Engineering and Mining Journal
A Weekly Journal of the Mining and Mineral Industries
METALS NON-METALS PETROLEUM

F. E. WORMSER
[illegible]

Volume 113 New York, March 18, 1922 *Number* 11

West and East

THE WEST has been populated from the East; but there is no doubt that the amount of positive energy is greater per capita the further west you go—that is, after you have passed Omaha.

The Eastern ports are the great gateways of immigration. New York is a foreign city, an unwieldy, indescribable, undigested, sheer mass of mostly motley European or near-European arrivals. Boston is dominated by foreigners. New England is populated mainly by the races of Southern and Central Europe—the lastest comers and not the most virile type.

In the process of filtration from the East coast to the West, an increase of individuality has resulted. The men of the West are more intense, more spontaneous in their reactions.

In Congress, in the Senate, men from states like Nevada and Oregon are commonly factors in lawmaking out of proportion to the population which they represent.

Take the mining industries—take the mining engineers, for example. The prominent mining engineers of the West will work enthusiastically for whatever will benefit their industry. In the East, mining engineers have more the tendency to remain apathetic and indifferent when they are subordinate; and to graduate into superciliousness and snobbishness as they attain what seems to them like dizzy heights of prominence.

The Pittman Act has been a wonderful thing for the mining industry. Its drawing up and introduction was properly entrusted to a Nevada Senator. The average Eastern mining engineer at his meetings proved unenlightened, suspicious, even superior to this problem.

There was a McFadden bill proposed some time ago. It is no longer advisable; but when it was proposed it was a good measure. The West was alive to the problem and interested in it, many favorably; the Eastern engineers, such as concentrate in New York, were amused and superior, yet without more than a suspicion of comprehension.

The mining engineer in the East starts out to enlighten the world about economics, the elimination of waste in industry. The economics of the mining industries? How to eliminate waste in the mining industries? Oh, Lord, no. The ready-made clothing industry, the boot and shoe industry. Why is it that there is such timidity about trying to improve our own business, take an intelligent interest in its underlying principles, discuss it, elevate it, make it more efficient? The East is for a Department of Public Works which would engulf the mining bureaus, and in which they would be lost; it is not interested in the practical problems of organization whereby our mining bureaus would have better organization and co-operation and be rounded out into a subdepartment, or even a department. One would gather that such homely wisdom was something that concerned Eastern engineers not, or was beneath the level of their eagle gaze.

Does the Institute of Mining and Metallurgical Engineers stand for a progressive development of the industrial side of mining? It is not very noticeable. They have men in Washington—American Engineering Council—to do their thinking for them, and that Council thinks in terms of engineering, not of mining—and at that, with no clear conception of what engineering is, or what they should do about it. Is the Institute for or against a Department of Mines? Bless you, it doesn't know. It has not been educated that far. If Hoover will tell them what he thinks, then they will know. Otherwise, they rather instinctively feel that the subject is not quite in good taste. One has a certain social standing, you know.

Yes, we must look to the West for leaders in mining, at least out of all proportion to the number of mining engineers. Out of the West came Hoover. Pittman, of Nevada, has the glory of the preservation of the silver industry; Nicholson, of Colorado, a horny-handed, two-fisted miner, sees the necessity for a better representation of mining in the executive department, and is working for it.

If we are obliged to sense this finally as we do, we must also realize that the West has sensed it long ago; and the loud opposition to the proposed mining law, which arose in the West, represented nothing but an opportunity to vocalize the fixed and underlying distrust. The Far West was not adequately represented in the group which formulated the law; hence the Far West was suspicious and quite vociferous in its suspicion.

To the indifference or the superciliousness of the Eastern engineers concerning the vital questions of the mining industries, which questions absorb the attention of the West, the Western mining man responds with distrust of such measures as the East does condescend to propose. Shall we not get together?

Gold and Money

WE ARE ACCUSTOMED to think of gold as the ultimate in money. When we have a ten-dollar gold piece weighting down our pocket we somehow feel richer than when a Federal Reserve note for the same amount is folded in our wallet. Suppose a contest is announced: do we ever see in the list of prizes, "Ten Dollars in paper money will be paid the winner," or even "A Ten Dollar Bill will be awarded"? No; it is always "Ten Dollars in gold," in this country at least. There seems an instinctive prejudice for gold as against a printed piece of paper. Still, gold as a medium of currency never became generally popular in this country except in the West, where, before the Great War, there was much gold in free circulation. For a time thereafter there was none to be had, but now it is again freely obtainable.

Most of us would think offhand that gold would be an ideal thing to carry to Europe should we plan a trip to that continent; that it would instantly be convertible into the maximum amount of paper money in any country. This is not so, however, and travelers are often penalized for having it in their possession. Most European countries have enacted laws restricting the export of gold; and in exchanging it for paper it is actually often worth less than credit instruments payable in New York, or "paper." This is because of the greater ease in using such instruments in making payments of trade balances to this country. However, the wisdom of the gold standard is evident, and we have little doubt of its continuance so far as is possible among the nations of the world. We believe that gold producers have little reason to worry over any possible financial cataclysm that would make their product worthless except for manufacturing purposes.

The time is probably not far distant when the English paper pound will again be exchangeable for its old-time gold equivalent, and other countries will slowly follow. We do not mean that the currency of every country will go back to its former value. The German mark, now worth about one-half a cent, is never likely to be exchangeable for 23.82c. worth of gold as it was before the Great War. Some adjustment is likely to be made, and a new mark, or a coin of some other name, will be originated, which will have a definite gold value.

Treatment of the Technical Man By the Corporation

WE WONDER whether mining and other industrial companies are really appreciative of the wealth of human power that is turned out from our technical schools and placed in their hands. Have they ever considered the outcome were this flow to be turned to other channels? Are they sufficiently appreciative to reasonably reward these men? The cost of a technical education is roughly $8,000, of which $4,000 may be the approximate direct money outgo and $4,000 the valuation of four years of suspended earning power. This investment is placed at the service of industry. Along with it goes a huge investment in schools and colleges and money outgo in excess of the student's input. Without more than nominal effort upon the part of industry these resources and the individual's investment have been secured.

Omitting the instances of spectacular remuneration and the remuneration of the consulting specialists, the question may well be raised as to the average compensation of the technical graduate. Does he really get out of industry a compensation commensurate with his input? We do not think that he does. We believe that industry has absorbed the technical graduate without due consideration to the individual's self-sacrifice. It has been able to do this principally because of the numbers of young men who have been attracted to technology. Whether this flow will continue is an important question that mining and other industries may well consider.

Industry has now no substitute for the technical graduate. There is danger that unless he is accorded a more cordial welcome in the form of adequate compensation, he will turn to newer fields and other forms of activity than the ones dictated by fashion and convention. The mining industry is at greater fault than others, and perhaps may feel the pinch soonest.

The present depression has its byproduct of individual questioning influenced by the experiences of men who have had to change their chosen field fundamentally. We bespeak earnest thought upon this question and greater responsiveness on the part of those who have the responsibility of apportioning the compensation of the technical graduate.

Mining Education

THE POLICY and course of study at mining schools are receiving nowadays a great deal of thought, as are, indeed, those of schools and especially of colleges and universities in general. The whole higher system of education is under fire. Is a college education—a general education—a help or a hindrance? Does it make more men than it cripples? Does it spoil many good artisans to make dependent and regretful pseudo-gentility; or are these noted cases exceptions, which are insignificant beside the men who have been raised by their college training to a higher degree of efficiency? We shall find such men as Ford and Edison and many others questioning the latter natural assumption; and there is, at any rate, enough of truth in their cynicism, and examples enough to support it, so that the applicability and efficiency of education should be honestly and frankly scrutinized and criticized. The colleges are the great examiners—they distinguish and classify men according to their academic standards, with calm and superior assurance of their divine right as judges. Let them without indignation and philosophically bear the reversed rôle, and submit to a rigid examination at the hands of the thinking public.

The faculties of the colleges—or at least the most valuable part of these faculties—are, indeed, among those who are most perplexed and inquiring; and our mining schools are no exceptions. It is for this reason that the reports of the committees and the discussions of the meetings of the Mining and Metallurgical Society of America have aroused such interest in the mining schools themselves; and that the series of critical articles on the various schools of mines which we are publishing in *Engineering and Mining Journal* are receiving such close attention. These articles are being written by an experienced, thoughtful, and unprejudiced writer; nevertheless, we get farthest and most safely from the exchange of many views, and we invite discussion from engineers and from the mining schools themselves. Part of the *Journal*—that succeeding the editorials—is devoted to an open forum, in which every thoughtful man may have his say, addressing the mining public.

The Webster Process

THE ANNOUNCEMENT of the termination of the patent proceedings of the Webster process now releases this method to commercial exploitation. On p. 376 of the issue of March 4 the details of the operation of the process are given. It is applicable to oxidized copper ores and mixed oxidized and sulphide ores associated with gangue material insoluble in acid solvents. Gold and silver in the ore will be recovered with the copper. The process consists of, first, fine comminution of the ore; second, treatment with an acid solvent; third, precipitation of the dissolved copper by finely divided iron; fourth, recovery of the precipitated copper by flotation and tabling, the operations noted to be continuous. Preliminary work warrants the belief that the process will become a commercial success.

Oxidized copper ores have long represented an important metallurgical problem, particularly when they also contain gold and silver. Apparently, the most acceptable method for their treatment has been the leaching of the ore in vats or heaps with sulphuric-acid solutions and the precipitation of the pregnant solutions by scrap iron or by electrolysis, as at Ajo. This process has been a metallurgical success as applied to those ores which contain no precious metals and in which the gangue is insoluble in sulphuric acid. Its limitations have been prescribed by the cost of acid, iron, power for precipitation and the degree of crushing necessary to liberate the copper minerals (though only slightly by the latter). Similar limitations will apply to the new process, with the additional element of cost in the application of flotation. This, however, is a nominal expense.

It is probable that in an endeavor to make the process a continuous one, it will be necessary to crush finer than for leaching. Some form of agitation vat will be necessary for solution and precipitation. If wet crushing is used, dewatering before applying the acid will be necessary, and after flotation the excess acid will entail more or less complicated steps for its recovery. The process will likely consist of dewatering after crushing, the addition of acid solvents, precipitation of copper in the pulp and its recovery by flotation, removal of excess acid solutions by dewatering appliances, and, finally, filtration of the concentrates in acid-proof filters. The equipment will closely parallel that used in the cyanide process.

In applying the method to mixed oxidized and sulphide ores, the solution and precipitation steps can be introduced in the mill circuit before flotation treatment or may be applied to the tailing residue after it has been dewatered. Probably in existing mill arrangements the latter plan will be used.

The process as a whole, in our opinion, will find definite applications where the cost of acid solvents and finely divided iron is not prohibitive. Somewhat over one pound of iron and two pounds of sulphuric acid will be necessary for each pound of copper precipitated. The iron needed will probably be obtained by the local reduction of roasted iron sulphide concentrate or of finely ground magnetite. Any copper or precious metals contained in this material will be recovered in part along with the valuable metals in the ore. The concentrate obtained will be higher in grade than sulphide concentrate and will contain a percentage of the gold and silver present in the ore.

Safety First

IT RAINS at times in California. Of late, Californians have had a surplus of the waters of the skies, and even a little of the real chill of winter has descended from the high reaches of the blue and has graced Tamalpais and the Berkeley Hills with a mantilla of lacy white of a kind all too familiar to us in New York. Nevertheless, it is true that the sun does shine in California at intervals and that the glistening raindrops shimmying upon the evergreens bring a message of cheer and foretell the golden brown of the hills in the summer and the sweet perfume and acres of color in the spring. We delight to think of this in our dreams as some of us work at our steel desks upon a rubber-tired floor, over the clack of the linotypes and the undulating vibrations of the flat-bed presses beneath. In the midst of these cheerful dreams, interlarded with the humdrum of everyday materialism, we received a bit of manuscript, humbly knocking at our doors and asking to be broadcast to our indulgent readers. It is entitled "California's Industrial Dead." It emanates from the California Industrial Accident Commission. Like a carrion crow upon the fence, this bit of safety propaganda tells us that

> "There are reported in the files of the Industrial Accident Commission exactly 4,391 fatalities for the seven years, 1914-1920, inclusive. The same ratio for the remaining three years (of the decade) gives 6,000 deaths as a conservative estimate. It would take a strip of land 3.41 miles in length to bury this army of dead, allowing three feet for each grave.
>
> "The commission has compiled some interesting information about the group of 6,000 dead. The average age was 37.8 years, and the life expectancy based on this average is 29.74 years, thus giving a total loss of 178,421 years for the 6,000. The average wage was $23.69 a week, and the total wage loss, figured in possible future earnings, amounts to $22,000,000.
>
> "The dependents of the industrially killed numbered 7,696 as the result of 3,555 deaths. The total dependents were 2,502 widows, 3,665 children, and 374 under the heading of 'all others.' The number of partial dependents was 1,155. The number killed leaving no or unknown dependents was 2,445. The average age of the widows was 38.2 years, and the average age of the children 8.6 years."

This is a grewsome story to put over the gospel of "Safety First," but maybe it is needed. At any rate the commission thinks that it is. Perhaps if its statisticians had paralleled it with the list of fatalities and injured resulting from automobile accidents, a still more grewsome and oppressive picture could have been drawn.

Looking, however, at the table of statistics presented, we find that there were only 592 industrial fatalities in 1920, in a population of 3,427,536, and that there has been a perceptible diminution in the ratio. We are sanguine of a still further decrease not only in California but also in other states. Insistent application of safe practices and persistent work on the part of inspectors will wear down this ratio to a minimum.

We are not going to publish this manuscript, for we do not believe in taking all of the joy out of life. Rather do we believe that a little of the joy, a beam of cheer, a bit of humor along with the pathos and gloom, if they be necessary, would have won us over, and we would have been glad to have given our precious space to it. Just a little of that exuberant spirit, that scintillating optimism, that makes the desert bloom and brings the "white blood of the mountains" out upon the plains of the San Joaquin and the "white coal" to the cities, will, in our judgment, help to reduce this troublesome fatality ratio.

We ask the commission, now that the facts have been spread before us, what that body, whose members are the trustees of "Safety First" in California, is going to do about it. We don't want the members of the commission to tell us, however, but we do want them to jump into the game with all of the cheerful optimism that Californians exude, and do it.

Professor Kemp, We Knew Better

Owing to an error which appeared in *Engineering and Mining Journal* of March 4th, in the biographical sketch of Prof. James F. Kemp, he was stated to have been past president of the American Institute of Mechanical Engineering, but, as all his friends and acquaintances know, the association mentioned should have been the American Institute of Mining Engineers.

WHAT OTHERS THINK

The Proposed New Mining Law

I have not been able to follow the discussion relative to the proposed new mining law, on account of frequently missing the regular mail service, but it would appear that much of it had failed to consider the more salient features.

We are not doing business on the actual mining code but on a code of decisions. The apex law went from Germany to Spain, from Spain to Mexico, and from Mexico to the United States. It has been set aside in certain districts by the Federal courts. Should we have a new code, years of litigation would be required to develop a new set of decisions; until then we would not know, as the Cornish say, "where we are to." It is possible that the best thing to do would be to abolish the lode claim and use the placer law, which has been threshed through the courts for some time.

Nature has not much use for mathematics. No law can be written to fit all contingencies. Undoubtedly, the law of the apex should be superseded by one of vertical lines. Some notable instances have occurred where a dipping orebody when it neared the vertical property line on the hanging side turned and went back.

A land company in Michigan once hired some of the best geological talent in the country to select "swamp lands." They selected all of the alternate sections along a certain range, being restricted by the terms of the grant to odd sections. These were colored red on the maps. When the orebodies were developed they twisted around through that checkerboard system so as to avoid the red sections and made some famous mines in the white. Such examples are simply interesting exceptions.

There will probably be a few more "grass-root" mines found in the United States, and only a few, for most of them were discovered years ago. The prospector has gone like the game that he largely depended upon for food. New mines will come trenching along vein outcrops to find ore chutes upon which to sink, drilling or sinking through oxidized zones, through soil, and through superimposed later strata (caps).

There is little prospecting done now. Venturesome corporations and exploring companies buy developed mines after spending thousands of dollars in scouring the country for something cheaper. Some companies have card catalogs of the known mines and prospects in the United States. There is plenty of venture money judging from the "get-rich-quick" failures that the newspapers make much of from time to time. What is most needed is a Federal incorporation law that will send the greater proportion of the money into the proposed enterprise, leaving a reasonable amount only for promotion. The oil people are now feeling the retardation in development due to the many stock swindles. The last mining boom nearly killed this department of the mining business except for the well-established companies.

When Cripple Creek opened it was fairly common practice to obtain a small fraction of a claim, well located, and an acreage outside of the district; then to advertise "our —— claim adjoins the famous —— mine. We have —— acres," and so on. The same practice went to Goldfield, Nev. There was an instance of a Maine corporation, a fraction in Goldfield, an acreage outside of the known district, an office in Denver, and fifty-seven girls answering letters and posting literature. No wonder the business slumped and with it legitimate mining. A large part of the public look upon mining men as swindlers. The postal laws are a help, but it is hardly the function of the Post Office Department to look after mine promotions.

A large proportion of the mining claims held now are held for speculation; some one locates the geology and waits for a miner or mine operator to reimburse him for being there first. To drive a bargain with these people is nearly a hopeless task. Few are willing to develop a claim when they must previously pay for the privilege. When the carnotite fields were opened, and it was evident that the ore was to be found in a certain sandstone stratum scarcely over two hundred feet thick, the cowboys soon learned a little geology and, knowing the country well, kept it located ahead of the miners.

The assessment law is the source of much evil; its temporary suspension has worked to the advantage of the speculator. Had some work been done some ore might have been discovered. It is rare that $100 is spent in the bona-fide development of a claim. The various states require for the initial year that a fixed number of cubic feet be removed, and many men assume this also to be the Federal requirement. A 10-ft. hole is sunk in a soft place, regardless of whether it is advantageous to the claim or not; the law is supposed to be complied with. The more common practice is to contract the assessment done on a group of claims for a fixed sum, the contractor filing the affidavit of labor to the effect that he has done $100 worth of work on each claim. The common price is $35 per claim; often it is as low as $25.

In Montana a Federal judge rendered a decision that caused the people in his district to play safe and spend a little more than $100 in each claim. The Government needs the money, and $100 per year, if the claim is any good, is not a severe tax. The practice, which is general, of doing title work regardless of its benefit to the property, is a sheer waste and in the aggregate amounts to a large sum of money. The Mexican system is satisfactory; in fact, the whole code is much better than that of the United States. We still have the one that Mexico abandoned about thirty years ago. The largest and best mine in Chihuahua went *caduca* (expired) because the owners did not wish either to pay taxes or develop the property. The best mine in Sonora was given to the watchman because he, and not the American owning company, was willing to pay the taxes and to search for some ore. The tax is a stimulant to an owner to make the ground productive.

The assessment law belongs to a considerable class of land laws that might be called laws to encourage perjury. It would be interesting to know how many iron mines are on land the title to which was obtained under the agricultural homestead law. The Duluth story apropos of this is worth repeating. A homesteader acquiring title to an iron mine on the Mesabi swore at the land office that he had built a house of the required dimensions, with a door, the right number of windows, and other stipulations, and had sowed two acres of land in turnip seed, the hardiest and lightest of all seed to pack, for there were no wagon roads. The clerk demurred, saying that it was during the month of March, there was two feet of snow on the ground, and the thermometer was below zero. The homesteader called his attention to the fact that there was nothing in the land office rulings as to when the seed was to be sown. The same thing was true of timber claims and also the desert land claims located actually for oil.

The land laws have grown more strict of late years, and it is time that the mining laws should too. Incidentally, it might be interesting to know how the Mexicans switched from the apex law to that of vertical lines. They left no dipping claims located under the old law. Our neighbors to the south do some things better than we do. H. H. TAFT.

El Paso, Tex.

Although expressions of opinion may be late regarding the proposed amendment to the mining laws extending quartz locations to 1,500 ft. square, with no lateral rights, I would like to say that I regard the suggested change as getting away from nature, even assuming that the location accords with the evident trend of the vein. In a well-mineralized locality, as you are aware, it frequently happens that a vein or veins of more value than the original discovery are found near the side lines, dipping off and therefore lost to the discoverer unless protected by an additional location. With a claim having 750 ft. each side of the vein the ore of the location vein might dip beyond the side lines as in the occurrences at a number of Sudbury's famed nickel mines. Of course, our Canadian neighbors play safe and secure an additional lateral extension, and the government is fair enough to protect original rights in granting possible conflicting concessions. We have no such benign rule as this, and, to our discredit, no department or commission to enforce a rule of that character. But the whole question of mere "dimension," as applied to the mineral fields of the United States, is aside from the mark, vain, and inconsequential in comparison with the real issue.

Instead of 1,500 ft. square (about fifty-two acres) why not a mile square (640 acres), at a mere nominal price for patent, providing that development work is carried on for five or ten years and a commercial orebody can be shown? It might not be a good policy, but it would at least be a consistent policy.

Are mining people in general aware that homestead grazing entries in mile-square and equivalent zigzag locations are being made by the thousands on some of the most valuable mineral lands of the West right to the very mountain tops? A vast mineral domain of unlimited potential value is simply gobbled up by "wise" homesteaders in 640-acre tracts, and patents are issued within three years from date of entry but at no cost to the entrymen aside from the mere filing fees, except the comparatively trifling cost of a habitable cabin and wire fencing to inclose the domain claimed.

Consider the great public mineral domain inclosed in a barbed five-wire fence and forever withdrawn and lost to the Government by act of Congress (stock-raising homesteads) Dec. 29, 1916! Very true, this deceptive act pretends to reserve the mineral on such grazing entries to the Government, and has a provision to that effect in the patent, but, whether overtly or through bucolic indifference, it is only pretense, as the experienced know full well. When a homesteader builds a barbed-wire fence around his mineral reserve, how, let me ask, is a prospector or mining man going to "inspect" for mineral, to say nothing of digging without being promptly placed under arrest for trespassing inside an inclosure? The following paragraphs outline the manner in which it works:

The same act that gave away the mineral fields of the West specifies that the intending prospector for mineral may enter a stock raising homestead by first putting up an available $1,000 bond, "commercial bond," preferred, to cover any damage (real or imaginary) that the homesteader may feel inclined to demand, provided that the prospector formally and at great length files certain petitions and observes certain lapses of time and formalities that with competent legal advice may easily reach $1,000 in addition to the expense of the bond itself. In the meantime, the homesteader, being fully advised, may do a little prospecting on his own account and block out the intending prospector altogether. The only other alternative is to "buy in" with the homesteader and give him, absolutely free of cost, an equal share in all mineral discovered. That's how! The lonely homesteader (?) is hardly to blame for taking everything in sight when Congress has given it to him simply for fencing up, and has pointed out just what to do to bring the prospector to terms.

The Canadian licensing system for prospectors, with its comparatively trivial fees, has been severely criticised, but it will be seen that a general license from the twenty thousand or more present and intending homesteaders on mineral land may easily reach a fabulous sum. In the various cities, large and small, adjacent to the mineral fields, including such important cities as Denver, Salt Lake, El Paso, San Francisco, Butte, and Spokane, there is a more or less active, red-blooded contingent of fully a quarter of a million of seasoned prospectors, not sissy-boys, ready for the field when the call comes. A license from the homesteader to each of these individuals to inspect a single homestead entry would involve a probable outright cost of $350,000,000, with nearly as much more to be put up as bonds for "constructive" damages. A general license or permit to the entire prospective contingent from the "lonely" homesteader would likely reach six trillion dollars in initial expense money, and an additional five trillions in commercial bonds subject to forfeiture, making the rather neat sum, all told, of eleven trillion dollars—many times the cash valuation of the entire civilized world. And that is the terms of the "reservation." Class legislation? Well, I guess. Unconstitutional? No doubt; but it's the law and seems to be going through. If it stands, mining is suppressed and the flag is imperiled.

The situation is simply this: The Government by its representatives in Congress made an outright present of its vast mineral domains to stock raisers on the sole condition that they inclose it with barbed wire, yet pretending to reserve the mineral to the Government. Then the prospector, being perforce the sole and only representative of the Government, is forever debarred from entrance on its mineral domain by terms that cannot possibly be complied with. The great mineral domain has therefore been definitely legislated beyond the jurisdiction of the United States, where it is wholly inaccessible and might as well be in Darkest Africa or the interior of far-off Thibet. The knife of the "invader" is at the throat of the whole future of mining, as relates to any new discovery. The sole condition of his entry is that he "entrench" behind barbed wire and stand pat on his rights as made and provided. And the lamentable fact is in evidence that his entrance was by way of Washington, D. C.

Baker, Ore. M. L. KEIZUR.

Central Idaho—A Rugged Mining Region

Country Well Mineralized but Little Developed—Many Deep Gorges And Lack of Roads Make Travel Arduous—Erosion Proceeding Rapidly—Rock Falls and Landslides Common—Water Power Wasted

By George J. Bancroft

(Written for Engineering and Mining Journal)

CENTRAL IDAHO is probably less developed and open to exploration and travel than any other part of the United States except Alaska. Two other tracts of ground in the West have no railroads, but these regions have wagon roads. Central Idaho has little but trails, and poor trails at that. The district is interesting in several respects. It is a rough country; it has wonderful undeveloped water powers; it has considerable undeveloped mineral resources, and the geology is worth investigation and study because of the fact that it contains the great Idaho batholith of granite.

By far the most impressive topographical feature of central Idaho is the great canyon of the Salmon. For 260 miles, between walls which rise 4,000 to 6,000 ft. above the water, this majestic river rolls toward the sea. At places there are precipitous cliffs, but for the most part the slopes are clad with coniferous trees that lend a softness to the landscape which is often lacking in most of our Western scenery. The more one sees of this great chasm, the more impressive it becomes. Viewed for the first time on a clear day, it may be disappointing, but as one sees it clad in the snow of winter, and in the verdure of summer, in light and in shade, in moonlight and in daylight, in fog and in smoke, it becomes more and more awe inspiring. I think it is most impressive when small fog clouds lend a perspective to the scene and force home the immensity of the great abyss. These clouds, drifting up to the side canyons, bring out ramifications of the panorama which otherwise are obscured by the haze of the distance.

CANYON OF THE SALMON RIVER, CENTRAL IDAHO

The Salmon has a swift but fairly deep current. It is now used for boating down stream. No one has yet successfully ascended the river in a power boat, but it is possible that it may be practicable with modern boats.

Salmon City, near the eastern border of the state, is a pleasing little town on a railway which branches off the Oregon Short Line at Armstead. Measuring down the river to Lewiston, near the western border of the state, the distance is 305 miles. Between Salmon City and Lewiston there is a wilderness—and nothing else.

A man named Guleke builds barges at Salmon and floats down the river to Lewiston, where he sells his barge for old lumber and goes back by train to Salmon City. He takes supplies to the trappers and prospectors and brings pelts and "dust" out. It is a wonderful boat ride.

Fish and Game Plentiful

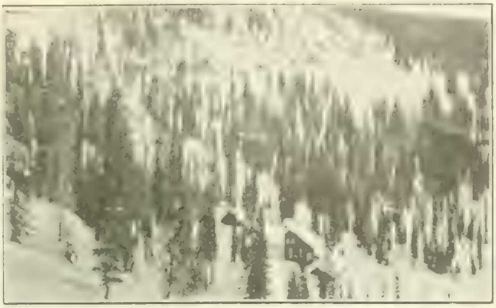
The country abounds in fish and game. In the bigger streams the fish grow to great size. They are locally known as salmon trout, bull trout, and dolly vardens. There is also the Salmon River pike, which is even a gamer fish than a trout. In the smaller streams one finds the ordinary trout in great numbers.

As for game, deer and grouse are the most plentiful. There are also bear, mountain lions, lynx, wildcats, coons, otter, martin, fishers, elk, mountain sheep and mountain goats, coyotes, and wolves.

Gorges Make Country Difficult of Access

The present topography of the country containing the Idaho batholith is that of a deeply dissected plateau. The higher summits range from 7,600 ft. (Mount Marshall) to 9,000 ft. (Buffalo Hump) above sea level. Buffalo Hump is, however, like a shark's fin sticking out of a plateau which is about 8,000 ft. high. As one stands on any of the high summits and gazes abroad, the country appears flat. One gets no idea of the deep gorges which render the region so inaccessible. The tops of the ridges are evidently not far below the old peneplane formed by the batholith, so their summits still preserve a semblance of a plane when viewed from a distance. If one then turns from gazing abroad and looks at the near-by surroundings, one is almost sure to look down into an awe-inspiring gorge, for the summits as a rule are narrow ridges. There are few patches of plateaus left that are over a few acres in extent. The Buffalo Hump plateau is an exception. It is a rough table land, ten miles long and a mile wide in places.

The streams are yearly cutting deeper. This is a condition not general in the West. In most districts



1. ORO GRANDE, A CAMP IN THE HEART OF THE IDAHO BATHOLITH. 2. JUMBO MINE ON THE FLANK OF BUFFALO HUMP

there are accumulations of silt, forming meadows and parks. Not so in central Idaho. The streams occupy the bottoms of V-shaped canyons. There are virtually no soil banks and no patches of flat land in the canyons of the main streams. The little ranches in the canyons are seldom more than a few acres in extent, and each one that I have seen was clearly caused by some other agency than the normal accumulation of silt.

Landslides are the most general geological basis for a ranch. The side of a mountain slips off, damming the stream, and a large lake forms, which in time becomes a meadow. Then, again, two torrential streams may enter a larger stream directly opposite each other. Their deltas will meet in midstream and build up, forming twin bars, which may become large enough for little farms.

Falls of Rock Frequent

So great is the fall of the main streams, and so large the volume of water during the season of high water, that the thunder and rumbling of boulders traveling toward the sea is most impressive. One can often feel the ground shake when an extra big one goes visiting. During the spring of the year great quantities of rock come tumbling off the cliffs. Much livestock and some men are thus killed. One sees the same thing in all steep countries, as in the San Juan Mountains of Colorado, for instance; but nowhere have I seen so much rock fall as in the Idaho batholith. In a recent four-mile trip along the cliffs of the Salmon Canyon, I venture to say that I was never out of sight of the freshly fallen boulders, and in places it was evident that great masses had come down. Yet the great Salmon River moves all this material, every year, clear out of central Idaho and is ready next year for more. We are accustomed to regard erosion as a deduction of abstract reasoning. We can seldom actually see much erosion take place; but central Idaho is an exception in this respect as in many others. Here one can actually see material erosion take place from year to year. The central Idaho region is naturally the home of landslides. One sees them every few miles. Some, no doubt, come down like snowslides, attendant with terrible havoc, but most of them are relatively tame affairs. There are two kinds: one the creeping kind, the other the sluffing kind. The creeping landslides are the larger, so far as my observation goes. Sometimes they involve eighty acres or so. A steep sidehill will start to slide. Every spring it creeps a little further. During the dry season there is no movement, but in the wet season it groans and cracks and the trees tilt and fall; and altogether things look ominous. Then the dry season comes, and men cross it again with unconcern. All the east side of lower Bear Creek is involved in a slide of this type.

The sluffing type seems to be often caused by a vein or a moving fault fissure. The sulphate solutions from an oxidizing vein soften the rocks and, in favorable locations, they crumble and fall. There are numbers of these sluffing slides, and they are unpleasant to inspect because they are never inactive. Even in the dry season, showers of rock come tumbling down at intervals. Hence, my curiosity never prompted me to inspect more than two of them closely. One I located as a mining claim: it was caused by a vein which assayed $10 per ton, and which had been exposed by the slide.

One of the most prevalent causes of loss of stock and even of men is called "rolling" in the local vernacular. By "rolling" is meant tumbling to death down the steep hill slopes. The winter of 1920-1921 was exceedingly bad for "rolling." Of the fourteen horses which wintered on Crooked Creek, six "rolled." This was caused by severe cold weather in November, which froze the ground so solid that even the southern slopes stayed frozen all winter.

Men sometimes "roll" as well as horses. I have heard

BUFFALO HUMP, CENTRAL IDAHO, IN WINTER

of three deaths from this cause, and mysterious disappearances are not uncommon.

With all the heavy fall of snow in the highlands, and the long steep slopes, snowslides are remarkably rare. I do not understand why this is. I have seen 12 ft. of snow resting on a 37-deg. slope half a mile long, which had no live timber upon it. In Colorado these conditions would almost surely produce a snowslide, but not in Idaho.

The winter of 1920-1921 was marked by a few serious snowslides, because of the early freeze. The Cracker Jack mill was carried away, and trees that were probably one hundred years old went with it. The slide must have been impressive. The mill was fully a third of a mile down a gulch of moderate slope from the center of the basin that slid in. A river of snow was formed that filled the gulch about 300 ft. wide and 60 ft. deep, and flowed to a point a little below the mill. Despite the bad conditions of last winter, there were relatively few slides, but those that did run were wicked.

OUTCROP OF WAR EAGLE VEIN

ROADS AND TRAILS BUILT ON RIDGES

The foregoing description shows that the logical avenues of transportation in this country are the deep snow-free canyons of the larger streams. The existing roads and trails, however, are almost all built on the high ridges.

The canyons are difficult places in which to build roads or trails. There are no river banks. The slopes run right to the water's edge for the most part. Where there is a bank deposit, it is likely to be composed of great angular boulders, and is sure to be a tangle of brush and timber. Naturally, the Indian traveled the open ridges. The pioneer improved the Indian trails with his axe, and became dependent on the lines of communication thus established. Then the county commissioners, with their piecemeal appropriations, extended wagon roads cut along the pioneers' trails. Now, as we look backward, we see that enough money has been spent on these ridge roads and in the yearly snow fight to have built first-class canyon roads in the first place.

The day of good road building has arrived, however, and this difficult country may soon cease to be inaccessible, and may then be a busy mining and lumbering center. At present, I believe that it is the most impenetrable part of the United States.

SEVEN STAGES TO THE WAR EAGLE MINE

I asked a wag as to the means of reaching the War Eagle mine, prior to my initial venture in central Idaho, and he replied: "You take the 'Limited' as far as you can, then you take a log train as far as you can, then you take the stage as far as you can, then you take a sleigh as far as you can, then you take a dog sled as far as you can, then you snowshoe as far as you can, and then you climb up a rope." In a measure this was correct. I took the limited to Nampa, a log train to McCall, a stage to Half-way House, a sleigh to Burgdorf, a dog sled to Warrens, snowshoes to the Salmon, which I crossed in a canoe, and the latter end of the trail approaching the mine was so steep that a rope was provided as an aid in climbing the incline leading to the property.

The central part of central Idaho has no roads at all, and the trails are not worthy of the name. They are at best a string of blazes through the omnipresent forest, and every trapper in the country considers it his personal privilege to blaze a line out to any trap he may set. So one can imagine the bewilderment of a stranger trying to pick out the right string of blazes from the maze of trappers' and prospectors' blazes. Of course, after a bit one learns that the main trails will follow the main ridges in the direction intended, and this fact often helps one to pick the right string of blazes from the wrong one.

The climate of central Idaho is chiefly characterized, from a utilitarian standpoint, by the enormous snowfall on the higher levels. For instance, the snow lies 8 ft. to 15 ft. deep on the level at Mount Marshall and Buffalo Hump, while at the same time there will be no snow at all on the southern exposures near the bottom of the canyon of the Salmon River, which lay 5,000 ft. below.

The climate of the Pacific Northwest is characterized by a long stormy winter and a dry summer. Central Idaho is no exception to this rule. In the winter it will sometimes storm for two months steadily, and in the summer time it will often be cloudless for a similar period. It is at the end of the long dry summer that forest fires are such a menace. The dense smoke is most depressing to the spirits. The sun looks like a blood-red ball, and the light (or darkness) is about equal to moonlight.

With topography and climate such as those described, it is obvious that this is a locality prolific in splendid water-power sites. I have not investigated the power features of the main streams, but have measured some of the smaller ones. Minimum flows of 75 sec.-ft. and falls of 600 ft. to the mile are not uncommon. A stream of this sort will develop 4,000 hp. to the mile, and there are miles upon miles of such streams in central Idaho.

Central Idaho has been generously mineralized. Gold, silver, copper, lead, zinc, molybdenum, tungsten, and radio-uranium deposits have been found. The predom-

INTERNATIONAL MINE, NEAR ORO GRANDE, CENTRAL IDAHO

inant metal is gold so far as explorations have gone. There are great numbers of large outcrops, similar to those at Butte, which may develop into copper or zinc mines below the zone of leaching, but these prospects must of necessity await the development of the country. The little work being done is chiefly gold mining.

During the period of readjustment following the Civil War this country proved a godsend to the Union, for it produced $150,000,000 in gold during those lean years. The gold came from small rich placers, soon exhausted.

The lode mines have not as yet proved as profitable as the placers. The placer miners, even the Chinamen who followed the whites, cleaned up their claims, and, finding nothing which they could work at a profit, abandoned the country. So it is again a sparsely inhabited wilderness.

The gold-bearing veins are many, and the values are such that many of the veins could be profitably worked under more favorable conditions than those which have existed heretofore. A few high-grade mines have paid handsomely, but high grade in central Idaho is like high grade elsewhere—it is limited in quantity.

Around the rim of the Idaho batholith are the following mining camps: Payette Lake, Boise Basin, Rocky Bar, Atlanta, Thunder Mountain, Yellow Jacket, Salmon City, Shoup, Elk City, Peirce, Newsome, Florence, Mount Marshall, Seven Devils, and New Meadows. In the heart of the batholith are Warrens, Oro Grande, War Eagle, and Buffalo Hump.

With the building of new roads in the bottoms of the snow-free canyons, which is now under way; with the opening of the Salmon River to down-stream navigation, which was done by Harry Guleke with the financial aid of William H. Day, Jr., of Dubuque, Iowa, and with the general lowering of working costs which is now in progress, it is safe to say that central Idaho is at the dawn of a period of increased mining activity.

Rolled-Zinc Production Declined in 1921

The output of rolled zinc in the United States in 1921 fell off nearly one-half, as shown by reports made to the U. S. Geological Survey by producers. The market quotation on rolled zinc, in mill lots at the smelter, at the beginning of 1921, was 11.5c. per lb., with the usual discounts, but the quotation declined to 8.50c. per lb. at the close of the year.

The notable feature of the year in the rolled-zinc industry was the importation of large quantities of sheet zinc, for only a few tons had been imported each year since 1915. From April 1 to June 30, 1921, there was imported and entered for consumption 4,245 tons of sheet zinc, having a declared value at the foreign mills of $277,830, or 3.27c. per lb. In the first quarter also the imports were large, but during the last half of the year they were small. The declared valuation in the last half of the year was larger by 2 to 3c. per lb., and at the same time the domestic price fell off 3c. from the price at the beginning of the year, so that at the close of 1921 the price of American sheets was less than that of the foreign.

ROLLED ZINC IN THE UNITED STATES, 1920-1921

	1920	1921
Sheet zinc not over one-tenth inch thick:		
Quantity, lb.	56,812,989	28,580,704
Value	$6,625,660	$2,844,406
Average price per lb.	$0.117	$0.100
Boiler plate and sheets over one-tenth inch thick:		
Quantity, lb.	3,950,489	2,545,755
Value	$402,035	$192,987
Average price per lb.	$0.102	$0.076
Strip and ribbon zinc:		
Quantity, lb.	45,704,052	29,673,327
Value	$5,262,538	$2,902,815
Average price per lb.	$0.115	$0.098
Total rolled zinc, lb.	106,467,530	60,800,186
Total value	$12,290,233	$5,940,208
Average price per lb.	$0.115	$0.098
Sheet zinc imported and entered for consumption:		
Quantity, lb.	7,572	13,375,245
Value	$614	$496,445
Declared value per lb. at foreign mills	$0.081	$0.037
Rolled zinc exported:		
Quantity, lb.	23,704,197	3,631,647
Value	$2,832,993	$425,618
Average price per lb.	$0.12	$0.117
Available for consumption, lb.	82,770,905	70,543,784

Reactions in the Purification of Copper-Sulphate Solutions

At the Pacific Station of the U. S. Bureau of Mines, at Berkeley, Cal., in the study of the purification of copper-sulphate solutions, it has been definitely proved that some active form of oxygen is formed when ferrous-sulphate solutions are blown with air in the presence of suspended finely divided lime rock. In solutions containing both ferric iron and aluminum under the same conditions, the calcium carbonate is converted into almost pure calcium sulphate containing hardly any iron or aluminum, the latter forming colloidal hydroxide, deep brown and clear in solution.

Hardwood Creosote on Differential Flotation

In the course of flotation experiments being conducted by the Moscow, Idaho, field office of the U. S. Bureau of Mines, in co-operation with the Simon Silver-Lead Co., of Mina, Nev., it has been found that hardwood creosote alone gave a fair differential separation of the galena and sphalerite. In combination with sodium dibasic phosphate, a marked flotation of the galena in preference to the sphalerite was given. Sodium carbonate and creosote gave better results than creosote alone, the same being true for potassium permanganate.

Costs of American Copper Production, 1909-1920 Inclusive*

Wide Fluctuations Indicated by a Survey of the Average Production Expense Of the Principal Porphyry, Vein, and Lake Mines, Reduced to a Common Basis—Porphyries Are the Dominant Group, Followed by Vein Mines

By H. A. C. Jenison

[illegible] Engineering and Mining Journal

THE COST of copper production has been a subject of much discussion and varying opinions for many years. During the war, when both the selling price and the costs of production of copper reached such high levels, the subject of costs and profit was of still greater interest, and yet, so far as I have been able to learn, no general analysis covering the costs of operations reduced to a single basis has been published.

The Super-power Survey of the U. S. Geological Survey, in its study of the possible general electrification of industrial plants and railways on the eastern coast of the United States, found it essential to know what the average cost of production and the selling price of copper had been for the last decade, so as to formulate some basis upon which to calculate the probable price of copper required by that project. No such data were available, and I was designated to make an analysis of costs and selling price. The results were so largely a confirmation of the opinion of those familiar with the industry, and of such apparent interest, that their publication was requested for the general information of the public.

Mines of Three General Classes

To determine the relative costs and market influence of the various mines, they have been roughly divided into three natural groups: (1) The vein and replacement group, which embraces the mines of the Butte, the Copper Queen, the United Verde, and United Verde Extension, and Calumet & Arizona and other types; (2) low-grade disseminated ore mines of the (a) open-cut type, such as Utah, Nevada, and Chino, and (b) under-ground disseminated ore mines of the Inspiration, Ray, Miami, Shannon, Arizona Copper Co., Moctezuma, and similar type; (3) the Lake mines, which include all mines in the Lake Superior district. There is no fundamental difference in the character of the Lake mines and the Western disseminated ore mines so far as grade or the necessity for the beneficiation of ore is concerned, but the geographical occurrence, the long intimate association in the public mind, the depth and unique genesis, and the mineralization of the Lake ore make a separate grouping advisable.

Eleven of the principal vein and replacement mines, eleven of the principal disseminated ore mines (loosely known as porphyries), and twenty of the principal Lake mines are included in this analysis. All but two of these mines are in the United States; one is in Alaska, and the other in Mexico. The Mexican mine included is operated by an American company, and the operations of the Mexican and American branches of this company are so intimately related that they cannot be satisfactorily separated. Only one of the important producers of copper from domestic ores has been omitted. This omission was necessary, as the available data upon costs by this company are reported in such terms that they could not be satisfactorily reduced to the basis employed in this analysis.

Under normal conditions there probably is no appreciable difference between the average costs at the forty-two mines herein considered and the total average cost of copper from domestic ores.

This assumption is supported by the fact that the production by these mines since 1909, with the exception of 1920, has been a high and fairly constant percentage of the total production of copper from domestic ores.

Price Average Fairly Constant

Furthermore, though the same selling price has not been obtained by every company, except when fixed by the Federal Government, the individual variation from the average selling price has been slight. Under pre-war conditions the difference between the average cost of production and the average selling price was fairly constant. An increase or decrease in cost of production by these mines was with few exceptions quickly reflected in the average yearly selling price, and a decrease in average yearly selling price was soon followed by a decrease in production.

These conditions clearly indicate that the mines considered in this analysis dominate and regulate the copper-mining industry of the United States, and therefore largely control the copper industry of the world. It is evident, then, that the costs of production by the mines herein considered must determine the costs at which the small domestic mines may operate at a reasonable profit, under normal competitive business conditions. During the war, however, the demand was so much greater, and the selling price so much higher, that the industry no longer operated upon a normal competitive basis. Consequently, the principal mines no longer determined the costs at which the smaller mines could profitably operate, and temporarily the control of the industry largely passed out of the hands of the principal companies.

As soon, however, as the war demand was terminated and the copper market became commercial and industrial again, the selling price declined to a figure which represented the average cost of production by the principal mines plus a profit nearly equal to the pre-war profit. This condition was evidently truer in 1920 than in 1919. The difference between average cost and average selling price in 1920 was about 3.5c. per lb., or somewhat less than the average difference for the pre-war period, but about equal to the difference during four of the six pre-war years, and indicated a willingness upon the part of the principal producers to accept a profit comparable to the pre-war profit.

The decrease in price in 1919 and 1920 was followed by the closing down of many small mines, and the 1920 production showed that a higher percentage of the total production was derived from the principal mines than in any previous year. Many small mines which together had made a considerable production during the war could not profitably operate any longer, and the control of production and selling price was restored in a great measure to the principal mines.

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The data upon which these costs have been calculated have been obtained in nearly all instances from the companies' annual reports. Companies which published no annual reports, or those which are engaged in such a variety of metal production that the annual reports contain too little data to determine the costs of copper production separately, supplied confidentially their costs of copper production or sufficient supplementary data to make it possible satisfactorily to determine them from their annual reports.

COSTS BROUGHT DOWN TO A COMMON DENOMINATOR

In this analysis all costs have been reduced to a common basis, which consists of mining, milling, smelting, refining, transportation, and selling costs, general administration charges, depreciation of plant and equipment charges, and state and local taxes. Federal income and excess profits taxes and depletion charges are the only items excluded. These items and their influence upon profits are discussed separately and in general terms only, on account of inadequacy of data.

In considering production where precious metals were recovered from the treatment of copper ores, their value has been credited to the costs of copper production, as has also miscellaneous income actually incident to copper-mining operations. Such miscellaneous income embraces all income derived not from the production and sale of metals but from other operations or enterprises which were maintained as a necessary auxiliary part of mining operations and which would probably cease to exist immediately upon the discontinuance of mining operations, such as the profit realized on the smelting of small quantities of custom ore by a company which maintains a smelter for the sole purpose of smelting its own ore and to which the smelting of custom ore is purely incidental, and the income realized from the sale of small quantities of power by a company which maintains a power plant for the sole purpose of supplying power and light to its mines, mills, and smelter.

SELLING AND DELIVERY CHARGES REQUIRED SPECIAL TREATMENT

During 1919 and 1920 many companies produced more copper than they sold, and in their annual reports they indicated the cost of production of all copper produced, and to this cost was added the selling and delivery cost of copper actually sold and delivered. To arrive at satisfactory total costs for the total production of such companies, it was necessary to consider all copper as sold and to add to the production costs of the unsold part of the year's production proportional selling and delivery costs which would have been incurred had the unsold copper been sold.

It is not to be supposed that the figures contained in this analysis represent absolutely the costs of production of the individual mines, of the three groups, or of the three groups combined. Such an analysis could not be made from the data available, especially as there is no exact uniformity in accounting practice. However, the results obtained in this analysis are believed to approximate closely enough the actual costs to present a fairly correct summary of the industry during the time considered.

The following tables and diagrams summarize the costs of production and the cost and production relations between the various groups and the total smelter production:

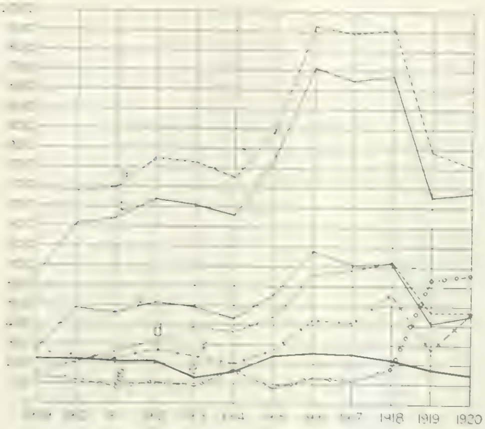
[illegible]

Year	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1909	272,830,408	8.97	226,575,286	9.9	154,089,208	9.2
1910	487,289,463	8.2	218,272,734	9.9	205,593,242	[illegible]
1911..	463,322,929	8.8	213,093,306	9.6	[illegible]	8.1
1912	[illegible]	9.0	215,859,751	10.7	[illegible]	8.7
1913	492,092,409	10.1	130,487,378	[illegible]	389,239,696	9.3
1914....	428,435,453	9.8	159,278,415	11.5	365,445,511	8.3
1915....	557,696,842	9.5	243,802,361	9.6	[illegible]	[illegible]
1916....	787,443,989	10.7	259,511,319	12.4	665,469,103	9.3
1917....	712,239,051	12.2	253,769,681	15.6	680,700,041	12.7
1918....	[illegible]	13.6	226,901,556	[illegible]	724,069,192	13.98
1919	408,348,013	14.6	177,463,610	18.4	467,695,747	14.6
1920....	450,760,285	14.2	153,021,787	18.2	470,250,341	[illegible]

AVERAGE COST OF PRODUCING COPPER BY PRINCIPAL MINES DURING THE PERIODS 1909 TO 1914 INCLUSIVE, PRE-WAR YEARS, 1915 TO 1918 INCLUSIVE, WAR YEARS, AND 1919 AND 1920 POST-WAR YEARS

Year	Copper Smelter Production of the U. S., Pounds	Production by Principal Mines, Pounds	Average Price Received per Pound, Cents	Average Cost per Pound, Cents
PRE-WAR YEARS				
1909	1,092,951,624	653,494,902	13.0	9.3
1910	1,080,159,509	[illegible]	12.7	[illegible]
1911............	1,097,232,749	939,700,756	12.5	8.8
1912	1,243,268,720	[illegible]	[illegible]	[illegible]
1913	1,224,484,098	[illegible]	[illegible]	[illegible]
1914	1,150,137,192	[illegible]	[illegible]	[illegible]
	6,888,233,892	5,510,028,643	14.0	9.3
Average cost...........................			9.3	
Difference between average price received and average cost..........................			4.7	
WAR PERIOD				
1915	1,388,009,527	[illegible]	17.5	[illegible]
1916	1,927,850,548	[illegible]	24.6	[illegible]
1917...........	1,886,120,721	1,646,708,773	27.3	12.9
1918...........	1,908,533,595	1,674,449,649	24.7	14.5
	7,110,514,391	6,277,208,352	23.2	11.9
Average cost			11.9	
Difference between average price received and average cost			11.3	
POST-WAR YEARS				
1919	1,286,419,329	1,053,507,370	[illegible]	[illegible]
1920...........	1,209,061,040	1,074,032,413	18.4	14.9
	2,495,480,369	[illegible]	[illegible]	[illegible]
Average cost			[illegible]	
Difference between average price received and average cost..........................			3.4	
Grand Total 1909-1920	16,494,228,652	[illegible]	[illegible]	[illegible]
Average cost			[illegible]	
Difference between average price received and average cost..........................			7.30	

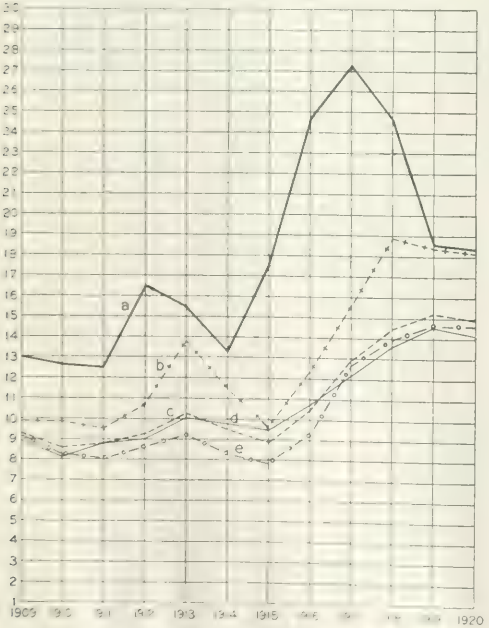
It is apparent that the copper industry realized a great operating surplus during the war, particularly during the years 1916, 1917, and 1918, but the actual profit realized during the period was much less than the operating surplus. The operating surplus indicated by the costs herein shown is exclusive of depletion charges and Federal income and excess profit taxes. Though depletion charges have not been carefully calculated, they probably averaged for the last six years the equivalent of about 3c. per lb. of copper produced. Some of the largest producers have been allowed a depletion charge equivalent to almost 4c. per lb. of copper produced and a few of them less than 2c. per lb. of copper produced.



PRODUCTION AND STOCKS OF COPPER

[illegible] production of the United States from domestic ore.
b—Total production of principal mines (all groups).
[illegible] of principal mines ([illegible] and replacement group).
d—Production of principal mines (porphyry group).
[illegible] of principal mines (Lake group).
[illegible] in process of refining at end of year.
g—Stocks of new refined copper in hands of refiners at end of [illegible].

Note—Vertical scale is in millions of pounds.



AVERAGE SELLING PRICE AND COSTS OF COPPER PRODUCTION

Average selling price per pound.
Average cost per pound Lake group.
Average cost all groups.
Average cost per pound [illegible] and replacement [illegible] group.
Average cost per pound porphyry group.
Costs include mining, milling, smelting, refining, trans-[illegible] administration [illegible] and [illegible] charges and all taxes except Federal [illegible] and excess profits taxes. Depletion charges not included. [illegible] recovered and [illegible] income [illegible] t to actual mining operations are credited to costs of production. Vertical scale is cents per pound.

The depletion charge is transferred from operating income to depletion reserve, and the operating income applicable to dividends is reduced that amount—roughly 3c. per lb. of copper produced for the entire industry.

In addition to the reduction of apparent profit on account of depletion charges, there are the Federal income and excess profit taxes, which further reduce the operating income applicable to dividends. It is at this time impossible to determine the amount of such taxes which must be deducted from operating income, as many of the companies have not yet had final adjustment of the 1918 taxes, and the 1919 and 1920 taxes are almost without exception still subject to adjustment.

A second condition which must be taken into consideration is that of arrears in development work. During the war many mines, on account of the high cost, shortage, and inefficiency of labor, the high cost of material, the great demand for copper, and the high selling price thereof, curtailed development work to that which was essential to early ore extraction. Under the circumstances it was safe and necessary to curtail development, but the abnormal curtailment reduced development costs per ton of ore mined and per pound of copper produced during the last three years of the war.

DEVELOPMENT CHARGES INFLUENCE POST-WAR COSTS

The making up of these development arrears was undertaken largely in 1919 and 1920, but the cost thereof properly belongs to the war period. The costs of this work appeared in 1919 and 1920, and in a number of instances prevented a material reduction in costs during the last two years. Though the cost of making up the arrears in development should be added to the war costs, it cannot be distributed and will serve only to prevent in a measure the reduction of production costs by the companies which have it to do, thereby making their post-war profits smaller for a time than they otherwise would be.

Another consideration to be taken into account is the considerable production costs by one large mine and numerous small mines which do not appear in this analysis. During the war the principal mines were unable to supply the entire copper requirements of this country and the allied nations, and the deficiency was made up by numerous small mines. The cost data available upon these mines is too meager to make a satisfactory determination of them possible, but it is sufficient to indicate clearly that their costs were much higher than those of the principal mines.

It is more than likely that in numerous operations the high selling prices during 1917 and 1918 were necessary to permit numbers of small mines to continue at even a small profit. During 1920 the production by the principal mines exceeded the previous year's production, but the total smelter production from domestic ore was much less than the previous year's production, which indicates that numerous small mines were unable to produce copper profitably at 18.4c. per lb., and probably, not having a sufficient surplus to attempt to continue operations until conditions improved, had closed down. There appears to be no doubt that a large part of the metal produced by these small producers during the war was derived from ore which they cannot profitably mine under normal conditions. If the costs of such production could be satisfactorily determined, they would no doubt materially increase the average costs of production for the war period as here shown.

The comparative costs and production by the three groups are interesting, as they indicate governing factors of the industry and shed some light upon the question of low cost by the porphyry copper-producing group.

It is difficult to determine whether or not as a group, for a long period of years, the porphyries can produce copper at a lower cost than the vein mines can. The porphyries operated at a capacity worthy of their reserves for such a short time before the war that the low costs they attained can hardly be considered more than an indication. They did, however, demonstrate that so long, at least, as the vein and replacement mines were the dominant factors in production, and their reserves could be maintained at the grade worked before the war, they could, by treating a sufficient tonnage, produce copper at a lower cost than the Lake or vein mines could.

PORPHYRIES REACHED MAXIMUM PRODUCTION DURING WAR

Had not the war upset normal competitive production, it is more than likely that the difference in cost between the vein and porphyries would have been maintained and perhaps increased in the porphyries' favor for some time longer. In 1916, however, the war demand upset all normal tendencies, and the lowering of costs became of less importance than increasing production. Prior to the war, the porphyries had not reached their maximum capacity or efficiency and were treating only such ore as they could be sure of profitably treating under the existing conditions. In most operations the ore was of higher grade than the principal part of the reserves, and it is certain that if average-grade ore had been treated the costs would have been much higher. It is doubtful if much of what is now considered reserves could have been profitably mined prior to the war. The accompanying table, which represents the weighted averages of the seven most important porphyries, indicates these conditions clearly.

During the pre-war period, the total average costs of production more closely approximated the costs of production of the vein group than either of the others. During the war the relation changed, and the porphyries became roughly equal to the vein group, and cost and selling competition was largely eliminated. However, it appears that prior to the war when the vein group was the dominant factor in the market its average costs largely determined the grade of ore which the porphyries could mine profitably.

It appears from the tables that despite greatly increased recoveries in 1919 and 1920, the porphyries cannot operate at a greatly curtailed capacity as economically as can the vein mines. Had the 1919 and 1920 porphyry group production been at capacity and the same high recoveries been attained, it is certain that their costs would have been less than the vein mine costs. Some of the porphyries can operate at capacity reduced almost one-half without increasing their costs greatly, but as a group production must be made at nearly full capacity to decrease costs.

If under normal conditions the porphyries continue the tendencies manifested before and during the war, and the costs of labor and supplies come down, it will be only a short time until the porphyries are dominant factors in the market, determining largely the selling price of copper and thereby the grade of ore the other groups can profitably mine.

The Lake mines have ceased to be an important factor either in production or costs. Lake production has become so small compared to that of the other two groups that it no longer influences the market greatly. The Lake mine costs have indicated a steady tendency to increase, which has been interrupted only three times since 1909. The high costs in 1912 and 1913 were due largely to labor troubles, which augmented the tendency to increase, and therefore cannot be considered as truly indicating conditions. During the war the costs at the Lake mines reached a higher level than those of any of the two other types under consideration, and the greater increase compared to the vein mines was due to the same conditions which caused the relatively greater porphyry cost. These conditions when reversed should have the same effect upon the Lake costs as upon the porphyries, except that the maximum possible production from the Lake group or individual mines may not be great enough to realize materially the advantage of the reversal of such conditions. If the Lake mine production could be materially increased in the future it would perhaps result in a material reduction in costs of operation.

IDEAL PRODUCTION COSTS AND SELLING PRICE DEFINED

The great increase in the number of pounds of copper recovered per ton of ore treated in 1920 could not at the limited rate of production effect a material reduction in costs. Two things, however, are certain: the Lake mines must in the future effect a material reduction in costs, and must operate at nearly full capacity in order to make such a reduction.

It appears that the ideal situation for the copper producers in general is about 15c. per lb. selling price and a cost of about 11c. per lb. Under such conditions it is probable that copper would experience the least competition from substitutes, the largest market, and make the maximum production with the greatest net profit. It is certain that the producers will endeavor to create such conditions, and the chances for success are much better than generally supposed.

GROWTH AND OPERATIONS OF THE PRINCIPAL PORPHYRY MINES (a), 1909-[illegible]

Year	Ore in Reserve, Tons	Average Copper Content, Per Cent	Total Copper Content, Tons	Ore Milled, Dry Tons	Average Content, Per Cent	Copper Content, Tons	Recovery, Per Cent	Total Recovery by Mills, Pounds	Pounds Recovered Per Ton	Net Refined, Production, Pounds	[illegible] Per [illegible]
1909	119,000,000	1.80	2,142,000.0	3,757,180	1.81	68,004.96	66.54	90,322,607	24.04	85,032,581	8.272
1910	243,860,823	1.6749	4,084,424.9	6,577,273	1.72	113,129.10	67.79	153,184,688	23.29	147,274,817	7.63
1911......	492,870,487	1.76	8,674,520.6	9,145,598	1.69	154,560.61	68.53	211,62[illegible]	[illegible]	202,376,519	7.807
1912......	546,810,524	1.699	9,290,310.8	11,894,830	1.641	195,194.16	66.89	261,091,519	21.95	249,712,570	8.615
1913	560,289,576	1.67	9,356,835.9	16,025,309	1.55	248,392.29	66.45	330,281,618	20.61	314,636,019	9.194
1914	585,056,240	1.635	9,565,669.5	14,542,093	1.646	239,362.85	67.48	323,212,362	22.23	309,234,720	8.164
1915......	691,035,064	1.6276	11,247,597.4	18,931,562	1.641	310,722.03	67.17	416,711,649	22.[illegible]	398,628,110	7.619
1916	768,956,864	1.571	12,080,356.8	28,501,741	1.587	452,386.36	68.74	618,760,669	21.71	599,861,127	8.631
1917	816,032,667	1.559	12,723,973.9	30,086,587	1.479	444,980.83	67.91	601,959,445	20.01	590,009,375	11.607
1918	814,140,979	1.537	12,514,224.2	32,425,668	1.436	465,696.17	68.91	636,613,359	19.63	628,265,818	12.105
1919......	795,752,000	1.533	12,195,967.4	18,453,710	1.502	277,209.01	75.75	416,765,462	22.58	407,305,108	14.264
1920	790,818,949	1.477	11,676,999.7	20,278,611	1.392	282,321.97	76.33	427,610,499	21.09	416,434,944	13.984

(a) Statistics cover operations of two companies in 1909 and 1910; five companies in 1911, 1912, 1913, and 1914; six companies in 1915 and 1916, and seven companies from 1917 through 1920

Promoting Efficiency in Drilling and Blasting*

More Care Advocated in the Selection, Testing, and Use of Explosives By Mining Companies—Burning Rates and Preparation of Fuses—Use And Care of Blasting Machines—Delay Explosives—Detonator Tests

By B. F. Tillson

Written for Engineering and Mining Journal

THE ART OF BLASTING ROCK has perhaps not been given the careful engineering scrutiny and research that its importance in mining should warrant, and it is hoped that the following comments may be instrumental in producing a freer discussion of this subject. Do not engineers and executives entrust the proper selection and use of mining explosives to men who have only the background of experience to guide them and do not have the time or equipment for determining the suitability of materials or methods? This practice is unjustifiable under the present conditions, when all operations should be given careful scrutiny so as to achieve the much-needed increases in efficency. The tendency of the workman is quite properly to use more explosive than is necessary, to avoid wasting the time, labor, and power involved in drilling the rock, on the ground that it is better to use a few pounds too much of dynamite than to run the risk of exploding fifty or one hundred pounds with no useful effect, and, in fact, only to be hindered in the recovery of all the other work which has been performed in preparing the round. This condition persists because of the lack of basic knowledge which might permit the specification of the most efficient use of explosives for varying conditions.

To be more specific, it may be well to present a number of queries, as follows:

1. What relation has the diameter of the drill hole to the burden which it may carry?

2. For every 10 per cent reduction in the diameter of the drill hole, what percentage increase in the strength of the explosive should be made to permit the burdens to remain equal?

3. What influence has the rate of detonation of an explosive in increasing its effectiveness for mining?

4. Can any approximate tabulations of strengths and rates of detonation be made for uniform classes of sound rocks?

5. What correlation may be made of the rate of detonation and the initial shock produced by an explosive?

6. What are the minimum sections of strings of explosives of various strengths which will permit a proper propagation of the wave of detonation?

7. What are the respective efficiencies of propagation through explosives, air, water, tamping, cylinders of wood which nearly fill the bore hole, or pieces of powder box which may be spaced between the sticks of explosive in a hole?

8. What effect has the period of time for chemical reaction upon the effective mining strength and rate of detonation of an explosive?

9. Should not this maximum initial force be exerted for an interval long enough to stress the rock beyond its elastic limit?

10. How long should this interval be for various rocks?

11. What effect has the coefficient of heat conductivity of a surrounding rock upon the effectiveness of an explosive?

12. What forces are involved in the blasting of rock?

13. Is the contention justified that as much of the explosive as possible should be placed in the bottom of the drill hole, or is it preferable to distribute the explosive as much as possible in the rock burden? When?

14. Can tests made in mortars, on steel plates, in lead blocks, by ballistic pendulums, with pressure gages, or crushing tests be relied upon to give either a true or a comparative index of the merits of various explosives,, for mining purposes?

15. What tests would give a better understanding of the instantaneous rupturing force of an explosive, excluding its heaving or propelling force?

16. Will a detonator placed in an explosive at right angles to the axis of the bore hole produce a greater effect than one placed axially?

17. What length column of explosive can be successfully detonated by a No. 6 detonator and what by a No. 8?

18. Will not the fineness of grinding of the nitrates and other ingredients of an explosive shorten the period of chemical reaction and thus produce a higher rate of detonation and greater effect in blasting rock? If so, should not standards for this be established?

19. Is it not possible to obtain a greater useful effect from a given explosive by charging it in a column of a different shape than the cylindrical form in general use?

Rending Effect Produced by Stresses

Let us consider the ramifications in this last query and seek any fallacy which may be involved in such a supposition. The explosive effect is a resultant of three prime factors: (1) The amount of gases formed from a given weight of explosives (the gas volume of course being estimated at a standard temperature and atmospheric pressure); (2) the temperature of the gases resulting from its detonation (which is in turn dependent upon the amount of heat of instantaneous chemical reaction, the specific heat of the gases and other products of combustion, and the temperature and heat conductivity of the surrounding medium); (3) the reciprocal of the time of gas evolution. It seems that rock is broken by an explosive when the latter produces such a violent wave of compressional and resulting tensional stresses as to strain it beyond its elastic limits both in tension and shear. Therefore, no matter how great the force, it must be applied for a sufficient distance to exceed the expansion of the rock within its elastic limit. Once the rock is ruptured from the solid, the attraction of gravity will cause its displacement, and so the propelling force of an explosive is of relatively little value to most mining operations. Although it is unlikely that the Trauzl lead block test correlates so well with the instantaneous rupturing power as with the total amount of energy liberated by an explosive, it may be of profit to try some of the following experiments with such a test.

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*[illegible] other articles by Mr. Tillson, "Promoting Efficiency in Drilling Ore and Rock" and "Increasing Efficiency of Mine Labor," [illegible] the issues of Jan. 21, 1922, and March 11, 1922, respectively, [illegible] Engineering and Mining Journal.

Initial Force Proportionate to Area

The force exerted by an explosive, as represented by the gas pressure in pounds per square inch at the temperature of explosion, is independent of the quantity of that explosive and depends solely upon its composition and the relative size of the container to the volume of the explosive. The area of surface bounding any given volume depends solely upon the form assumed by the volume and is a minimum in a sphere, although if the form be limited to bodies whose surface is generated by a straight line moving parallel to itself, a cylinder will have the least area of surface per unit of volume. The total initial force resulting from the detonation of an explosive in a container of a volume equal to the bulk of such explosive is equal to the unit gas pressure developed multiplied by the total area of bounding surface. Therefore, a greater total initial force will be developed by an explosive if its container be so designed to present a greater area of surface. A practical demonstration is suggested, using a Trauzl lead block.

Place a standard charge of explosive in a cylindrical hole of ½-in. diameter, confine with standard weight of tamping, and detonate, producing a chamber with a certain increased volume which should be measured. Compare with this the increased volume due to the detonation of a similar charge of the same explosive, confined by tamping of a similar weight, in a rectangular volume ¼-in. thick by 0.7854 in. wide and therefore of an equal area of cross section (0.1943⅓ sq.in.).

Measurement of Effective Work

As in the first test the area of the lead block exposed to the force of explosion equals the area of one end (0.1943⅓ sq.in.) plus the area of the curved surface (1.5708 in. times the length of charge), and in the second test equals the area of one end (0.1943⅓ sq.in.) plus the area of the four sides (2.0708 in. times length of charge), if we use a column of explosive 2 in. long, the respective areas of affected surface in the first and second tests will be 3.3359⅓ sq.in. and 4.3359⅓ sq.in. Therefore, the relative increase in the volume of the resulting chambers should be as 3.3359⅓ is to 4.3359⅓, or about as 1 is to 1.3, and the increase in effective work done in the second test because of the shape of the hole would approximate 30 per cent. The limit with a charge infinitely long is 31.8 per cent.

The conclusions stated are based on the assumption that the modulus of elasticity of lead permits a Trauzl lead block test to indicate properly the initial rupturing force of the explosion, and that the useful work performed by an explosive is due to the total initial force exerted. This supposition disregards the element of time due to the resistance of the tamping, which permits some work to be done by the gases after they have expanded to a pressure lower than the initial pressure. As the increased volume of cavity due to the initial force of the explosion in the second test should be greater than that in the first, the pressure operative during the period of time taken to throw the tamping from the hole should be less, so that the useful work performed by this latter cause would be less than in the first test, and the total useful work would not be quite 30 per cent greater in the second test.

In the practical application of explosives to mining, there is a line of least resistance, and the useful work is measured by the amount of material disrupted or distorted in the direction of a face, so that a more representative demonstration would be given if the explosive were detonated in a hole placed parallel to the face of a lead block, and as close to the same as the tensile strength of the lead would permit, so as to cause a maximum deformation toward such face without actual rupturing of the material.

Experiments Made to Determine "Useful Work"

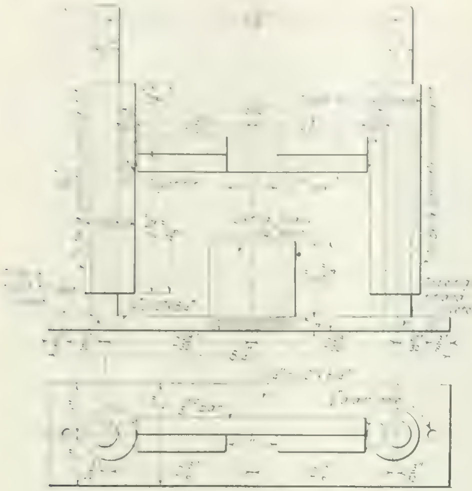
I do not suggest that the law of conservation of energy does not hold true nor that the work done by an explosive varies for any given quantity, but rather that the "useful work," for breaking rock from the solid, may vary with the shape of the drill hole or method of loading it. Field experiments made several years ago seemed to support this theory. Sticks of gelatine dynamite were stripped of their wrappers and split longitudinally; these half sticks were each placed in a tamping bag backed with a semi-cylinder of plastic clay. The sticks were loaded in the drill holes so that the explosive half faced in the direction toward which the holes were supposed to break. A heading of a drift was continued for a month with the holes loaded in the above manner, and a saving of 40 to 50 per cent of explosive was made. A similar experiment was tried in some back stopes, in which the holes were pointed upward with an angle of about 50 deg. to the horizontal. The work was not carefully supervised in regard to powder control, and as a result the miners drilled their holes so as to carry less than the normal burdens, and accordingly less tonnage of ore per unit of labor was broken in a month. So the experiment ceased, being an unprofitable venture. However, it would be interesting to hear what results others may have obtained on similar tests.

It is quite possible that the mining man has not given sufficient attention to fuses, as these are sold throughout the country with widely different burning rates. This may result in an unpleasant or disastrous experience to miners who change from one mining camp to another; for they may get accustomed to a certain time allowance for the lighting of fuses for a round of holes, only to find out too late that they have been using a more rapid fuse.

Functions of Thread in Fuses

There seems to be a popular belief that the thread in the powder train in the center of the fuse controls the rate of travel of fire in the fuse. This is erroneous, as the function of this thread is only a mechanical one—namely, to assure the even carrying of powder from the overhead hopper to the center of the strands as they are twisted to surround the powder train. There are no grounds for the suspicion that a fuse in which this thread is missing will burn with greater speed. However, the speed of a fuse varies with a number of conditions, such as the compounding of the powder, the amount of hygroscopic moisture (therefore the humidity of the room in which it is made), also the pressure exerted by the tape and various plies of wrappings, and whether paper wrapped or jute.

In general, it may be stated that the greater the pressure exerted upon a fuse, the slower the flame will travel in it. It therefore is evident that the portion of fuse tamped in a drill hole will burn at a slower rate



CAP TESTING DEVICE

than that in the free air. A more impervious covering, as a paper tape, or a double or triple tape, will better confine the gases of combustion, increase their pressure, and produce a slower burning rate. Fuse will therefore burn faster at high altitudes than at sea level. If the end of a fuse is not inserted all the way in a detonator so as to touch the fulminate of mercury, the crimping may increase the gas pressure at this point so that it will spit a rather feeble flame and may not cause the cap to detonate.

BURNING RATES OF FUSES

The manufacturers of fuse claim the privilege of a 10 per cent variation in the burning rate above or below its rating, thus making a total variation of 20 per cent possible. This seems entirely too much, for such a variation would seem to be fruitful of inefficient work and hazard. The danger is not in the question of time available for the lighting of fuses—for miners should allow themselves a greater factor of safety than this—but in the probability that the holes may be exploded out of rotation and unexploded powder be thrown into the muck pile. This condition has been experienced, but, on the other hand, tests over a period of several years have indicated that it was possible to obtain fuses with a burning rate of about 90 seconds per yard which did not vary more than one second per yard more or less than this rate. It would seem possible to require the fuse manufacturers to lessen considerably their 10 per cent allowance and perhaps they could meet a 2½ per cent variation guarantee if the demand were great enough to warrant their humidifying the rooms in which such fuse is manufactured. If smaller variations were specified, it would also be necessary to standardize the conditions of testing and the correction factors for altitudes and other variables, but this does not offer a difficulty which has not been met in power-plant specifications and other fields of engineering.

The cutting of fuse to proper length and the crimping of the detonators upon them is now done by many mines at a central point on the surface. In some mines both ends of each length of fuse are dipped into a waterproofing compound, such as a thickened black asphaltum paint, and this practice helps to standardize the work of blasting and tends to increase the efficiency. It is, however, highly important that the free end is waterproofed, or else the humidity of the mine air will give some of its moisture to the powder train of the fuse and will cause irregular burning. The fuse should not be roughly handled when it is unusually cold, for the waterproofing impregnation is then likely to be brittle and so the fuse may receive cracks through its waterproofing. The temperature of a fuse will also affect its burning rate.

The use of electric exploders with a blasting machine (magneto) is well adapted to some conditions, such as blasting the V cuts in a drift heading, where the simultaneous detonation of a number of holes produces the maximum useful effect, but does not cause a loose back in the near-by working places. But in most of the stopes and other workings it is usually necessary to have rounds of holes fired in sequence, so if ordinary fuse is not used one can employ the electric ignition of a delay acting exploder or especially slow fuse. The delay acting exploders are made in five delay periods, and really contain a short piece of unusually slow fuse. The electrically ignited delay fuses can be obtained in several lengths, such as 4 in., 8 in. and 12 in., and intermediate time periods may be arranged for by cutting off certain amounts. These fuses require that usual detonators be crimped on them. They are preferred to the delay acting caps because they permit a greater range of time intervals.

THE GALVANOMETER IN CIRCUIT TESTING

Considerable dissatisfaction may result from either of these electrical delay fuses if one important factor is not observed. They should never be wired with instantaneous electric exploders, for the detonation of the latter may tear away the wires of the former before they are properly ignited. In general, the use of electric blasting is not satisfactory underground where power circuits are not convenient and where a number of rounds must be fired in succession or it is preferable for all of the holes to go in rotation, for the lead wires are badly messed up by each blast, and recovery of them wastes time.

Too frequently the use of old lead wires with damaged insulation causes blasting troubles and delays. A galvanometer test should always be made of the circuit before connecting to the blasting machine. There are portable galvanometers with calibrated scales permitting a check of the actual against the calculated resistance of the circuit, but in general a simpler form of galvanometer tester will prove satisfactory. This device has a hand with a disk marked O.K., and when the O.K. shows it is an indication that the circuit is unbroken. Electric exploders should never be connected in parallel, as their variation in resistance will cause the shunting of the blasting current chiefly through those of the lowest resistance, and the other holes will probably misfire.

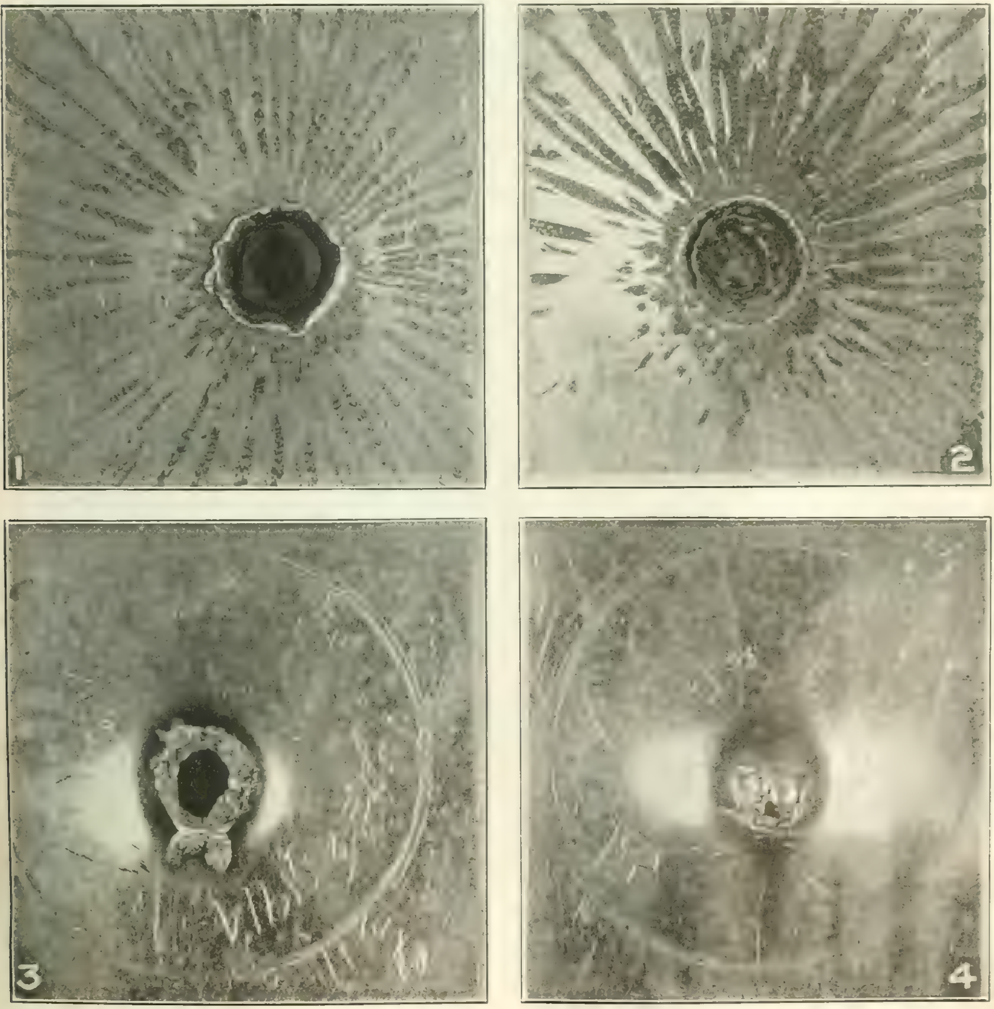
CARE OF BLASTING MACHINES

The proper handling of a blasting machine is a rather tricky matter, for, unless it is securely set upon a level floor so that the push rod may be vigorously pushed down without any side thrust to give a binding tendency during the stroke, the magneto will not receive the sharply accelerated rotation which seems to produce a maximum potential and cur ent. Under such conditions there is often sufficient variation in the resistance of the bridge wires in the electric exploders to cause some of high resistance to be heated enough to produce detonation of the fulminate of mercury or ignition compound, though the others will not be ignited. This condition may more frequently exist with the delay action exploders. Another practice should be bo ne in mind to help obviate difficulties in blasting by magneto. Before connecting the magneto to the circuit, the operating handle should be raised and pushed down vigorously several times so as to increase the residual magnetism in the field of the generator.

It would seem that improved types of blasting machines might be developed and more generally used. For instance, the magneto might be driven by a small, high-speed, compressed-air turbine; or the magneto might be driven through [illegible] gears from a large heavy coiled spring, which could be wound up with a crank and released when the shots were to be fired. Such designs would eliminate much of the personal equation of the miner and reduce most of the unsatisfactory performances which now prevail.

ALUMINUM PREFERRED IN DETONATOR TESTS

Detonators should be tested from time to time by the mine managements to assure the operator that they equal the desired strength. The accompanying illustration shows the design of a simple device for making tests in the commonly accepted manner. A piece of aluminum plate 1½ in. x 1½ in. x No. 8 gage (0.12849 in.) is laid on the ring, and the detonator is placed upright upon it with the beveled edge of the weight resting upon the edge of the detonator where it is crimped upon a



RESULTS OF TESTS ON NO. 6 AND NO. 8 BLASTING CAPS
Observe sides of No. 6 and No. 8 shown in 1 and 2; reverse, in 3 and 4

piece of fuse. The amount of depression put in this plate or the size of the hole torn through it by the explosion of a detonator is considered an index of its strength comparatively with the results produced by other detonators in similar tests. Lead plates have commonly been used for such tests, but it is difficult to obtain the sheet lead with as uniform physical properties as the aluminum, so the latter is preferred.

As an example of the value of such tests the following experience may be cited and illustrated by the accompanying photograph:

With the belief that more efficient results would be obtained from a 50 per cent low-freeing blasting gelatine if No. 8 detonators were used in place of No. 6, the former were adopted at an added expense. After they had been used for some time it was thought that the results were inferior instead of being superior, and such a testing machine was built and applied. It was found that many of the No. 8 detonators did not rupture the aluminum test plates as severely as the No. 6 caps. So a return to the use of No. 6 detonators was indicated and adopted with more satisfactory results and less cost.

The No. 8 detonator is slightly larger in diameter and has a deeper charge of fulminate than the No. 6, but it is questionable whether the greater depth of charge produces useful results. If it does, perhaps the above noted method of testing is not a true index. This matter should be investigated, or, if decisive investigations have been made, the mining fraternity should be advised of the results.

It seems, also, that we should have available more definite data of the useful effects produced by various diameters of detonators with various charges of fulminate of mercury upon explosives of different compositions and strengths; also, the effective length of a column of explosives for which different detonators are adapted, of course varying with the composition and strength of the explosive. Does the detonator need to do more than detonate the explosive surrounding it, and should the wave of detonation propagated by the explosive itself be relied upon to explode the remainder of the charge? If not, then it would seem that the more general application of a denoating fuse is indicated and our underground blasting practice should be revolutionized. What data may be offered to make out a case for the detonating fuse (*cordeau détonant*), and what is the minimum length of a column of explosive in which it will show a saving which will warrant its use, although its cost is greater?

Cadmium Production Declined in 1921

Figures obtained from producers by the U. S. Geological Survey show that the total production of metallic cadmium in 1921 was 65,101 lb., a decrease of 64,182 lb. or about 50 per cent, as compared with the production in 1920. On the other hand, the production of cadmium sulphide in 1921 amounted to 65,446 lb., an increase of 33,313 lb., or more than 100 per cent, over the production in 1920.

The value of the metallic cadmium produced was $63,799 and that of the cadmium sulphide was $71,336, making a total value of $135,135, as compared with $188,535 in 1920, a loss of 28 per cent. The average selling price of metallic cadmium in 1921 was 98c. per lb., as against $1.17 in 1920, and that of cadmium sulphide was $1.09 per lb., as against $1.16 in 1920.

A noteworthy development of 1921 was the extension of the use of cadmium electroplating for preventing rust.

Compressed-Air Blowers in Metal-Mine Ventilation

Compressed-air blowers should never be used in lieu of a permanent ventilation system, according to Richard V. Ageton in *Reports of Investigations*, U. S. Bureau of Mines. Probably the most common error made in placing dependence on compressed-air blowers as an aid to underground ventilation is the tendency to over-rate their cooling efficiency. It is a common but natural error to assume that compressed air which issues freely from a blower is of the same temperature as the compressed air which issues freely from the exhaust port of a rock-drilling machine. A number of readings were taken in different mines of the temperature of the rock-drill exhaust, of the compressed air flowing from the blowers, and of the surrounding air. In general, the temperature of the rock-drill exhaust was from 10 to 30 deg. below that of the surrounding air, in many instances being slightly below freezing, 32 deg. F.

In some of the larger mines visited, the compressed air used by the rock-drilling machines and by compressed air blowers constituted 10 to 20 per cent of the total air in circulation, and in some of the smaller mines, as much as 90 per cent. It has been considered by some that the exhaust air from the drills, with an occasional blowing of the face by compressed air from the hose, is sufficient to ventilate the drifts and stopes. In some mines, however, special blowers are used, and considerable time and thought has been devoted to their construction.

Compressed-air blowers are an aid to metal-mine ventilation in that they do increase the cooling power of the mine air in the immediate vicinity of the blower, and will dilute the noxious gas content of the mine air to a certain extent. The capacity of one of these blowers, approximately 80 cu.ft. per minute, though as much as that of a rock-drilling machine, is not sufficient to remove the fumes caused by blasting, nor is the cooling effect of the air felt at distances of more than 50 ft. from the blower, and then only when directly in the line of the compressed-air stream used for ventilation.

On the other hand, a small, self-contained, electric fan, forcing from 1,000 to 2,000 cu.ft. of free air per minute either through a canvas or galvanized pipe, gives instant relief from heat and humidity, and, if a galvanized pipe is used with a reversible fan, the fumes and powder smoke can be quickly removed, to the expedition of the work and the increased comfort of the miners.

Pure Acetylene Not a Precipitant of Gold or Silver

The U. S. Bureau of Mines is continuing, at Reno, the investigation of various precipitant reagents, proving that pure acetylene does not precipitate silver or gold from cyanide solution. Acetylene, as ordinarily generated, contains some hydrogen sulphide, which will precipitate silver, but if this gas be removed by passing through a sodium-hydroxide solution, the purified acetylene will not precipitate either silver or gold from cyanide solution, but does precipitate silver from aqueous solution of silver nitrate in the form of a white acetylide, which is an explosive chemical when it is dry.

Mining Engineers of Note

Horace Pomeroy

"MY TRAINING and experience have been rather ordinary," says Horace Pomeroy. This is a common complaint among mining engineers who have made enviable records in the profession, many of them seeming to think that it requires a narrow escape from voracious cannibals in the African tropics, the successful administration of the technical and business affairs of a great mine, or a rise from a struggling shoelace peddler to the affluent presidency of a reasonably sized mining corporation to entitle the engineer to any recognition. Although perfectly true that the operators of large mining properties are usually well known by name to fellow engineers, it is no less equally true that the engineers of smaller mines have problems just as momentous and difficult to solve. Inasmuch as fewer people are financially interested in the smaller ventures, it is not surprising that engineers connected with them do not receive as much publicity as the fellow members engaged in larger operations. Horace Pomeroy was born in Pennsylvania in 1875—nothing out of the ordinary in that. His father, who was a mining engineer, took his family out West when Horace was but a few years old. We hate to think what would have happened had father Pomeroy remained in Pennsylvania—Horace would probably have gone into coal mining, and the War Minerals Relief Commission would have been without the services of a valuable member. However, he received a grammar- and high-school education in Portland, Ore., and was graduated from the engineering department of Leland Stanford, Jr., University in 1897. The love of an outdoor life which he acquired and his fondness for athletics undoubtedly had something to do with his stay at the university for a year after graduation as graduate manager whose duties involved a supervision of athletic funds.

For five years Pomeroy worked with his father in various gold-dredging and gold-mining operations. He occupied himself with different engineering tasks and ultimately became engineer for the King of Arizona mine, at Kofa, Ariz. In 1903 he was made general superintendent and for five years remained in charge. The King of Arizona was a low grade gold mine, with fuel and water scarce and situated forty five miles from a railroad. In other words, one of those mines—there are many in the United States—far off the beaten track and requiring much perseverance and skill to overcome unusual operating conditions. That he managed to make a good profit on $6 ore under those circumstances is surely nothing ordinary. In 1906 Pomeroy resigned to become the general manager of the Black Mountain mine, in Sonora, Mexico, a gold-silver property, where he stayed until 1911. The mine was equipped with a 1,000-ton plant, and mining, milling, and cyaniding were done under $2 per ton. "Conditions, of course, were all in our favor," modestly says Mr. Pomeroy, which, if correct, is also out of the ordinary. The Black Mountain mine closed down in 1911, and he took up consulting and examination work for about five years. He then directed the operations of the Mammoth mines, at Schultz, Ariz., as general manager, a mine producing molybdenum and being developed into a gold mine. He remained there from 1917 to 1919, when he was called to Washington to act as a commissioner on the War Minerals Relief Commission, filling the vacancy caused by the death of Dr. Foster, one of the three commissioners originally appointed. Mr. Pomeroy quickly made his presence felt in the expedition of the work of the commission. He never forgot his role of a public servant and discharged his duties and contributed his opinions from that standpoint. He was true to the training of judicial decision and prompt impartial action which alone can make a successful mine operator and hence is the best preparation for a man for public service. When we compare men of this type with those who come into public service through the school of law and politics, and observe how the latter have come to forever act with an ear to the ground for an unfavorable reaction against their decisions, and a hand swift to retract, alter and conciliate any and every faction, we heartily wish that we could fill up the public service with mining engineers.

HORACE POMEROY

CONSULTATION

Further Comments on Ground Silica

"I have read the article on the uses of finely ground silica in your issue of Jan. 28, which is of some interest to me as I have located a large deposit of decomposed silica of which I think over 50 per cent will come under a 300 mesh. It comes in a moist state and when dry is as white as snow. I have shown this to a few persons in Denver who use it in small quantities and who pronounce it fine, but there is not enough of it used in this district to justify equipping the property of the company with which I am connected to handle it properly, and the freight rates at the present time are too high, I fear, to warrant trying to supply Eastern manufacturers. I am not familiar with the locations and quantities of this product over the country, and it may be that there are good deposits nearer the large users of it which would make it useless for our company to try to compete with other producers.

"Your article seemed to be in answer to an inquiry, and it struck me that you might be kind enough to furnish us a little information along the same line. If in your opinion you think we have something worth while and think we might be able to supply some of the heavy users of the product, we would greatly appreciate it if you would give us the names of some of the manufacturers who use it in large lots."

Without an inspection of a mineral property and its products it is impossible to state whether it has any commercial possibilities. In general, the mining and marketing of the non-metallics should be attended with careful supervision of the uniformity of the product. Nothing is so disastrous to cordial relations between producer and consumer as shipments that vary widely in chemical or physical properties. Silica is a common non-metallic, and is produced by many localities in practically every state in the Union, although most of it comes from the South and Middle West. Before attempting to produce it, the local market should be investigated, as it ordinarily controls the disposition of the product. Only exceptionally pure minerals or those with special properties can stand high freight rates to distant points.

Supplementing the article on silica in our issue of Jan. 28th, the following remarks, taken from a recent Bureau of Mines report by R. B. Ladoo, will give additional details regarding the preparation of silica for the market and specifications:

"Methods of mining the various siliceous materials vary widely, dependent on the form of the material, nature and location of deposits, and type of product to be made. However, most of the deposits are worked by open-pit or quarrying methods, often in a crude way. Sand deposits may be worked by hydraulicking, by dredging, or by the use of a steam shovel. Vein quartz is often obtained as a byproduct in the mining of other materials. Pegmatite quartz is almost always obtained as a byproduct in working pegmatite dikes for feldspar or mica.

"The mining, preparation, and utilization of tripoli and of diatomaceous earth are rather specialized, and these subjects are covered by Bureau of Mines publications.

"No true flint is mined in this country, either for grinding pebbles or for ground flint, and all flint marketed is imported, chiefly from Europe. Much of the material sold to the pottery trade as ground flint is either ground quartz or ground sand, although considerable true flint is gound in this country, chiefly for ceramic purposes.

"In the grinding and preparation of silica for market several methods are in use, dependent upon the type of raw material, the character of the product desired, and the progressiveness of the producer. For ceramic use silica is ordinarily ground to pass through a 140-mesh sieve, but for paint, polishes and fillers, much finer grinding is necessary, a 200 or even 300 mesh product being required. For sandpaper much coarser grains are needed, and these grains must be carefully graded by size.

"Massive flint and crystalline quartz are exceedingly hard and tough. Crushing the crude rock is difficult and expensive, and to obviate this it is often calcined before crushing. Calcination is usually done in a small vertical kiln, resembling a lime kiln, fired with wood or coal, in which are placed alternate layers of rock and fuel. As the fuel burns away the charge slowly sinks in the kiln, the heated rock being removed at the bottom and quenched with water. The calcined rock may then be broken down by hand, and fed to 'chaser mills' or crushed in jaw crushers, possibly followed by 'chaser mills.' Fine grinding may be done either wet or dry. Wet grinding may be accomplished in conical mills, short tube mills, in long tube mills, or in wet grinding pans. If a wet grinding process is used, the finished product is usually sized by some system of water classification. Dry grinding may be done in conical mills, short pebble mills of the intermittent type, or long tube mills. In dry-grinding methods, sizing of the finished product is not common, but in some instances air separation may be used. The wet-ground product may be dried by steam in open tanks or over steam-pipe racks or in rotary driers.

"The present tendency is toward grinding less flint and vein quartz and more glass sand, loosely consolidated sandstone and tripoli, on account of the high cost of pulverizing the massive forms of silica.

"Few standard specifications and tests have been formulated for finely ground silica, but most products are sold on sample. For ceramic use, most consumers require a product 99 per cent of which will pass through a 140-mesh screen. They also require that the iron content be low (sometimes less than 0.05 per cent). Amorphous silica in the form of ground flint is often preferred by the pottery trade. For paint and for fillers a 200-mesh product is usually required, although for some uses a product as fine as 350 mesh is demanded. Angular grains are often preferred to rounded grains for use in paint and fillers. For abrasive purposes the grain size varies from a coarse sharp sand (for coarse sandpaper) down to an impalpable dust (for fine polishes). It is important that abrasive silica have sharp angular grains, rather than rounded grains."

The demand for ground silica is smaller than the supply. We have no list available of the largest and most important consumers, but suggest that the prospective producer of fine silica communicate with near-by manufacturers of scouring soaps, tooth powders, filter mediums, paint, wood fillers, rubber, and pottery as possibly being interested in his commodity.

A better understanding of the non-metallic products and experiments to determine their characteristics are constantly opening new uses for them. Additional experimentation and research promises to widen the field. The lack of complete knowledge on the part of some consumers of non-metallics reacts upon the producers. A present tendency toward standardization promises greatly to benefit both interested groups, assuring the consumer the most economical material for his purpose and permitting the producer to supply it.

HANDY KNOWLEDGE

Leakage in Compressed-Air Lines

BY THEODORE SIMONS

Written for Engineering and Mining Journal

With the object of calling attention to the startling magnitude of energy losses caused by seemingly insignificant leaks in air lines, the following method of approximate calculation is suggested, that may be used in the absence of accurate measuring appliances such as were described by W. S. Weeks in the Jan. 7 issue of the *Engineering and Mining Journal.*

The escape of air from an orifice (leak) in the pipe line is due to the pressure of the air flowing through the pipe. The volume of the escaping air is a function of the area of the orifice and the velocity with which the air flows through this orifice, thus:

$$q = vA \qquad (1)$$

in which

q = quantity of escaping air in cu.ft. per second
v = velocity of air in ft. per second
A = area of the orifice, in sq.ft.

The theoretical velocity of the escaping air is:

$$v = \sqrt{2gh} \text{ ft. per second} \qquad (2)$$

in which h = height, in feet, of a column 1 sq.in. in cross section, and consisting of air of uniform density. The density in this instance corresponds to the average gage-pressure (p) of the air in that portion of the pipe where the leak occurs.

The volume of this air column is expressed in the formula

$$\text{volume} = \frac{1}{144} h \text{ cu.ft.} \qquad (3)$$

Obviously, the weight of the air column must be p lb. to exert a pressure of p lb. on its base, which is 1 sq.in. in area. Assuming an average temperature of 60 deg. F., and knowing that 1 cu.ft. of atmospheric air at sea level (atmospheric pressure = 14.7 lb.) and at 60 deg. F. weighs 0.0764 lb., the weight of 1 cu.ft. of air, having a gage-pressure of p lb. at a locality where the atmospheric pressure is P_a lb.

is:

$$W = 0.0764 \frac{p + P_a}{14.7} \text{ lb.}$$

As the air column under consideration weighs p lb., it follows that

$$p = \frac{1}{144} h \times 0.0764 \frac{p + P_a}{14.7} \text{ lb.}$$

whence

$$h = 27{,}707 \frac{p}{p + P_a} \text{ ft.}$$

Introducing this value of h in equation (2) gives

$$\text{Theoretical velocity } v \doteq 1{,}336 \sqrt{\frac{p}{p + P_a}} \text{ ft. per second.}$$

Owing to friction and other resistances, the actual velocity is, of course, much smaller. For pressures up to 200 lb. it may be taken to be approximately one-half of the theoretical velocity. Calling the area of the leak or leaks A square feet, the volume of compressed air escaping per minute is:

$$V_1 = 60 \frac{1{,}336}{2} A \sqrt{\frac{p}{p + P_a}}$$

or

$$V_1 = 40{,}080 A \sqrt{\frac{p}{p + P_a}} \text{ cu.ft. per minute} \qquad (4)$$

Its free-air equivalent is:

$$V_a = V_1 \frac{p + P_a}{P_a}$$

Introducing value of V_1 from (4) gives:

$$V_a = \frac{40{,}080 A}{P_a} \sqrt{p(p + P_a)} \text{ cu.ft. of free air per minute.}$$

Example: From various leaks in a pipe line aggregating 1 sq.in. in area, air at an average pressure of p = 90 lb. gage escapes into the atmosphere, in a locality where the atmospheric pressure is P_a = 12 lb. per sq.in.

(a) What is the volume of the escaping air, expressed in cu.ft. of free air per minute?

(b) What is the loss of energy, expressed in horsepower?

(a)

$$V_a = \frac{40{,}080 \frac{1}{144}}{12} \sqrt{90(90 + 12)} = 2{,}220 \text{ cu.ft. per minute.}$$

(b) Assuming two-stage compression, the theoretical horsepower required to compress 2,220 cu.ft. of free air per minute from 12 lb. to 102 lb. absolute is

$$HP = 2 \frac{144\, n\, P_a V_a}{33{,}000\,(n - 1)} \left[\left(\frac{P_2}{P_a} \right)^{\frac{n-1}{2n}} - 1 \right]$$

in which n = 1.406
P_a = 12 lb.
V_a = 2,220 cu.ft. per minute
P_2 = (90 + 12) = 102 lb.

whence theoretical horsepower = 290.

Adding 15 per cent for resistances and mechanical imperfections, the actual loss is 333 hp.

Such glaring waste of energy due to what might appear to be an insignificant leak points to the importance of stopping leaks as soon as discovered and of preventing escape of air from valves left open without serving a useful purpose.

Repairing Jackhammer Handles

BY HENRY WARRINGTON

Written for Engineering and Mining Journal

Do you have trouble with the threads in the handles of your jackhammers wearing to such an extent that the spud of the water hose connection will not stay tight? If so, have a small male and female bushing made, the male end fitting into the jackhammer handle and the female taking the spud at the end of the water-hose connection. These spuds can be easily and cheaply removed and discarded when worn, leaving the handle as good as new.

Some time ago there were picked up at the plant of a California mining company at least a dozen jackhammer handles which had been thrown to one side as useless simply because the threads had become so worn that the miners could not keep the spud tight. The superintendent had them tapped out and a bushing put in, thus reclaiming $100 worth of handles. These bushings are now put into the company's new machines before sending them underground, and the men have no more trouble from this source.

Hoisting Ropes

Written for Engineering and Mining Journal

Five types of steel-wire ropes are used in hoisting —the ordinary lay, the Lang lay, the non-spinning, the lock coil, and the flat rope. The ordinary lay and Lang lay ropes are most used for hoisting. Non-spinning ropes are used for bucket hoisting. The lock-coil rope is used to a considerable extent in England but not in the United States. It is non-spinning and could be used for bucket hoisting. Flat ropes are used with reel hoists. The rope most used in American mining practice is the ordinary lay. Some Lang lay ropes are used as well as the flattened strand. Non-spinning ropes are not much used.

The ordinary lay rope consists usually of six strands twisted about a hemp center. The strands are composed of seven, twelve, fifteen, or nineteen wires. Flexibility is obtained by increasing the number of wires in an individual strand. Ropes with a greater number of wires to the strand than nineteen are not used in hoisting, as they wear rapidly. The standard for hoisting is six strands, nineteen wires to a strand. Maximum wear is obtained by using wires of large diameter, and this limits the number of wires to a strand. Ropes made of strands containing seven to twelve wires are less flexible, but wear longer, and are used for haulage.

Strands are constructed of circular or oval section. The "flattened strand" rope is made of strands of oval section. In still another type, the strands are of approximately triangular section and give a rope of the same characteristic as the flattened-strand rope. Such ropes present a greater number of wires on the crown of the strand and thus will withstand a greater amount of wear than the circular strand. In ropes of ordinary lay, the wires in the strand are twisted in one direction and the strands in the opposite when made into a rope. The rope is in more or less equilibrium, although it will untwist when loaded and requires a rope attachment which prevents turning. The length of lay or twist in the strand is one-third that of the lay of the rope. Ropes of ordinary lay cannot be used for bucket hoisting, as they cause the bucket to spin.

In ropes of Lang lay the twist of the wires in the strand and the strands in the rope are both in the same direction. The rope is not in equilibrium, and the attachment must be such as to prevent untwisting. Such ropes cannot be used for bucket hoisting. Lang lay ropes have proved in practice to give greater resistance to wear and greater freedom from weakening through bending. They give excellent service in haulage work.

Non-spinning ropes are used for sinking operations where bucket hoisting is necessary. They are made of two sets of strands, an inner set of ordinary strands which are twisted in one direction and an outer set twisted in the opposite direction. The rope is "dead"—that is, it will not untwist under load.

Lock-coil ropes are constructed of an inner core of round wires and three outer layers of wires of a special section which admits of locking the wires together. A smooth outer surface like that of a solid bar is presented. Such ropes are flexible enough for hoisting, are non-spinning, and wear excellently. They weigh more per unit of length and are stronger than round ropes of equivalent size. The lock-coil rope has a section of solid metal equivalent to 90 or more per cent of the area of the circle inclosing the rope, the flattened strand about 70 per cent, and ropes of ordinary lay from 50 to 60 per cent.

Flat ropes consist of a series of strands of opposite lay laced together with soft iron wire. The lacing wears rapidly, and such ropes have to be relaced at quite frequent intervals. The maintenance cost and the necessity for rope-repairing equipment are the principal reasons for the restricted use of flat ropes. They are still used in some mining districts. They are also used for counter-balance ropes in the Koepe system of hoisting. Their greater weight for equal strength is another objection to exclusive adoption, the excess weight ranging from 12 to 20 per cent more than that of round ropes.

The material used in the construction of wire ropes is iron, ordinary steel, crucible steel, plough steel, and steels of special quality. The wire used will range from a tensile strength of from 100 to 135 tons per sq.in. The grade most used has a tensile strength of 120 tons per sq.in. In some rope manufacture steel of a tensile strength of 150 tons is used. The wire is hard-drawn and is subjected to tensile, torsion, and bending tests. The number of flexures under standard conditions for new wire is from twelve to twenty. (The wire is clamped in jaws the edges of which are rounded with a radius of 5 mm. The wire is bent through an angle of 90 deg. and back for each flexure.) The number of twists for new wire under the torsion test is from twenty to forty.

Galvanized steel wire is used for the construction of ropes which are to be used where the conditions causing corrosion are severe. Galvanizing weakens the wire. As an example, a galvanized wire gave 2.5 per cent less tensile strength, 25 per cent fewer bends, and 20 per cent fewer torsions than the ungalvanized. Such ropes last longer under severe conditions. One writer gives as his experience that the life of a galvanized rope is 50 per cent greater than that of a bright steel rope. (*Mines and Minerals*, February, 1912; p. 405.)

Commercial sizes of wire rope range from $\frac{1}{4}$ to $\frac{3}{4}$ in. in diameter, by increments of $\frac{1}{16}$ in. and from $\frac{3}{4}$ to 2 in. in increments of $\frac{1}{8}$ in. Above 2 in. the diameter increment for different sizes is $\frac{1}{4}$ in. Flat ropes are $\frac{3}{8}$ to $\frac{1}{2}$ in. thick and from 3 to 7 in. wide in increments of $\frac{1}{2}$ in. The weights per foot and other details can be readily obtained from manufacturers' catalogs.

Hoisting Speed

Written for Engineering and Mining Journal

Safe hoisting speeds are determined primarily by the depth of the shaft and are for depths of 500 ft., or less, 1,200 ft. per minute; for 500 to 1,000 ft. depth, 1,600 ft. per minute; for 1,000 to 2,000 ft., 2,000 ft. per minute; for 2,000 to 3,000 ft., 2,500 ft. per minute, and over 3,000 ft. up to 3,000 ft. per minute. These are conservative maximum speeds and are recommended in Bulletin 75, p. 112, of the U. S. Bureau of Mines.

THE PETROLEUM INDUSTRY

The Oil Supply of the World*

THE QUESTION is often asked, Why is the United States, whose petroleum market is now depressed because of a slight excess of oil supply, especially concerned about how much oil there is in our own country and the world? The concern of the public in the economic problem of oil supplies arises from the following outstanding features of the situation, which give the question an incisive significance to every American user of oil:

To date the United States has furnished nearly two-thirds of all the oil yet taken from the ground in the world—5.5 billions of barrels out of a total of 8.5 billions. Our American fields are now pouring out 62 per cent of the world's annual supply while our country is using over 75 per cent of that total supply. In other words, the United States requires over 115 million barrels more than it produces; for, whereas our output now approximates 470 million yearly, our requirements, even during the business stagnation of 1921, called for 525 millions.

HOW ABOUT THE FUTURE?

Where will the oil to satisfy these requirements come from year after year, and how long can we keep up the pace? These are plain, common-sense business questions, predicated on our present oil requirements as an established fact and on the suggested possibility that our prodigal spending of our petroleum heritage may cause its too rapid depletion if not its early exhaustion in the midst of our spendthrift career, and at some untoward moment send us as beggars to foreign countries for the precious fluid necessary not only to satisfy our extravagant habits but even to sustain our industrial prosperity, our standards of living, and our civilization.

Obviously, the first thing to be done is for the nation to proceed in the nation's business just as the business man proceeds under similar conditions in his private business—namely, to take account of stock, to find out how much oil there is left in the United States, and then to learn as nearly as possible how much oil there is in the rest of the world and where the principal deposits or reserves are situated, due consideration being given to probable availability and conditions of production of these reserves.

No apology, therefore, is needed for the searching appraisal and careful estimate recently made of the oil reserves remaining in the ground recoverable by present methods in the United States nor for its publication for the information and advice of the industry and the country at large. The justification of the formulation of estimates of the oil reserves in other countries, based upon long and painstaking studies of the available data relating to the oil reserves and relative oil possibilities of those other regions of the world, is evident. Such information is indispensably requisite for understanding the present economic situation, for the development of that perspective and breadth of vision necessary for the formation both of domestic and of foreign policies, and for the more effective safeguarding of the future of our country.

WORLD'S TOTAL OIL RESERVE SEVENTY BILLION BARRELS

The oil reserves to be found in the regions of the earth where oil has already been proved to exist in commercial amounts were in 1920 estimated by Eugene Stebinger and myself at 43 billions of barrels. The consideration of the geology of other regions in which oil has not yet been proved to be present in commercial amounts led to the formulation of an additional estimate of 17 billion barrels for these regions, placing the total estimate for the world's oil reserves in the ground and recoverable by present methods at 60 billions of barrels. From data subsequently reviewed and on consideration of further information in hand I am disposed to regard an estimate of 70 billion barrels for the world's total resources as conservative.

The most important oil regions outside of the United States are believed to be in Mexico, Venezuela, Colombia, Bolivia, Argentina, Russia, Mesopotamia (together with western Persia), Assyria and Arabia, the East Indies, China and eastern Siberia (including northern Sakhalin), the Japanese empire, India, and probably northern Africa.

Inaccessibility of the oil regions, lack of transportation and other industries essential to oil exploitation, and remoteness from all important markets, will deter for long periods the discovery as well as the development of many of the oil fields in both hemispheres. Further, periods of glutted markets may recur, but it seems to me more probable that, in general, oil-field development is likely to be led by competitive demands arising from the inevitable enormously expanding world markets.

Considering the economic situation of oil as it affects this country, we find that in the United States we have at the present moment produced a total of 5½ billion barrels of oil. We have therefore used up more than one-third of our estimated original heritage of oil. Contrasted with our more than 5 per cent rate of annual depletion, the rest of the world withdrew in 1921 not much over 280 million from its store of over 60 billion barrels, or less than one-half of 1 per cent of its reserve recoverable by present methods. In other words, the reserves of the rest of the world would stand the present rate of drain for over two centuries. From the standpoint of the world distribution of oil and the economic relations of our reserves to those of the rest of the world, an error of two or three billion barrels—four to

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*Abstract of a paper by David White presented at the Engineering Congress on the Petroleum Industry at Kansas City, Mo., March 6.

[illegible] years' supply in the estimate of the oil reserves of the United States is comparatively insignificant.

The co-operative committee expressly affirms that not all the oil pools in the United States will have been discovered a generation hence. On the other hand, the committee takes great pains to point out that though our reserves would not meet our present rate of consumption demands for twenty years, if they could be taken out of the ground fast and cheaply enough to supply our market (a conditioning clause that has generally been lost sight of by the press and the public), this country will be producing oil for as long as seventy-five years to come.

Production Peak Imminent

As oil cannot so rapidly be located and taken from the ground, it follows with certainty that, according to the laws of oil production, the annual oil output of the United States must at an early date pass its peak and enter upon a long-drawn-out period of general though fluctuating decline to ultimate exhaustion; except so far as fields in great numbers may be rejuvenated by better methods of mining. Opinions differ as to how soon the production peak will be passed, but most geologists believe that within a few years, perhaps less than five, we shall in the normal course enter on a period of waning fields in increasing numbers, with discoveries more infrequent and in general more costly.

A large portion of the public does not yet fully recognize that the United States is already dependent upon foreign oil to meet its still growing requirements. Our oil importations, 18 million barrels in 1913, grew to 38 millions in 1918, 53 millions in 1919, 106 millions in 1920, and 125 millions in 1921. A small part only (less than 9 millions) of this amount is offset by exportation of crude petroleum from the United States. In short, in a period of industrial depression, we have imported one-fourth as much as we produced. Nearly all of this oil comes from Mexico, and that is why Americans are so profoundly interested in Mexican oil.

The present production in Mexico, amounting to about 195 million barrels in 1921, is mostly drawn from a relatively small number of wells situated along a single axis of folding in which a thick limestone, the Tamasopo, is caverned by solution and, in the structurally high points, gorged with gas and oil under most tremendous pressure of salt water. No wells of such enormous production are known in any other part of the world. It is practically certain that, though some new discoveries of Tamasopo oil may come to the aid of the rapidly failing pools, sooner or later the production of oil from world-record-breaking Tamasopo limestone gushers will wane, and the remaining portion of Mexico's 4 to 5 billion barrels of oil reserves, as estimated, must be won by the sweat of the oil operator's brow from wells of the ordinary type.

The magnitude of the task of developing enough oil fields of the "common or garden variety" in Mexico to take over the load of an annual production of 195 million barrels, which was produced from less than 300 wells in 1921, may be inferred from the fact that in 1908, when for the first time the production of oil in the United States amounted to so much as 175 million barrels, over 140,000 wells contributed to that output. This number is, of course, subject to radical discount for rapidity of development and freshness of production. It would take over ten Haynesvilles or a group of four Mexias or fourteen Salt Creeks, all running full blast, simultaneously, and all continuously maintaining their January rates of production, which, of course, is impossible. It is difficult to estimate the oil price stimulus necessary to develop a production of 200 million barrels of oil in Mexico from wells of the ordinary type under existing transportation, climatic, and industrial conditions, within five years. The prices requisite would certainly be most encouraging for the production of oil from shale in this country.

Disadvantages of Oil Shortage

The collapse, or, better, the great slump in Mexican production which seems, sooner or later, inevitable, can hardly fail to react on our own oil-field production, probably driving it to the limit; and it is likely that in the early period of this strain the annual output of petroleum in the United States will pass its peak. Beyond this point our need for more foreign oil is likely to spring from our decreasing domestic production more than from further growth of our consumption requirements. In this period relief must come from other foreign oil fields and from the production by distillation of shale oil, on whose adequacy and on whose yet undetermined cost we may be obliged to rely for protection against transoceanic importation at transoceanic prices beyond our control. Too great an advance in price will, of course, check our use of oil and bring it nearer within the bounds of practicably available supplies from all sources, at prices then viewed as practicable. The oil we cannot afford to buy we will do without.

Among the constructive economic deductions to be drawn from a review even so superficial and elementary as this summary of the high points of the situation as to oil resources it is to be seen that:

1. The need of foreign oil reserves available for continued use in the United States is obvious.

2. Waste in producing, in transporting, and in using oil should be prevented or curtailed as far as economically practicable. The problems are insistently pressing. Large results are known to be immediately possible.

3. Increased concentration of thought and experimentation on the more efficient use of the oil now available and on the production of commodities of greater efficiency are economically urgent. On every occasion consideration should be given to the general abandonment of oil to generate steam, in favor of the three times as efficient Diesel motor or some other still more effective substitute.

4. More intense and more widespread researches in the production of liquid hydrocarbons through processes —so-called low-temperature carbonization—aimed at the more efficient use and the wider adaptation of our bituminous and lower-grade coals, are important.

5. The development on a commercial scale of an oil-shale industry deserves more earnest and wiser consideration. The deposits of rich shale in Colorado, Utah, Wyoming, and Nevada alone are sufficient, if fully used, to generate more than seven times the oil estimated to remain in the ground in the United States recoverable by present methods.

6. The recovery of a much larger portion of the oil in the reservoir rocks than is obtained by present methods is an imperative necessity, demanding the faithful, the intelligent, and the immediate consideration of the states and of the Government as well as of the oil industry.

Book Reviews

Metallurgy of Zinc and Cadmium. By H. O. Hofman, E. M., Met. E., Ph.D. Cloth; 6 x 9; pp. 341. McGraw-Hill Book Co., New York. Price, $4.

Professor Hofman's book will be welcomed by all zinc metallurgists, as no comprehensive work on the subject has been published in English for many years. The general plan is that of his other works, and, like them, gives a host of references to current publications that will be invaluable to those desiring fuller details than can be given in the space available.

The first five chapters take up the history, properties, commercial grades, industrial uses, and compounds of zinc, and cover the subject as fully as can be done in the space allowed. The ores are next taken up, the principal varieties are described briefly, and examples are given of the formulas sometimes used for determining prices. These are all in the form of a more or less elaborate calculation, based on the market price of spelter, assumed smelting losses and treatment costs, ending with an arbitrary deduction according to the buyer's fancy. As a matter of fact, outside of the Joplin district there is no recognized basis, each contract depending mainly on the individual desires of the buyer and seller.

The next section, which occupies about half the book, treats of the smelting of ores. Calcining and roasting are first taken up, and the furnaces actually used in this country are fully described and their performances given. Most of the dead matter commonly given in books on this subject has been omitted, and little space is given to furnaces that have not proved acceptable for work under American conditions. The same may be said of the descriptions of smelting furnaces and practice. The furnaces and methods described are those in present-day use. The comparison of results is not as complete as might be desired, as little if any allowance appears to be made for the great differences in the quality of fuels and ores in different locations. These differences are often the controlling factors, as when the old Bertha works, at Pulaski, smelted a refractory silicate in direct-fired furnaces, using Pocahontas coal, with less fuel per ton than is used in regenerative furnaces smelting Joplin ores in the West. The chapter ends with short notices of the attempts that have been made to smelt in blast furnaces and electric furnaces. As Professor Hofman says, none of these have been successful, and none show much probability of being successful under present conditions.

Electrolysis is next discussed, the general principles being first clearly described and then the three plants that alone show probability of continued existence on this continent are taken up in detail. The necessity of extreme purity of the solution is pointed out, although perhaps hardly enough emphasis is given to it and to the difficulty of obtaining it. Much information is given on the effects of different variables on current efficiency. This chapter gives the most complete description of this most important process that has yet been published.

A brief chapter follows on the manufacture of zinc oxide. It gives a short and rather unsatisfactory account of the French process, regarding which scarcely any information is available. In this the order of quality of the three commercial grades is given as White Seal, Red, and Green, whereas it should be White, Green, and Red. The discussion of the two modifications of the Wetherill processes that are in use is excellent.

The second part of the book treats of cadmium, and gives a more complete account of its properties and metallurgy than has heretofore been published. It is a difficult subject on which to obtain information, as there are few producers, and they are not communicative.

On the whole, Professor Hofman has given us the best work on the metallurgy of zinc that has been published in English. If in places it is not as full as we could have wished, the zinc smelters have only themselves to blame. If all of them had given information as freely as a few of the larger ones did, Professor Hofman would have had the information that would have enabled him to write an even better book. Unfortunately, the proofreading has not been as carefully done as it should have been, and there are numerous typographical errors that may cause trouble.

G. C. S.

The Mining Manual and Mining Year Book for 1922. By Walter R. Skinner. Cloth; 5½ x 8½; pp. 1,000. Published by W. R. Skinner, 15 Dowgate Hill, London, E. C. 4. Price, foreign post paid, 21s. 6d.

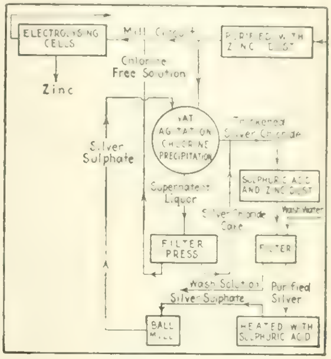
Mr. Skinner's red book is too well known among mining engineers to require extensive comment. It is somewhat on the order of our American publication sponsored by Walter Harvey Weed, though an important item of difference is that the English work is published promptly every year. It gives particulars regarding about 1,400 mining companies in all parts of the world, including gold, diamond, silver, copper, tin, iron, and coal companies, thus having a wide scope, though in general only the most important companies are listed. The information given is largely that which is sought by financiers or investors, rather than matter which would be of interest to the purely technical man. It is without doubt the best digest of up-to-date information on foreign mining companies obtainable.

The present edition has no new features, but the data have been brought up to date. A list of mining directors and a tabular summary of the tons of ore crushed and gold recovered by all British producers are included in the book.

Recent Patents

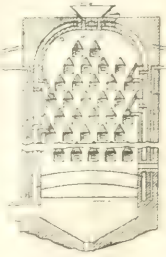
Copper Converting—No. 1,403,2 J. J. Dawson, Globe, Ariz. The patent covers a system of introducing fuel oil into the compressed air pipe of a copper converter.

Electrolytic Zinc—No. 1,403,065. David Avery, Melbourne, Victoria, and R. H. Stevens, Hobart, Tasmania, assignors to Electrolytic Zinc Co. of Australasia Proprietary, Ltd., Melbourne. A method of removing chlorine from the zinc-bearing solution prior to electrolysis for the purpose of reducing the corrosion of the electrodes during the electrolysis of the solution.



Chloridizing—No. 1,402,732. David Avery, Melbourne, Victoria, assignor to Amalgamated Zinc (De Bavay's), Ltd., Melbourne. Leaching chloridized material containing lead and silver with a cold brine solution saturated with lead chloride and containing ferric chloride.

Roasting Furnace—No. 1,399,046. F. J. Bowman, Cleveland, assignor to the Grasselli Chemical Co., Cleveland. An ore-roasting furnace consisting of a plurality of triangular heated elements. Means for introducing finely divided ore and heated oxygen are provided.



Grinding Mill—No. 1,400,123. George Wolff, Paterson, N. J. Design for sectional grinding plates for attrition mills.

Flotation—No. 1,400,308. D. D. Moffat, Hayden, Ariz. A method of introducing the flotation agent by volatilizing it in heated compressed air which is afterward passed through the porous bottom of a pneumatic flotation cell. The process described has proved useful at the Ray Consolidated mill.

ECHOES FROM THE FRATERNITY

Columbia Section, A. I. M. E., States Objection to Arentz Bill

The Mining Law Revision Committee of Columbia Section, A. I. M. E., has prepared a detailed critique of the so-called Arentz Bill, and has issued the following statement:

"In general the committee does not believe the present law is so perfect that no improvement is possible, and it therefore favors the enactment at this time of the following portions of the proposed law: (1) The provision for recording of claims in the United States Land Office, the burden to be placed, however, on the county or district recorder and not on the prospector; (2) the disqualification from relocation for one year; (3) the specification that monuments shall govern descriptions, and (4) with certain reservations, the plan for allowing extra land in lieu of the present mill sites.

"The committee is opposed to the following clauses: (1) The requirement for [illegible] of claims; (2) the certification of discovery by a mineral surveyor; (3) the restrictions on locations in Alaska (Why pick on poor Alaska?), and (4) the proposal for the creation of a mineral development fund, and all payments upon which it would be based."

The following general comments are made:

"Your committee further feels that it is no reflection upon the eminent gentlemen who compiled the proposed law to say that their point of view is radically different from that which actuated the makers of the law of 1872, and the framers of the 'Miners' Rules and Regulations,' upon which it was built. We are forced to the conclusion that the present framers have most naturally, in large measure, and with considerable justification, ignored the individual locator and prospector, and framed a law designed mainly for development and exploration by organizations of considerable capital. It is evident, of course, that much of the prospecting of the future will be of a kind beyond the scope of the prospectors of the past; at the same time your committee does not believe that we have yet reached a place in our development where the small man can be entirely relegated without detriment to the mining industry.

"Concomitantly with this it seems to us the bill contemplates a further extension of the regulatory powers of the Land Office and similar organizations, and to your committee, all of whom have lived and operated within the confines of the national forests, further extension of the exasperations and annoyances, opposition and apathy, inflicted upon persons engaged in mining development in these areas appears fatal.

"All of us deplore the decline of prospecting. To encourage it requires helpful stimulation, not further regulation and restriction by unsympathetic and uncomprehending jacks in-office. The wild free days of the early West are of course gone forever, but we need not swing from that extreme to one of officialdom bristling with 'verbotens' of one kind and another.

"In conclusion, it appears to your committee that one of the greatest difficulties connected with mining litigation is the method of court procedure, and we, as a constructive measure, desire to embody as a rider to this report the suggestion put forward by the chairman of this committee with regard to a modification of present procedure, with the earnest recommendation that serious consideration be given to the best method of putting it into practice."

British Columbia Boards of Trade Discuss Mining and Smelting

Statements made by J. J. Warren, president of the Canadian Consolidated Mining & Smelting Co., at the recent annual meeting of the Associated Boards of Trade of Eastern British Columbia, at Nelson, B. C., indicate that the lead surplus of that company has been sold out, that the smelting costs of the treatment of eastern British Columbia silver-lead-zinc ores now are so low that the company can fearlessly compete with the world in the production and sale of lead and zinc, and that the lead refinery at Trail is to be enlarged from a capacity of 90 tons to 150 tons a day.

The meeting was attended by many of the mining operators of the Kootenay districts as well as by business men representing those sections of the province. The opinion was expressed on all sides that the indication of a new and progressive policy on the part of the company would have an immediate and a beneficial effect on the mining industry of the Canadian West.

Admitting that he preached cutting costs, Mr. Warren said the Consolidated company had first practiced what he now preached, for it had cut the costs of production of lead and zinc to such a point that it did not fear competition. Lead and zinc were down in price, but in spite of that, owing to the progress made in treatment, the company would be able to sell them at a price sufficient to enable it to keep going.

Mr. Warren said the Consolidated had found a way by which it could accept shipments of zinc-silver-lead ores, paying shippers a reasonable sum for the metal contents of all three ores. Formerly the zinc operated as a penalty. In a short time the company would be able to accept and treat the zinc and give full value for it.

A number of questions relating to the mining industry of the province were also discussed at the meeting. Resolutions were passed asking for "adequate duties on all base metals entering Canada up to the point where metals can be supplied by Canadian producers," and advocating adequate duties on "copper rods, copper wire bars, zinc sheeting, sulphate of lead, and fluorspar." Regarding fluorspar F. W. Bingay, of the Canadian Consolidated Mining & Smelting Co., said that Canada imported that article both from England and Kentucky, and that Eastern manufacturers using that product have plentiful supplies in Ontario to draw from and would not be injured. It also was urged by resolutions that "The same duties on scrap copper, zinc, and brass be imposed as upon the virgin metal."

A resolution from the Northwest Mining Association, in convention at Spokane, asking support for reciprocal free re-entry of lead bullion to the country of its origin, was almost unanimously opposed. This was offered by the Nelson Board of Trade, although it had not been indorsed by that board.

Accident Rates for Mineral Industries

The safest branch of the varied mineral industries in which to work would appear to be the sandstone and bluestone quarries, according to data of the comparative accident rates for all divisions of these industries compiled by the U. S. Bureau of Mines for the year 1920. The lowest fatality rate was found to be for this class of quarries, which employ a relatively small number of men and in which all work is done in daylight, free from many dangers that are inherent in underground mining. For the same year, the highest fatality rate was that for gold, silver, and miscellaneous metal mines, a group that includes all metal mines except those producing copper and iron and those in the Mississippi Valley that produce lead and zinc.

No reports of non-fatal accidents at coal mines are received by the Bureau, but for all other branches of the mineral industry the highest injury rate was that for the lead and zinc mines of the Mississippi Valley, and the lowest was that for marble quarries.

Since the enactment of compensation laws by nearly all of the states, increased importance attaches to the accuracy and completeness of the statistical publications on industrial accidents. The insurance premiums that operators of metallurgical plants, mines, and quarries have to pay are determined largely from a study of statistical reports relating to accidents in these industries. It is highly advisable, therefore, that full and accurate data concerning accidents be reported promptly by operators, not only to aid in the study and prevention of such accidents, but also to assist state compensation commissions and other insurance bodies in establishing fair premium rates.

As the practical usefulness of statistical reports is increased or diminished by the promptness or tardiness with which the figures are published, the Bureau hopes that its annual inquiries relating to accidents may be filled out by all operators and returned promptly, so that the value of the reports of the Bureau on this subject may not be diminished by unnecessary delay in their publication.

MEN YOU SHOULD KNOW ABOUT

J. B. Tyrrell, of Toronto, left for London last week.

E. J. Collins, of Duluth, is in Arizona on professional business.

D. W. Brunton sailed for Tahiti from San Francisco on March 3.

Fred J. Siebert, consulting engineer of Reno, has been in Randsburg, Cal., on professional business.

W. H. Williams, discoverer of the California Rand Silver mine, at Randsburg, is in San Francisco.

E. P. Mathewson arrived in San Francisco on March 13 from a six months' business trip to India.

Walter A. Rukeyser left last week for The Pas, Manitoba, en route to the Elbow Lake district in Canada.

Major H. H. Armstead returned to Talache, Idaho, the first of March, after spending the winter in New York.

C. W. Purington has been at Vladivostok during January and February and has now returned to Yokohama.

J. E. Spurr, editor of *Engineering and Mining Journal*, addressed the San Francisco section of the A. I. M. E. on March 6.

George D. Carpenter, of St. Louis, vice-president of the St. Louis Smelting & Refining Co., was recently in San Francisco.

H. S. Munroe, general manager of the Granby Consolidated Mining & Smelting Co., Ltd., has left Canada on a visit to California.

Burt G. Shields, of New York, has been nominated as assayer of the New York assay office, succeeding **George R. Comings**, deceased.

R. C. Gemmell, general manager of the Utah Copper Co., accompanied by **J. E. Cawley**, left Salt Lake City for New York on March 2.

W. C. Browning, general manager of the Magma Copper Co., Superior, Ariz., is visiting New York and other Eastern points on a business trip.

J. W. Sherwin, general manager of the West End and Halifax companies, in Tonopah, is in Tonopah, having come from his headquarters in Oakland.

W. C. Fellows, manager of the Ben Harrison mine, in Grant County, Ore., returned to Oregon recently from a three months' sojourn in Kentucky.

Julius M. Cohen, consulting engineer of the Elbow Lake mines in The Pas district, Manitoba, has gone to the property to arrange for preliminary development work.

Bulkeley Wells, president of the Metals Exploration Co., left Denver on March 10 for the New York office of the company, where he will remain until about April 1.

Norman Carmichael, former general manager of the Arizona Copper Co., Ltd., has been named to represent the interests of that corporation on the Phelps Dodge directorate.

C. B. Manville, of the Johns-Manville Co., of New York, accompanied by **Robert Malcolm** and **John S. Evarts**, was a recent visitor to the Thumb Butte property, in Mohave County, Ariz.

L. S. Cates, assistant general manager of the Utah Copper Co. and general manager of the Ray Consolidated Copper Co., and **D. D. Moffat** left Salt Lake City on March 2, for Arizona, on an inspection of the company's properties.

Charles V. Safford, administrative assistant to **A. B. Fall**, Secretary of the Interior, was in Denver on March 10 and 11, conferring with heads of the General Land Office, Reclamation Service, National Park Service, and Bureau of Mines.

Harmon F. Fisher has been appointed as engineer, connected with the research division, of the American Petroleum Institute. Mr. Fisher has been a consulting engineer and was previously engineer in charge of operation at the Government helium plant No. 3, Petrolia, Tex.

Charles S. Herzig, of New York, made an inspection of mining property in Montana the latter part of February; from there going to the Coeur d'Alenes, where he made an examination of the Independence Lead Co.'s property above Mullan, Idaho, and the Rex Consolidated, north of Wallace.

D. A. Rossell has resigned the superintendency of the Iron Cap mill, at Globe, Ariz., to take charge of the milling department of the Mineral Products Co., with headquarters at Boston. He will be succeeded at Globe by **W. H. Rith**, who has been in charge of the C. O. D. mill, in Mohave County.

Dr. J. D. MacKenzie, head of the British Columbia Branch of the Canadian Geological Survey, has left Vancouver for Ottawa to confer with **Charles Camsell**, deputy minister of mines, and other officials regarding the plans of the Canadian Geological Survey for field work in British Columbia during the coming summer.

Carl Sparks, a mining engineer who has been specializing in placer mining at the Fairbanks, Alaska, station of the Bureau of Mines, is returning to the United States and will be stationed at Berkeley, Cal., until the end of the fiscal year, where he will be engaged upon a report of the results of his work. After July 1, he will return to the mine-rescue division, in which he formerly served.

H. Foster Bain, director of the Bureau of Mines, was elected president of the Joseph A. Holmes Safety Association, at its annual meeting at Washington, D. C., last week. **Charles D. Walcott**, secretary of the Smithsonian Institution, was named first vice-president, and **Samuel Gompers**, president of the A. F. of L., second vice-president. **George S. Rice**, chief mining engineer of the Bureau, and **James Lord**, of the mining department of the A. F. of L., were elected directors.

Mining and metallurgical engineers visiting **New York City** last week included: **L. C. Fopeano**, Kannarock, Va.; **Alma Ek**, Chile, S. A.; **T. B. Counselman**, Babbitt, Minn.; and **John T. Reid**, Lovelocks, Nev.

OBITUARY

Benjamin Magnus was found dead in Poughkeepsie on March 13. Mr. Magnus was a graduate of the Columbia School of Mines and for many years was connected with the Mount Morgan Copper Co. in Australia.

Dr. John Casper Branner, noted geologist, and for a time president of Stanford University, died recently at his home in Palo Alto. Dr. Branner was known principally for his researches in the geology of Brazil. As an inspiring teacher, he did much to develop the department of geology at Stanford.

William H. Nicholls, a pioneer of the Cascade range, in Michigan, died on March 7 at the age of eighty. Captain Nicholls came to America from England about forty years ago, and was first employed at the Jackson mine, Negaunee. Later he took charge of the Star West mine, at Palmer, for the Corrigan-McKinney interests.

Alexander M. Gow, assistant chief engineer for the Oliver Iron Mining Co., Duluth, Minn., died at his home on March 8. Mr. Gow had been connected with the Oliver Iron Mining Co. for the last seventeen years, during which time he had complete charge of its mechanical activities on the Mesabi and the Michigan iron ranges. The introduction of larger type machinery in open-pit work and underground mining on the Lake Superior iron districts was due in great measure to his effort and foresight. Mr. Gow was greatly esteemed by all who knew him and was distinguished in his profession. He was a graduate of Washington and Jefferson University and also took a post-graduate course at the University of Ohio.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

Violence amounting to open warfare has characterized the strike situation at the gold mines on the Rand, in South Africa.

The Old Dominion Copper & Smelting Co. is milling 500 tons daily at Globe, Ariz. The International smelter at Tooele, Utah, chiefly a lead plant, is said to be preparing to resume.

British zinc smelters are complaining that the government's policy with regard to Broken Hill concentrates practically amounts to subsidizing the Australian enterprise.

Coal miners in the Crow's Nest Pass district of the Northwest have threatened to strike April 1 unless their wage demands are granted. Ordinarily this would affect mining and metallurgical operations.

Another attempt to secure further suspension of assessment work has been made at Washington by Senator Stanfield.

Back taxes on Mexican mining properties will be canceled under certain conditions. A decree to this effect has been promulgated by President Obregon, according to advices from Washington.

International Smelter at Tooele Preparing To Resume

Utah Consolidated Expected To Start Production of Milling Ore for New Concentrator

It has been announced by William Wraith, general manager of the International Smelting Co., that the company is preparing to resume operations at its plant at Tooele, Utah. The date will depend upon a number of factors, including the amount of ore contracted for and consigned to the smelter, and it will probably be about the end of spring when the furnaces are blown in. At present stockpiles are being built up and will be added to for from sixty to ninety days. Existing ore contracts have been kept up during the time that the smelter was closed since last June, by transferring the ore to other smelting plants, and a number of new ore contracts have recently been acquired. A sufficient tonnage is assured.

When the International opens it will be possible for the Utah Consolidated, in Bingham Canyon, which has not yet operated its new mill near the Tooele smelter, to start production of lower grade ore, a large tonnage of which is developed. When smelting operations are resumed it will give employment to between 300 and 400 men. When operating at full capacity the plant can handle about 1,500 tons of ore daily. In 1918 a tonnage of 560,579 tons of ore was smelted, and in 1920, the last complete year of the plant's operation, 104,210 tons of copper ore and 200,787 tons of lead ore were treated.

Carmichael a Phelps Dodge Director

Normal Carmichael, formerly general manager of the Arizona Copper Co., has been nominated by the shareholders to represent them on the board of the Phelps Dodge Corporation. This is equivalent to election.

Steel Companies Get Injunction Against Trade Commission

The controversy arising over the demand of the Federal Trade Commission for reports of business relative to many of the iron and steel companies has been temporarily won by the companies. An injunction has been granted twenty-two of the steel companies by Judge T. J. Bailey, of the Supreme Court of the District of Columbia, which prevents the commission from demanding these reports.

Strike of Coal Miners Looms in Colorado

Coal miners' unions in various coal fields of the state have served notice upon the Colorado Industrial Commission that unless a new wage scale and working agreement is negotiated between the coal operators and the "proper officials of the United Mine Workers of America" a strike will take place April 1. With the large reserves and independent mines, it is believed that the strike, unless greatly prolonged, will not affect smelting or metal mining companies that are operating in Colorado.

U. S. Smelting Leases Balaklala Property

A mortgage release involving $1,000,000 has been recorded by the Balaklala Consolidated Copper Co. at Redding, Shasta County, Cal. The bonds held by the Windsor Trust Co., of New York, have been paid, resulting in the cancellation of the mortgage. A fact of additional interest is the leasing of the Balaklala property to the U. S. Smelting, Refining & Mining Co., which owns the Mammoth mine and smelter, in the same district. The terms of the lease have not been made public, nor have any definite plans been announced for resumption of mining at either the Balaklala or the Mammoth.

Violence Marks Strike at Mines on Rand

Armed Whites Clash With Police and Government Troops—Workmen Dominated by Radicals

So serious had the strike situation become at the gold mines on the Rand in South Africa during the first week in March, that martial law was declared on the tenth of the month. Violence, amounting almost to actual warfare, marked the conflicts between the strikers and the police. Many points along the Reef fell into the hands of the former and for a certain period a large part of Johannesburg was dominated by the "commandoes," mounted and unmounted, who struggled desperately to gain control of the town before the arrival of the government forces. Many casualties were reported on both sides and a large number of prisoners were said to have been taken by the troops. The situation is now controlled by the latter.

Conditions leading up to the strike and that have obtained since the gold mines shut down about the first of the year, have been described in the *Engineering and Mining Journal* by its Johannesburg correspondent, John Watson, in the latter's weekly letters. Summed up briefly, the cause is threefold—namely, radicalism, the absolute necessity for cutting labor costs and the talk of removing the "color bar." Under date of Feb. 7 Mr. Watson wrote:

"The gold mines of the Rand have now been idle for four weeks, through the strike of white workers. We read on Feb. 1 that the Germiston Strike Committee had passed a resolution suggesting the appointment of an arbitration court to settle the present strike. The resolution expressed a desire to meet General Smuts to lay their proposal before him. It was understood that the Prime Minister was willing to receive such a deputation next morning. Next day, we read that the proposals of the Central Strike Committee had excited the keenest opposition among a section of the [illegible] strikers and that section had made a demonstration at the offices of the Central Committee and told the members they would not be allowed to leave the office until they had changed their plan about proceeding to Pretoria to interview the Premier. It was only when the strike committee gave their word of honor not to proceed to Pretoria that they were allowed to leave the room. The Rand gold industry has been the milch-cow of South Africa. If we take three of the low-grade mines, the restarting of which will now be extremely doubtful, the average monthly wages paid have been:

	Whites	Natives
Roodepoort United	£5,254	£4,303
New Goch	5,310	4,125
Luipaards Vlei	6,200	5,495

It must also be remembered that the expenditure in stores and material reaches a big figure, now withdrawn from circulation.

"A special feature of this strike has been the formation of commandoes, both infantry and mounted, of strikers. In several cases these commandoes have marched to mine-shafts and warned, or 'pulled-out' officials engaged on essential services, such as pumping to dewater deep-level mines. The Commissioner of Police is now warning the strikers that the use of such bodies of men, or commandoes, to pull out officials constitutes a crime of public violence, and the police have been instructed to take action in such cases."

A little before this, on Jan. 31, Mr. Watson wrote:

"So far, the strikers have been orderly in their behavior. Unfortunately, there appears to be a disposition on the part of the younger and less responsible section to interfere with essential services, such as pumping, which are being carried out on several of the mines by samplers and mine officials. Yesterday, some hundreds of strikers collected at Fordsburg, went through certain drilling evolutions and then marched in column of fours to No. 7 shaft of the Crown Mines. A force of union police stood by while the strikers interviewed the mine officials. It is understood these officials were told that if they worked after yesterday, Jan. 30, the responsibility would be theirs for anything that might occur. The body of strikers paid a similar visit to No. 5 and No. 1 shafts and then returned to Fordsburg."

Hollinger Appeals From Decision in Power Case

An appeal has been entered by the Hollinger Consolidated Gold Mines, Ltd., of Porcupine, Ont., against the recent decision of Justice Middleton. The latter dismissed the company's action for over $1,000,000 against the Northern Canada Power Co. for failure to supply power.

Snake Creek Tunnel Co. Appeals to Supreme Court

The Snake Creek Mining & Tunnel Co. has filed a brief in the U. S. Supreme Court asking that its right to percolating waters in Utah, which are contested by the Midway Irrigation Co., be affirmed.

Old Dominion Milling 500 Tons Daily at Globe

No Merger With Iron Cap Pending, Says Manager of Latter—Coal and Coke Rates Cut

The Old Dominion Mining & Smelting Co., of Globe, Ariz., started the mill recently and is handling 500 tons of ore a day. No date has been set for starting the smelter, which has two weeks' supply of coke on hand and which has been kept in good condition. There is a distinct shortage of good miners, 200 being needed by the company, which now has 400 at work. Only a few new hands were needed at the mill. It is denied, however, that shortage of miners has had any material effect in delaying smelting.

A feature of benefit locally has been a reduction of coal and coke rates. Coal freight from Gallup now is $7 a ton, and reductions from Colorado and New Mexico points average about $1.50 a ton. Old Dominion is the only coke user of the district and benefits by a cut in freight from Dawson from $8.88 to $6.85 a ton.

F. A. Woodward, general manager of the Iron Cap Copper Co., denies the report that his company is about to consolidate with Old Dominion. It is locally believed that the report is based upon merger plans that have been considered for a long time between Old Dominion and Arizona Commercial, whose properties adjoin and are connected on several levels. These two companies have close financial relations, and it is said, could be operated as a whole with economy and efficiency.

Part of Force Quits on Wage Cut by Simon Silver-Lead

Operations at the Simon Silver-Lead Mines Co.'s property at Simon, Nev., have been somewhat curtailed since March 1, owing to lack of labor. The wage scale was cut to $4 for muckers and trammers and $4.50 for miners on March 1, the result being that about one-half of the crew quit. The mine and mill are operating at partial capacity, but it is expected that a new crew will be obtained soon.

P. A. Simon, president of the company, has stated that the company's zinc smelter at Harbor City, Cal., is an assured success. He says that the entire zinc product of the mine can be successfully handled, converted into marketable form, and disposed of at a profit.

To Make Motorists Help Copper Market

In Arizona it is proposed to amend the motor travel law so as to help the copper market. License plates are to be of copper, of somewhat smaller size than ordinarily used, and are to be accepted at metal value when turned in at the end of the year. It is planned to use Arizona electrolytic copper.

Mount Lyell Co. Reduces Working Forces

Melbourne, March 9—The Mount Lyell Mining & Railway Co., of Tasmania, has [illegible] of the Mount Lyell mine, which has been shut down.

(By Mail.)—Metallurgical treatment carried out last year now proves that North Mount Lyell concentrates can be smelted without adding Mount Lyell pyrites. To get the full economic benefit of concentration treatment, the board of directors has decided to enlarge the concentrating plant to a capacity of 10,000 to 12,000 tons of North Mount Lyell ore monthly. During construction, the output will be limited to the present capacity of about 7,000 tons. The alterations will cost between £15,000 and £20,000 and will take six months.

Gold Production of India and New South Wales

By Cable From Reuter's to Engineering and Mining Journal

London, March 13—The production of gold in New South Wales during January and February totaled 5,692 oz.

The gold output of India during February amounted to 31,270 oz.

Lead Mines in Cumberland To Resume

By Mail From Reuter's

According to Lloyd's List, the Threlkeld lead mines, in Cumberland, England, are to be opened after being idle for twelve months. The difficulties of working the mines are accentuated by the fact that half the product—namely, zinc concentrates—cannot be produced except at a loss compared with the price at which the government is selling Australian concentrates.

Canadian Royalty Regulations Issued

Regulations fixing the royalty to be collected by the Canadian government on sales of the products of quartz mining locations on Dominion lands have been published. The royalty is fixed at 2½ per cent on a scale of values laid down as follows: Gold, $15 per oz., royalty 37½c.; silver, 60c. per oz. royalty 1½c.; copper, 12c. per lb., royalty 30c. per cwt.; zinc, 4c. per lb., royalty 10c. per cwt.; lead, 4c. per lb., royalty 10c. per cwt.

Date Set for Butte & Superior Accounting Hearing

The hearing on the accounting proceedings between the Butte & Superior Mining Co. and Minerals Separation Limited is expected to be resumed in New York on March 28 next. Last November, at the hearing held then before the master, Minerals Separation put in a claim for $11,904,913.95. Adjournment followed and since then further hearings have not been held. A hearing set for Feb. 14 was postponed.

NEWS FROM WASHINGTON

By **PAUL WOOTON**
Special Correspondent

Hearings on Ore Freight Rates Before I. C. C.

Southern Pacific Attorney Argues That Lower Metal Prices Have Not Increased Demand

Reduced freight rates on mining products were advocated recently by [illegible] as witnesses in the closing arguments in the rate investigation before the Interstate Commerce Commission. Secretary James F. Callbreath, of the American Mining Congress, favored a general rate reduction on metals, coal, and other raw mine products; H. W. Prickett, speaking for Western interests, advocated lower rates on ore. Reduced petroleum rates were advocated by F. B. Dow and Clifford Thorne, and lower pig-iron rates were favored by F. L. Ballard. R. C. Allen, of the Lake Superior Iron Ore Association, recommended lower ore rates, as did also Charles S. Belsterling, F. B. James, and others.

Referring to ore rates in general before the I. C. C., F. H. Wood, attorney for the Southern Pacific railroad, in arguing against reductions, said that exhibits filed in the case show that there had been a progressive and continuous drop in the prices of metals and metal products since September, 1920, the drop being manifestly largely in excess of the decrease demanded in freight rates, but that it has had no apparent stimulating effect upon demand.

The commission has sustained the complaint of the United Verde Extension Mining Co., that the rates on coal from Dawson, N. M., to Clarkdale and Jerome, Ariz., were unreasonable. It has prescribed reasonable rates for the future and awarded the company a refund on previous shipments overcharged.

In the complaint of C. G. Chevalier, the I. C. C. held that the rate on manganese ore from First Ford, Va., to Pittsburgh and Sharpsburg, Pa., was unreasonable and reduced it to $4.50 a ton from the former rate of $5.52.

In the complaint of the General Chemical Co., the commission decided that the rate on bauxite ore from Republic, Ga., to Chicago Heights, Ill., was not unreasonable.

L. & N. Must Continue Service to Pinkney, Tenn.

On the ground that it will prevent development of ore in the vicinity of Pinkney, Lawrence County, Tenn., the Interstate Commerce Commission has denied the application of the Louisville & Nashville railroad to abandon a part of its branch line extending from West Point to Pinkney.

Another Bill To Suspend Assessment Work Introduced

A joint resolution to suspend the requirements of annual assessment work on mining claims in the United States, but not in Alaska, during the years 1920 and up to and including June 30, 1924, has been introduced in the Senate by Senator Stanfield, of Oregon.

Back Taxes on Mexican Mines Canceled

President Obregon of Mexico has issued a new mining decree which cancels all back taxes on mining properties if the owners will pay, before Sept. 1, the full amount of taxes due for the twenty months previous to that date. The action was taken, according to semi-official advices reaching Washington, on the ground that heretofore it had been impossible to extend the protection necessary, in many regions, to make possible the working of mining properties.

First-Aid Work in Oil Fields To Be Continued

Preliminary work in first-aid training in the oil fields has been so successful that the Bureau of Mines has under consideration the permanent extension of its first-aid training work to the petroleum industry. With the exception of the tentative work that has been conducted recently, first-aid instruction has been confined to coal- and metal-mining industries. On close examination, it was found that the hazard in the petroleum industry is higher than was supposed.

Industrial Moving Pictures Will Be Censored

A board of censorship for technical and industrial moving pictures has been set up by the Bureau of Mines in conjunction with the Department of Commerce. T. T. Reed is the representative of the Bureau of Mines on the board and Oliver P. Hopkins represents the Department of Commerce. These two members are to select a third member, who is to be a specialist in the activity with which the picture deals. In each instance at least two additional persons familiar with the subject of the picture are to sit with the committee in an advisory capacity. Though only the pictures prepared in the Interior and Commerce departments will be subject to the board's jurisdiction, it is believed that other departments and outside agencies preparing industrial moving pictures will seek to have films reviewed by the board.

Alaska's Mineral Resources Considered in New Bill

Sutherland Measure Provides $5,000,000 Development Fund—Bureau Concerned With Territory

Following the recent suggestion of Albert B. Fall, Secretary of the Interior, for development of mineral resources in Alaska under a revolving fund, Delegate Sutherland, of Alaska, introduced in the House a bill to put the plan in effect. His bill creates a $5,000,000 Alaskan development fund and authorizes the Interior Department to explore, prospect, or drill for oil or other minerals upon public lands, and in the event of discovery of minerals to dispose of them through competitive bidding. The bill provides for the construction and operation of smelters and ore reduction plants, pipe lines, and other facilities for mining and disposing of the minerals, and also for road construction to operating mines. The measure also authorizes the lease or acquisition of docks, wharves, terminal and other facilities incident to carrying on exploration, prospecting, and drilling for minerals. The Shipping Board is authorized to make vessels available for the Alaskan service. All receipts from operations under the plan would go into the development fund for continual use. Co-operation with territorial authorities or private individuals or corporations in carrying out the new plan has been authorized.

The statement of Secretary Fall, referred to in the foregoing, is as follows:

"In Alaska the non-metalliferous minerals lie more deeply underground, and the investment of capital in prospecting is necessary, which is true also of such deposits in the United States. Under the leasing bill, the permit provisions are not sufficiently liberal to justify expectation of immediate development of the great known oil, coal, and other non-metalliferous mineral deposits of Alaska. In deep prospecting in Alaska it will be necessary for Congress either to liberalize the laws, to the end that private capital may be invited with an opportunity to earn sufficient rewards to justify taking the gambler's chance, or, in lieu thereof, provide a revolving fund to be used by some department of the Government in the sinking of experimental oil wells and in prospecting for other non-metalliferous mineral deposits. The result of such prospecting would be to enable us to operate under the second provision of the leasing act and to sell or lease upon bonus and royalty and surface rental basis, the lands in oil fields, coal fields, shale fields, potash and phosphate and other fields, recommended to be developed. Either capital must have the speculative chance or the risks of prospecting must be assumed directly by the Government. A small revolving fund would do the work. The same policy should be pursued upon the public lands of the United States."

Mine inspection in Alaska will probably be conducted in the future on a co-operative basis. The matter has been the subject of conferences between Governor Scott Bone of Alaska and Director Bain of the Bureau of Mines. Consolidation of all of the Bureau's work in Alaska has also been effected, for which an increased appropriation will be available July 1. This appropriation is in the form of a lump sum and will permit of the assignment of a first-aid miner exclusively to work in Alaska.

Unusual need is said to exist for first aid training at Alaskan mines, owing to the fact that there are many small operations scattered over a vast territory, in which there are but few physicians. This work will be in charge of J. E. Willcox, who has been foreman miner on the mine rescue car stationed in the Butte district. Mr. Willcox plans to conduct first-aid classes at the various Alaskan mines just as rapidly as he can reach them.

Decline of gold mining in Alaska, because of high operating costs, was referred to by E. Lester Jones, director of the Coast and Geodetic Survey, in recent testimony before the House Appropriations Committee. "Due to the cheap price of gold, many people engaged in placer mining have been driven out of Alaska, as they could not afford to pay high wages and could get nothing out of it," he said. He looked for improved mining conditions, however.

Engineering Methods Changing for Valuing Mines

The U. S. Bureau of Mines is taking cognizance of an important change in engineering methods in valuing mines. In the old days, engineers determined the probable value by estimating returns through a series of years. This was done by figuring production costs and estimating future prices of the metal or metals concerned. Owing to the uncertainties which have grown out of the war situation, there is no longer great confidence in estimates of cost of production or as to the future selling prices of metals. The standards long used in making valuations have been lost, just at a time when they are more urgently needed than ever. To meet this situation, engineers are coming more and more to use a figure based on the margin necessary to keep the property in operation. For instance, if it can be ascertained that a margin of 2c. per lb is necessary to keep a particular copper mine in operation, this amount must remain constant, whether the mining costs go up or down.

Although this method cannot be applied universally, it can be used where there are large quantities of material which do not vary widely in grade in regions which dominate the situation as do the Lake Superior iron mines and the porphyry copper properties.

Oppose Dismissal of Ewert Case Involving Indian Lands

Attorneys for Oklahoma Indians have filed a motion in the U. S. Supreme Court in opposition to the motion of Paul A. Ewert to dismiss the case in which the Indians seek to set aside a sale of zinc lands in Oklahoma to Ewert on the ground that he was disqualified to purchase because of his connection with the Indians as a representative of the Department of Justice. In the new brief of the Indians they say that there is due them from Ewert $56,000 in royalties on the land, and deny the legality of contracts said to have been entered into by Ewert with certain representatives of the Indians for payment of additional sums for the land. Ewert had purchased the lands for $18,000, and the transaction had been approved by the Department of the Interior.

Argument was heard in the case last week. A stipulation was then filed with the court to strike the case from the docket on a reported agreement between the parties to the suit, under which the sale to Ewert would be approved upon the payment by him of $18,000 additional for the land. It is this motion that is now opposed in the manner stated.

Ducktown Company To Restrict Discharge of Sulphur Fume

In the suit of the State of Georgia against the Ducktown Sulphur, Copper & Iron Co., of Isabella, Tenn., in the Ducktown district, which action seeks to restrain damages to crops by reason of the alleged discharge of sulphur gases, a stipulation has been filed in the U. S. Supreme Court by both parties under which the company agrees not to permit the escape into the air of sulphur-dioxide gases which have a sulphur content of more than 40 tons a day, and to furnish the state a report as to the tonnage of ore smelted and acid made. The agreement also calls for a board of arbitration of one representative of the state and one of the company to supervise operations and to ascertain damages caused to citizens by the gases.

Bureau Officials To Meet at Rolla

Superintendents of the Eastern mining experiment stations of the Bureau of Mines, with the principal clerks of those stations, will meet at the Rolla, Mo., station on April 17 to discuss the technical and administrative problems arising in the conduct of their work. On that occasion the cornerstone of the new building which will house the Rolla station will be laid. The Eastern stations, so called to distinguish them from the Far Western stations of the Bureau, are those at Pittsburgh, Columbus, Ohio; Urbana, Ill.; Tuscaloosa, Ala.; Bartlesville, Okla.; Minneapolis, and Rolla.

To Consider Mining Industry If Tariff Commission Is Changed

Frelinghuysen Bill Proposes Transfer to Department of Commerce—Advisors for Each Interest

Under a bill introduced by Senator Frelinghuysen, of New Jersey, to transfer the Tariff Commission to the Commerce Department, it is proposed that the Secretary of Commerce shall appoint from each interest, including the mining industry, advisors to the commission, such additional representatives of such interest to serve without compensation, to assist in determining the conversion cost of articles produced or manufactured in the United States and in competing countries. Those appointed from each industry interested would be from each section of the country where such interest has substantial existence.

Fish Can Stand Some Pollution of Waters, Commission Says

Warning was given Congress by the U. S. Fish Commission not to injure industry by proposed legislation to prohibit the discharge of oil and other acid wastes into navigable streams in an attempt to save fishes from the effect of polluted waters. Officials of the fishery bureau pointed out that the pending bills before Congress against pollution would practically wipe out some industries on the theory that all pollution was injurious to fisheries, whereas, as a matter of fact, it was not known that it is so injurious.

Says Bureau of Mines Is Duplicating Work on Clays

Director Stratton of the U. S. Bureau of Standards, in testimony before the House Appropriations Committee, stated that the U. S. Bureau of Mines was duplicating work of his bureau on heavy clay products, including cement and concrete. His attention had been called, he said, to numerous activities of the Bureau of Mines in investigations being conducted by the Bureau of Standards, and officials of the latter were wondering how it happened that other bureaus got appropriations, although his bureau failed to get them. He said that the Standards Bureau was handling work on heavy clay products and that there was no need for provision being made elsewhere. Dr. Stratton declared that he was surprised the Bureau of Mines had asked for funds for work on cement and concrete, as the Standards Bureau had done that work with a fair degree of thoroughness.

Government's Silver Purchases Close to 100,000,000 Oz.

Purchases of silver by the Bureau of the Mint during the week ended March 11 amounted to 3,128,000 fine ounces. This brings the total purchases under the Pittman Act to 98,871,628 fine ounces.

NEWS BY MINING DISTRICTS

London Letter

Zinc Smelters Complain Broken Hill Is Subsidized — Rio Tinto's Position Uncertain — Two Rand Companies Recalculate Reserves

By W. A. Doman

London, Feb. 28—When the war was in progress, the British government entered into an arrangement with the Broken Hill mining companies to purchase their output of zinc concentrates for a series of years. This was to prevent the great German metal "octopus" from again securing control of spelter. The price at which the contract was arranged was not generally known, but the fact of its conclusion was lauded. The government now has 800,000 tons on its hands, and is offering it in Swansea at £3 15s. per ton. As £4 10s. a ton is being paid in Australia, and freight and other charges amount to about £3 a ton, the price received by the government is only about half the cost. Smelters in this country, consequently, are raising a loud voice of complaint, the burden of it being that the Broken Hill mines are being subsidized at the expense of home works.

It is estimated that during the twelve months ended March, 1923, the loss to the government may exceed £1,000,000. The government, however, is expected to stand by its agreement. Economy is the order of the day in national finances, and interested parties would like to see either the abrogation of the contract or some arrangement by which they will be able to resume smelting at a profit. The market price of spelter has declined so seriously that the costs of production in this country are prohibitive.

The Geduld Proprietary and the Modder Deep have made a recalculation of their ore reserves as at Dec. 31 last. The position disclosed in each case is remarkably good. This can be seen by comparing the following figures:

Geduld Proprietary

Dec. 31	Tons	Value Per Ton	Width Inches
1921	3,545,000	34s. 5d.	62
1920	3,220,000	34s.	61

Modder Deep

Dec. 31	Tons	Value Per Ton	Width Inches
1921	1,375,000	39s. 7d.	77
1920	1,100,000	39s. 11d.	77

If to the above be added the tonnage milled by each company in 1921, that is, 500,000 tons and 509,300 tons, respectively, capital progress has been made. The gold content is set down at the normal price of metal. One interesting point is the great stoping widths. In the early days of the Eastern Rand, the Reef was thought to be quite narrow, something not much in excess of the Main Reef Leader, in the Central Rand. There are one or two mining companies working much further to the southeast that seem to trade on these widths and values, and issue rather fantastic estimates of ore reserves and profits, putting, in fact, the New Modderfontein and the Modderfontein "B" into the shade. Unfortunately — or is it fortunately? — the public does not appear keen on subscribing to these companies. The backers of the undertakings allege that the South African finance "Houses" purposely ignore the district. This, I think, is a mistake, for with one or two exceptions, the Nigel neighborhood has been tested by representatives of the "Houses," and results have proved far from satisfactory to those who have ventured their money.

The Rio Tinto position is not yet regularized. Some of the directors have left London and proceeded to the property to study matters on the spot and see whether economies can be effected. Rio Tinto has felt the changed condition of affairs as seriously as other companies, and, as I mentioned recently, there is a rumor that additional capital will have to be raised.

Free List for Manganese Brings Protest From Leadville

A vigorous protest was wired recently to the Colorado representatives in Congress by the Leadville Chamber of Commerce against the action of the Senate Finance Committee in placing manganese on the free list. The house bill provides for a tariff of 1c. per lb. on all manganiferous ore containing more than 30 per cent manganese.

Former Governor Jesse F. McDonald, manager of the Down Town Mines Co., said: "During the war, Leadville produced 1,000 tons of manganese ore daily until the signing of the Armistice automatically canceled the contracts. By conservative estimate 2,000,000 tons remain as known manganese orebodies of the district. A tariff of 1c. a lb., as proposed by the House bill, would enable many of the manganese mines of this district to resume, which they cannot do under direct competition with ore mined with cheap labor in outside countries and transported to this country.

To Take Gold from New York's Atmosphere

Experiments to recover particles of gold carried into the air by smoke and dust escaping from the molten gold are being carried on by the Mint Service at the New York Assay Office.

AUSTRALIA

Queensland

Gold Output for 1921 Low—Market for Sapphires Better—Treatment Plant Under Erection at Cloncurry Cobalt Mine

From Our Special Correspondent

Brisbane, Jan. 30—The gold yield of Queensland for 1921, as was to be expected with Mount Morgan closed down for nine months of the period, shows a serious decline. The yearly production of gold from Mount Morgan was worth nearly £390,000, or more than 78 per cent of the total gold output of the state. The official returns for last year are not yet complete, but the output was approximately only 38,471 fine ounces, valued at £164,561, which is less by 75,440 oz. and £320,400 respectively than for 1920.

Apart from the special circumstances that have operated adversely in Queensland, the figures for last year for the whole of the commonwealth show that the falling gold output disclosed for 1920 was continued during last year, with the result that the total Australian yield for the latter period was 757,430 oz., as against 943,890 oz. for the preceding twelve months. The falling off not only in this state but throughout Australia would have been considerably greater had it not been for the operation of the Australian Gold Producers' Association, which has distributed monthly among its members large sums derived from premiums on the sale of gold.

Recently there has been considerable dullness on the Anakie sapphire field, caused entirely through a lack of buyers for the gems produced, but during the last month or so some signs of revival have been apparent. In December the recorded output was worth only about £1,000, but early in January two buyers arrived, and in three days gems to the value of £4,000 were purchased, as much as £400 being realized for a single parcel. A number of miners had been holding their stone, some for as long as twelve months, for a better market, which they are now finding. A green sapphire, with the Alexandrite property of showing red in an artificial light, was recently obtained and weighed 13 dwt., and a red zircon of 18 dwt. was also unearthed.

The company owning the cobalt mine in the Cloncurry district is doing little in the way of mining pending the erection of its treatment plant, which is well under way. The work being done is in the south shaft, where nothing but bagging ore is being taken out. The south drive from this shaft is in about 170 ft., showing a nice body of ore all the way, with an average width of about

3 ft. During the last two months a further lot of ore, consisting of about 80 tons, has been sent to England, making a total forwarded to date of about 530 tons. Nothing has been made public as to what this ore has realized. There is about 1,000 tons of ore on top awaiting the completion of the treatment plant.

A report on this mine by a government geologist, published a few months ago, shows that the cobalt occurs exactly on the contact of diorite and schists, which are of Silurian age. The schists form noticeable outcrops on the area, and the diorite is apparently intrusive in the schists, as it does not show evidence of the regional pressure to which the schists have been subjected, and, moreover, close to the contact line, indurated masses of schists are outcropping. Samples taken at the time that the geological report was made averaged 12 to 19 per cent cobalt. This is the second deposit of cobalt to be worked in Queensland; the first one, at Kilkivan, near Gympie, proved too low in grade to warrant its continued working.

The Chillagoe state smelters, which closed down on Nov. 20 last, are still idle, and there is a good deal of doubt as to when operations will be resumed. It is probable that the government has accumulated at these works as much copper, awaiting a better market, as it cares to carry.

CANADA

British Columbia

Premier To Ship Bullion — Florence Silver May Resume—Strike Threatening at Crow's Nest Pass

Stewart—The newly installed tramway of the Premier Mining Co. has been operating satisfactorily, 120 tons of ore being brought to seaboard every eight hours. The ore is graded at the bunkers, that containing the lesser values being deposited in an ore bunker for shipment to the smelter at Anyox, the higher grade being shipped direct to the Tacoma smelter. There are yet some details to be completed in connection with the tramway system, but these are of minor importance.

The company intends to construct this summer a number of houses for the use of married men in its employ. An assay office is being built next the cyanide plant, and in this will be installed a plant for the conversion of precipitates into bullion. This will not be pure gold bullion, as it will contain all the minerals that are in the Premier ores. As soon as this equipment is complete, the shipment of the product will start, and it will be the first bullion ever sent from the Portland Canal mining district.

Reports from Bitter Creek are to the effect that the L. L. and H. claims are showing up well on development. A tunnel has been driven about 15 ft., and is still in ore. New work on what is known as the second lead has proved it to be at least 60 ft. wide, and carrying gold and silver values.

Ainsworth—It is likely that the Florence Silver Mining Co. will resume operation in a few weeks. Improved marketing condition for output, as a result of the Consolidated Mining & Smelting Co.'s acceptance of customs ore on what is practically a cash settlement basis, makes such resumption possible. The mine has a large ore reserve sufficient to keep the mill running at capacity for several years. Values are chiefly in lead, with a limited amount of silver. Some production has been maintained by leasers for the last few months. It is anticipated that about fifty will be employed.

Fernie—The Crow's Nest Pass region, which produces the bulk of the coal used in the southern part of interior British Columbia and supplies all of the coke used in metallurgical treatment of the ores of East and West Kootenay, faces one of its periodical strikes. Unless a settlement of the difficulties between the operating companies and the coal miners of District No. 18, U. M. W. A., is soon effected, a walk-out will probably be ordered for April 1, as the agreement now in force between operators and the unions expires on March 31. The operators have definitely announced that the present contract will not be renewed, and have posted notices of wage decreases running from 30 to 50 per cent.

Ontario

Merger of Montreal Kirkland and Ontario Kirkland Ratified—Atlas Property at Shining Tree To Be Drilled

Cobalt — La Rose has encountered good ore at 600 ft. depth on the Violet property. Milling ore as high as 60 oz. a ton in car lots is being stoped on the 530 level.

The Castle Trethewey stock offering was oversubscribed to the extent of 1,000,000 shares. Work on the property will be resumed soon.

On March 4 the Coniagas shipped to London forty-six bars of bullion containing 47,000 oz. of silver.

It is understood that operations on the Colonial are about to be resumed.

Kirkland — Wright-Hargreaves has declared a dividend of 2½ per cent, payable April 1 to shareholders of record March 17.

The amalgamation of the Ontario Kirkland with the Montreal Kirkland has been ratified by the former company and will come up for ratification by the Montreal Kirkland in the near future. The new company will immediately proceed to sink the main shaft and explore at greater depth.

Porcupine — The McIntyre shaft has reached a depth of 2,000 ft., where a new main haulageway will be driven.

Clifton Porcupine shareholders are being asked to pool their stock until Dec. 31, 1922, to facilitate the sale of treasury shares. The company wants to raise $75,000 to $100,000.

A contract has been let for 3,000 ft. of diamond drilling on the Atlas property in Shining Tree.

CALIFORNIA

Shasta County Denied Rehearing in Tax Case—Applications for Patent Increase

San Francisco—Car No. 1 of the U. S. Bureau of Mines will be stationed at Taft, Cal., from March 13 to April 6. The car is in charge of E. D. Gardner, assisted by R. E. Donovan and J. J. Delahide.

In northern California, it is expected that the new zinc-oxide refinery of the Shasta Zinc & Copper Co., at Winthrop, will be completed some time in May. At present seventy-five men are employed at the mine and smelter.

The U. S. Circuit Court of Appeals has denied the motion of Shasta County asking for a rehearing of the tax cases against the Mountain Copper Co. and the Balaklala Copper Co. This practically settles the controversy and makes possible the return to the companies of taxes paid under protest during 1919. Other cases are pending covering taxes paid under protest in 1920 and 1921.

On March 1, three miners were imprisoned by a cave-in on the 1,000 level of the Idaho-Maryland at Grass Valley, in the north central part of the state. Prompt work rescued them uninjured about fourteen hours after the cave-in. An air pipe served as a means of communication between the three men and the rescue squad. John Fulton, manager, directed the work, and when the miners at last reached the surface they were greeted with cheers by a large crowd of their fellow townsmen which had gathered at the shaft.

Preliminary work has been started on the Bullion group, south of Grass Valley. The Galena shaft is to be unwatered to a depth of 1,500 ft. Discovery of a 4-ft. ledge is reported by the operators of the South Star mine on their 100 level.

The Plumas-Eureka Annex has purchased the Jamison group of claims for $12,000, according to a deed recently filed at Quincy, Plumas County. The Calnan group, near Genesee, is to be prospected from an adit on the Keystone claim. A compressor and drill equipment will be installed by M. J. Calnan for the initial work.

At the Land Office in Sacramento, John C. Inf, the register, reports that the number of applications for patents received recently is larger than for many years. This is a reflection of the greater activity which prevails.

In the Mother Lode region, the Belmont-Shawmut, at Shawmut, is reported to be operating at the rate of 200 tons per day. The shaft of the Moore mine, near Jackson, is to be sunk an additional distance of 250 ft., and the erection of a twenty-stamp mill has been decided upon at a recent directors' meeting. The Old Elephant gravel mine, near Volcano, is now being operated after a shutdown of short duration.

NEVADA

Influenza at Tonopah—Tonopah Divide Meeting Postponed—Conditions at Round Mountain Favorable

Tonopah—About 1,200 tons of ore per day is milled in this district. The principal contributers to this tonnage are as follows: Tonopah Belmont, 350 tons; Tonopah Extension, 300; West End, 250; Tonopah Mining, 200; and miscellaneous small producers about 100. The West End is making preparations to increase tonnage to about 300 per day. The Tonopah Belmont reported normal development for the week ended March 4, with work performed on the 700, 800, 900, 1,000, 1,100, 1,200, and 1,400 levels. Operations in this district have been hampered by an epidemic of influenza. Taken as a whole the cases are not serious, but many men have been obliged to temporarily quit work. This necessitates breaking in new men and is attended by additional loss of time and some expense.

Round Mountain—Conditions in the lode and placer mines of the Round Mountain Mining Co. are favorable for a successful year in 1922. More water is available this year than last, and many operating improvements have been made. In the hydraulic mine it is expected that 200,000 cu.yd. of gravel will be moved, as against 110,700 cu.yd. in 1921, with the value per cu.yd. about the same. The gross recovery in 1921 was $120,845.70, or at an average value of $1.09 per cu.yd. Underground conditions in both the Fairview and Round Mountain lode mines are said to be better than for several years.

Divide—On account of the inability of the president, Carl Brougher, to attend the annual meeting of the Tonopah Divide Mining Co., scheduled for March 7, it has been adjourned to March 30.

Virginia City—The Middle Mines group at Virginia City, which was recently taken under option by Dr. R. M. Ward, of Philadelphia and New York, is organized under the name of the Paramount Comstock Mines Co. The previous option held by the Boericke interests was dropped. The group involved includes the Best & Belcher, the Gould & Curry, the Savage, the Chollar, Hale & Norcross, the Potosi, and the Bullion. It includes the surface and underground to the 1,000 level of each of the mines named, with the exception of the Bullion, in which instance the option extends to the Sutro tunnel level. Certain conflicting interests were taken care of in the merger. The present work consists of driving drifts from the old Hale & Norcross tunnel in the Comstock fissure. The work is preliminary and for the purpose of opening up the ground preparatory to thorough samplug. It is rumored that about $150,000 is to be spent in doing work of this nature.

IDAHO

Armstead Mill Being Tuned Up—Much Interest Evinced in Central and Southern Idaho

Talache—Preliminary runs were given to the new 150-ton mill of the Armstead Mines early in March. Reports are that the plant is measuring up to expectations.

Boise—All indications point to an influx of prospectors, miners, capitalists, and mining engineers into central and southern Idaho during the spring. Much interest is being manifested in different sections, including some of the old camps, which were heavy producers of placer gold in the early 60's and for some time later. Negotiations involving large amounts of capital were consummated last year, and there is much promise of activity this season.

Moscow—People in and out of Idaho are writing to the state Bureau of Mines and the University of Idaho School of Mines for information regarding mining possibilities in such large numbers that a big revival in prospecting throughout Idaho this season is looming up as a possibility, according to Dean Francis A. Thomson of the University School of Mines. "The number of inquiries so far received this year exceeds any previous record," Dean Thomson stated.

WASHINGTON

To Prospect Iron Lands Near Tekoa—Will Drill for Gas in Benton County

Prosser—Following the discovery of natural gas and the determination of its existence in large quantities in Benton County, interests of Pittsburgh, Pa., are reported to have been in negotiation lately with property owners with a view to securing a suitable site for a gas well and a glass-manufacturing plant.

Tekoa—As soon as the snow disappears, Spokane interests who acquired a large acreage of iron lands in this vicinity plan to resume active prospecting with a view to determining definitely the extent of the deposit. The ore is classed as a good grade of iron, and much of it contains manganese, it is said.

Chewelah—The Washington Marble Products Co. has completed its organization, and officers have been elected as follows: Albert I. Kulzer, president; Louis A. Conyard, vice-president; and Roy A. Hattrup, secretary-treasurer.

OREGON

Ben Harrison Company To Sink Shaft This Spring

Whitney—The Ben Harrison Mining Co., a close corporation, owned by Kentucky interests, with property in the Greenhorn Mountains, in Grant County, will sink a 1,000-ft. shaft this season, according to a recent announcement. The cost of the work is estimated at $150,000. The work cannot be started until snow disappears from the higher levels.

ARIZONA

U. V. Extension Finds Ore on Jerome Verde Boundary—C. & A. Starts Small Force in Junction Shaft

By James H. McClintock

Jerome—At about the division line between the two properties, the drift on the 1,100 level of the United Verde Extension is in ore that evidently extends over into Jerome Verde ground, under which the latter company, in its Maintop chute, believed it had cleaned up all ore. This was only 200 ft. above the new Extension drift, of which the face is in solid ore, some of it 65 per cent glance. No lateral work has been done, and the drift will be pushed forward for an indefinite distance. The work has already added much to the ore reserves of the Extension and is believed locally to have established the value of the Jerome Verde ground on its Extension side.

United Verde steam shovels are digging through a body of gold-silver-copper ore of low grade, but valuable for converter lining.

Verde Central is installing new hoisting and pumping equipment. The shaft is about 50 ft. below the 650 level, and is in soft material, carrying good value in copper, gold and silver.

Application has been made for dissolution of the Venture Hill Mining Co., whose property was sold on execution in November, 1920. This mine, years ago, was considered one of the most promising in the district.

A mill has been installed at the Pocahontas mine, south of Mayer. Electric power is used from the Arizona system. About 75,000 tons of commercial ore is said to be available.

Oatman—Tom Reed is diamond drilling its Red Cloud property from the 725 level and is cutting the green quartz in which its best values have been found. For about 100 ft., a new orebody above the 500 level of the company's Aztec mine is in $15 ore. United American and Telluride are ready to supply twenty-five tons a day each to the Tom Reed mill. The former has ore opened on three levels and expects to have a gross daily revenue of $1,500 from its mill shipments. Telluride ores are expected to mill above $30 a ton, taken from the 500 and 300 levels, from a vein of from 3 to 5 ft. wide.

Miami—Inspiration Consolidated has secured a right of way from its main workings for a distance of a mile up Webster Gulch to the new Porphyry shaft.

Bisbee—A night shift of about fifty men has been started in the Calumet & Arizona Junction shaft. Otherwise there are few indications of increase in local operations in the last week. Little change is noted in the Copper Queen, and no indications of activity are visible around the new mill or Sacramento Hill.

NEW MEXICO

Silver Mountain Metals Co. Starts New Mill—Eighty-five Mine Advertises For Workers

By James P. Porteus

Chloride—The new 50-ton concentration mill of the Silver Mountain Metals Co. was started on its regular run on Feb. 28 and is producing a high-grade silver concentrate. The ore is first broken in a jaw crusher, then passed through a ball mill of special design made by the El Paso Foundry & Machine Co., then going into a Dorr classifier, the slimes going to the flotation machine and the sands to a Wilfley table. Two 40-hp. boilers will supply steam power for operations. About 2,000 tons of ore is reported broken ready for milling.

The Midnight & Tidal Wave Mining Co. is erecting a fifty-ton concentration flotation mill on its property about seven miles west of the Silver Mountain Metals Co.'s property.

Lordsburg—Though there is an ample supply of common labor for mining purposes, skilled miners and machine men are scarce, and the shortage is delaying the resumption of operations to some extent. The Eighty-five mine of the Calumet & Arizona Mining Co. is advertising for 100 experienced men, which will give that company an underground force of 200. The drums for the main hoist, which is being installed, will, it is thought, be in place within a week, and full production is looked for by March 15. Ore shipments will continue regularly to Douglas, Ariz.

The Last Chance silver mine has been examined during the last two weeks by J. D. Harlan, of Kingman, Ariz., acting for Denver interests. Since the death of Jack White the property has been under the direction of J. G. Nicholas, of Denver.

Hillsboro—It is reported that the Snake and Opportunity mines have been purchased by El Paso interests, who will contract with leasers to work the numerous high-grade silver showings.

Magdalena—The Old Soldier Mining Milling & Development Co., of Magdalena, with a property 14 miles up Mill Canyon, has resumed operation after four years' inactivity. Work will be done in the belief that the ore will prove of milling grade.

COLORADO

Down Town Mines Preparing To Resume

Denver—Jesse F. McDonald, manager of the Down Town Mines Co. at Leadville, was in Denver during the recent hearing on wage schedules before the State Industrial Commission, and stated that his company was preparing to resume operations and already had a small force engaged in retimbering the shaft. Before closing down, this company was the largest employer of labor in the Leadville district.

UTAH

High-Grade Silver-Lead Ore Opened in Emma Mine, at Alta—Alta T. & T. Co. Shipping—Chief Consolidated's Development Work

From Our Special Correspondent

Bingham Canyon — The Montana Bingham shows a production in 1921 of 416 cars of ore, or 24,525 tons, of a gross value of $192,027 and a net smelter value of $140,188. Most of this ore was a relatively low-grade fluxing iron-sulphide ore carrying copper. Officers and directors elected at the recent annual meeting were H. H. Green, president; C. E. Adderly, vice-president; and J. H. Brain, secretary and treasurer. Imer Pett continues as general manager of the property.

Eureka — Ore shipments from the Tintic district for the week ended March 3 amounted to 122 cars, compared with 148 cars the week preceding. Shippers were: Tintic Standard, 43 cars; Chief Consolidated, 36; Eagle & Blue Bell, 9; Grand Central, 6; Iron Blossom, 5; Colorado, 5; Victoria, 5; Centennial-Eureka, 2; Swansea, 2; Alaska, 2; Empire Mines, 1; Eureka Mines, 1; Tintic Drain Tunnel, 1.

At the Chief Consolidated two headings are being driven on the 1,440 level of the Water Lily shaft, which is just above water level. In the No. 2 shaft a station has been cut on the 1,400 level and drifting has been started. This is the third level opened from this shaft, the two others being at the 1,600 and 1,800-ft. points. Drifting will be done to the east on the 1,400 level to prospect one of the favorable limestone beds which is ore-bearing in other parts of the mine. The Godiva ore zone is a short distance south and east of the No. 2 shaft at a higher level than any work so far done in the No. 2 shaft of the Chief. West of the No. 2 shaft is the Tetro ore channel, which will also be prospected in this section.

A shipment of bullion was made by the Tintic Milling Co. the last week in February. Operations at the mill have been retarded by winter weather.

Park City—Shipments for the week ended March 3 amounted to 3,032 tons, compared with 2,841 tons the week preceding. Shippers were: Judge allied companies, 1,597 tons; Silver King Coalition, 885; and Ontario, 550.

Alta — Twenty inches of high-grade silver-lead ore has been opened in the Emma mine by a raise from the Bay City tunnel level. There is also 3 ft. of lower-grade material.

Shipments of ore are being made from the Alta Tunnel & Transportation Co.'s property in Big Cottonwood, despite the heavy snows. During the last week eighty tons of first class was added to the stockpile part way down the canyon, and fifty tons was taken through to the smelter. A new raise is being driven from the haulage level to the stope workings to facilitate the handling of ore. Much ore is exposed here, making on the limestone bedding and in three of the raises.

JOPLIN-MIAMI DISTRICT

Missouri-Kansas-Oklahoma

Indian Commissioner's Visit Awaited—Kanok Metal's New Mill Burned

By P. R. Coldren

Joplin—Local zinc-ore producers are awaiting with much interest the coming to this district of representatives of Indian Commissioner Burke, of the Interior Department at Washington, to consider applications for leases on the Quapaw Indian lands in the Picher camp. Following a decision at Washington recently in which he refused all applications that had been made by different individuals and companies, Commissioner Burke announced he would have special representatives at Miami by March 15 to hear each application separately. The applications adversely affected included offers of substantial bonuses for the leases, with royalty up to as high as 10 per cent. Operators had hoped they might get the lands for 7½ per cent royalty and without bonuses. The lands to be released hold probably 90 per cent of the production in the Picher camp.

Fire believed to have originated from electric wiring completely destroyed the McBee mill of the Kanok Metal Co., about twelve miles northwest of Joplin and two miles east of Crestline, Kan., on March 6. The mill was completely modern and was practically new, having been run only about six months. It had been idle for several months, and was recently put in condition for renewed operation, and would have been turned over March 7. The loss is estimated by A. M. Gaines, manager of the company, at about $45,000, most of which was covered by insurance. The office, pump house, and other outbuildings were not destroyed. The company will immediately rebuild the mill.

The Kansas Line Co. has lost a field derrick and hopper by fire of unknown origin. The property, which is just across the state line, northeast of Picher, was saved by prompt work by the Picher fire company. The loss is estimated at about $5,000.

An unusually bad accident resulting from the striking of a descending tub against the side of the shaft was recorded at the Cortez mine in the Picher camp on March 9, when two men were killed and two others injured.

The Black Hawk Mining Co. has taken over the Monarch mine and mill, in Kansas, just east of the Blue Mound property, and will operate it. G. N. Williams is manager for the Black Hawk company, which has operated the mine by that name, situated just south of the main portion of Picher, since 1917, and which has proved a rich property. The Monarch mill was completed and the mine opened up last fall.

H. H. Hartzell, formerly manager of the Ramage properties in this field, has been made manager of the Huttig properties, succeeding B. E. Brown. There has been a reorganization in the Huttig company recently, caused by financial reverses to the Huttig interests.

THE MARKET REPORT

Daily Prices of Metals

Mar.	Copper, N. Y., net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
9	12.75	28.125	29.00	4.70	4.40	4.65
10	12.50@12.75	28.25	[illegible]	4.70	4.40	4.65@4.675
11	12.50@12.75	28.25	29.25	4.70	4.40	4.65@4.70
13	12.50@12.75	27.875	28.75	4.70	4.40	4.65@4.70
14	12.50@12.75	28.125	28.875	4.70	4.40@4.45	4.675@4.70
15	12.50@12.75	28.50	29.125	4.70	4.40@4.45	4.70

*These prices correspond to the following quotations for copper delivered: March [illegible] 12.75@13c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Mar.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
9	[illegible]	[illegible]	67½	142	144	20¾	20⅝	25¾	25¾
10	60¾	[illegible]	67	145	147	20¼	20⅝	25½	25½
11	...	...	...	...	...	...	...	...	...
13	60½	[illegible]	67	[illegible]	144⅞	20⅞	20¾	25⅝	25⅝
14	[illegible]	[illegible]	[illegible]	142¾	144½	21	20⅞	25⅝	25⅝
15	[illegible]	61¼	[illegible]	[illegible]	145⅝	21⅝	21½	25⅝	25⅝

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Mar.	Sterling Exchange "Checks"	Silver			Mar.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
9	[illegible]	99⅝	[illegible]	[illegible]	13	[illegible]	99⅝	63⅞	33⅜
10	435¼	99⅝	[illegible]	[illegible]	14	428	99⅝	63⅛	33¼
11	435	[illegible]	[illegible]	[illegible]	15	[illegible]	99⅝	63⅝	33⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. [illegible]

Metal Markets

New York, March 15, 1922

The week has been a featureless one in the metal markets. Prices show little variation from previous quotations.

Copper

The week has been marked by an excellent export business, which has overshadowed domestic sales. The prices realized were also better than could have been obtained from local buyers, most of the metal netting producers here around 13c., f.o.b. refinery. Demand was well diversified among the European countries and the Orient, and the business was largely placed through the Copper Export Association, outside interests reporting an unsatisfactory market abroad. Not much export business has been done in the last two days, however, by anybody.

The domestic market has been unsteady, some producers, in fact most of them, holding for 13c. delivered, though others have sold copper for as low as [illegible]. The export demand lately has taken so much copper off the market that producers generally have not cared to attract domestic trade by price cutting. A fair tonnage has been sold in small lots at the 13c. figure; considerably more has been sold at 12⅞c., two or three comparatively large lots changing hands at this figure for March-April delivery. In two or three instances, where the delivery rate was low and where prompt delivery was acceptable, contracts have been closed by large manufacturing interests at 12.75c., delivered, though this price could not have been done in more than one or at most two directions. A weighted average of domestic sales for the week would probably show a realized price of about 12⅝c., f.o.b. refinery. There was some buying of importance in which consumers did not figure.

Lead

The official contract price of the American Smelting & Refining Co. continues unchanged at 4.70c., New York, and for desilverized, 4.50c. at St. Louis.

The market has been quiet but firm the last few days; business appeared to slump a little over the week-end. Demand has been well diversified, and many of the sales have been for carload lots. The automobile business is exhibiting a seasonable improvement, and this is reflected in increasing demands for lead for this purpose. Improved railroad buying is also reflected in a better demand from mixed-metal manufacturers and dealers. The market has been somewhat more active in the Middle West than in the East. Quotations of 4⅜c. St. Louis are no longer heard, and consumers would even have some difficulty in finding sellers at 4.40c. today. In fact, two of the largest lead producers are generally quoting 4.45c., though but little metal has brought this price so far. The increased strength has been caused by the fact that producers are well sold up on March production. Sales at New York continue at 4.70c., though this price has been bettered in some instances and a slight advance may come soon.

Zinc

Business has been more active, and prices have advanced to 4.70c., East St. Louis, which is the level at which producers are generally holding the metal. Statistics issued by the American Zinc Institute show an improvement in the zinc position during February. Stocks declined from 65,678 tons on Feb. 1 to 64,124 on Feb. 28. Production during February was 22,513 tons; shipments were 24,067. Average number of retorts operating for the month, 44,867.

Forward zinc is bringing a premium of about 5 points for each month. New York prices are generally 35 points above the St. Louis quotations. High-grade zinc, though active, has not been sold as heavily as earlier in the year.

Tin

Tin has been much unsettled by the wide fluctuations in sterling. Demand has been of fair volume, both dealers and consumers being in the market. The large amounts now being delivered in this country are generally in strong hands, and little or none is being pressed on the market. Forward deliveries have been quoted at the same prices as for spot to ½c. less.

Arrivals of tin, in long tons: March 1st, Liverpool, 50; 7th, Straits, 50; 8th, London, 150; Straits, 1,800; Liverpool, 25; 11th, London, 25; 13th, Australia, 95; London, 150; 14th, London, 25; Liverpool, 40; Australia, 25.

Gold

Gold in London: March 9th, 95s.; 10th, 95s.; 13th, 95s. 9d.; 14th, 96s. 9d.; 15th, 96s. 4d.

General stock of money in the United States, Feb. 1, 1922: Gold coin and bullion, $3,680,882,401; standard silver dollars, $357,481,851; subsidiary silver, $272,541,512; United States notes, $346,681,016; Federal Reserve notes, $2,560,887,510; Federal Reserve Bank notes, $11,140,400; National Bank notes, $749,611,367; total, $8,079,226,057. On March 1 there was: Gold coin and bullion, $3,720,755,655; standard silver dollars, $360,401,851; subsidiary silver, $272,380,601; United States notes, $346,681,016; Federal Reserve notes, $2,518,443,360; Federal Reserve Bank notes, $105,525,400; National Bank notes, $752,035,482; total, $8,076,223,365. During February the stock of gold and silver increased by about $43,000,000 and the amount of outstanding paper decreased by about $45,000,000.

Foreign Exchange

Somewhat disconcerting political news from South Africa, Egypt, England and India was probably the spark which touched off the reaction that has occurred in the foreign exchanges during the last few days. Such a movement was not unexpected after the recent continued advances. On Tuesday, March 14, francs were 8.915c.; lire, 5.05c.; and marks, 0.3725c. New York funds in Montreal, 3.626 per cent premium.

Silver

The silver market has been erratic in the last week, London fluctuating ⅝d. and New York 2c. per oz. The Indian bazaars and China have operated on both sides of the market, and America and the Continent have sold. These conditions, together with the violent changes in sterling exchange, are responsible for the fluctuations in silver, and the market is likely to continue uncertain for the present.

Mexican Dollars—March 9th, 49¼; 10th, 49¾; 11th, 49; 13th, 48¾; 14th, 48¼; 15th, 48⅝.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 4.25c.; market dull. W.C.C. brand, 5@5½c. per lb. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—7@7½c. per lb.

Bismuth—$2@$2.10 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Iridium—Nominal, $170@$190 per oz.

Nickel—Standard market, ingot and shot, 41c.; electrolytic, 44c. Small tonnages, spot, nominal at 32c.

Palladium—Nominal, $55@$60.

Platinum—$85@$90 per oz.

Quicksilver—$51 per 75-lb. flask. San Francisco wires $49.30.

The prices of **Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of March 4.

Metallic Ores

The prices of **Bauxite, Chrome, Manganese, Tungsten, Molybdenum, Tantalum, Uranium, Vanadium,** and **Iron Ore, Zircon and Zirkite** are unchanged from the prices in the issue of March 4.

Zinc and Lead Ore Markets

Joplin, Mo., March 11—Zinc blende, per ton, high, $30.70; basis 60 per cent zinc, premium, $27.50@$27; Prime Western, $27@$26; fines and slimes, $25; average settling price, all grades of zinc, $26.44.

Lead, high, $64.10; basis 80 per cent lead, $60; average settling price, all lead ores, $62.86 per ton.

Shipments for the week: Blende, 8,928; lead, 1,919 tons. Value, all ores the week, $356,680.

Sellers asked for a higher price level and withheld sales until the buyers found it necessary to advance offerings or secure a light tonnage. With a firm demand for ore, sellers won advances of $1 to $2 per ton. The existing association of producers keeps well informed on all market conditions, and asks all the market will bear.

Platteville, Wis., March 13—No ore sales or shipments from Wisconsin district last week.

Non-Metallic Minerals

Barytes—Crude, $6@$8 per ton, f.o.b. mines. Ground, white, $17@$23; off-color grades, $13@$21 per ton, f.o.b. mills. Foreign importations of crude are being laid down at Atlantic ports for $7.80@$8.25, c.i.f.

Fluorspar—Fluxing lump, $20; fluxing gravel, $17.50; No. 1 ground, $50@$55, No. 2 ground $40 per ton, f.o.b. Illinois mines. Market dull.

There are no price changes from those indicated in the market report of the issue of March 4 covering **Asbestos, Borax, Chalk, China Clay, Emery, Feldspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur,** and **Talc.**

Mineral Products

Sodium Nitrate—$2.85 per hundred weight, ex vessel, Atlantic ports.

The prices of **Copper Sulphate, Potassium Sulphate,** and **Sodium Sulphate** are unchanged from issue of March 4.

Ferro-Alloys

Ferromanganese—Domestic, 78 to 82 per cent, $62@$64, f.o.b. furnace.

Ferrovanadium—$3.55 per lb. of V contained, according to analyses and quantity.

The prices of **Ferrotitanium, Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotungsten** and **Ferrouranium** are unchanged from issue of March 4.

Metal Products

The prices of **Copper Sheets, Lead Sheets, Nickel Silver, Yellow Metal,** and **Zinc Sheets** are unchanged from the issue of March 4.

Refractories

The prices of **Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick,** and **Silica Brick** are unchanged from the issue of March 4.

The Iron Trade

Pittsburgh, March 14, 1922

Pig-iron production in 1921 is officially reported at 16,688,126 gross tons, the smallest in thirteen years, 55 per cent under the production of 1920 and 58 per cent under that of 1916, the record year. The present rate is 30 per cent over the average in 1921.

Steel-ingot production in February was at an average rate of about 27,000,000 gross tons a year, representing a rise in the rate from about 25,000,000 tons to about 29,000,000 tons, the rate having undergone no material change since the end of February.

Steel prices show weakening in some quarters and strengthening in others. The $2.40 price on nails is shaded more frequently than formerly, and there is considerable shading in tubular goods. Sheets maintain their stiffness, and predictions are that the next price change will be an advance. The local independent in bars, shapes, and plates has advanced its price to 1.50c., and other sellers in consequence, whereby 1.35c. is less common than formerly and 1.40c. is probably the closest approximation to the general market.

Pig Iron—A sale of 600 tons of basic at $18 is reported. Small lots of foundry bring $19. The market remains at $19 to $19.50 for bessemer, $17.75 to $18 for basic, and $18.75 to $19 for foundry, f.o.b. Valley furnaces, freight to Pittsburgh being $1.96.

Coke

Connellsville—Furnace, $3.25@$3.50; foundry, $4.25@$4.75.

Germany Buys American Copper

Imports Handled Differently Than in the Pre-War Period—German Electrical Industry Now Looking to Russia for a Market

Special Foreign Correspondence

Written for Engineering and Mining Journal

DURING the first year after the Armistice, Germany was supplied for domestic needs, as far as the requirements of metal were concerned, by scrap. A number of smelting and refining plants, started during the war, controlled the market. The imports of copper in 1919 were insignificant. After peace was concluded, business connections with the outside world were gradually re-established, and importation of fresh copper was resumed. The American Smelting & Refining Co. was one of the largest copper importers of pre-war times, but its business in Germany was wound up during the war. This business was re-established on Jan. 1, 1920, under the name of the Copper Import Company, which now represents the American Copper Export Association. The other large dealers in copper also resumed foreign business.

In spite of the vast supplies of scrap still on hand in 1920, copper importations, chiefly from the United States, assumed considerable dimensions during that year, the American imports amounting to about 55,000 tons, or a fourth part of the supply of 1913. In 1921 copper imports increased largely and amounted in the total to 130,000 tons, compared with 225,000 tons in 1913. The bulk of these imports, or 110,000 tons, came from the United States; 5,000 tons came from Belgium, over 2,000 tons from Great Britain, and about 13,000 from other countries. These imports do not constitute the total consumption of copper, which, if an estimate on the amount of copper recovered from scrap is included, will probably amount to 170,000 tons per year. At least one-half of the total supply was consumed by the electrical industry, chiefly for cables. The state railroads, also, were large consumers (as they needed large quantities of copper for the replacing of steel fire boxes), and post and telegraph companies were important purchasers. The rest of the business was distributed among metal-working industries.

The Copper Import Company supplies consumers only. The dealers obtain their supply from other sources, as far as American imports are concerned from those outside of the Copper Export Association, chiefly the American Metal Company. The latter company maintains close connections with the Deutsche Metall Gesellschaft, which in volume of business stands second to the Copper Import Company. The English firm of Brandeis, Goldschmidt & Co. is also handling a fair amount of American copper imports to Germany. Its German business is conducted by one of the partners in the company, William Brandeis, who resides in Berlin.

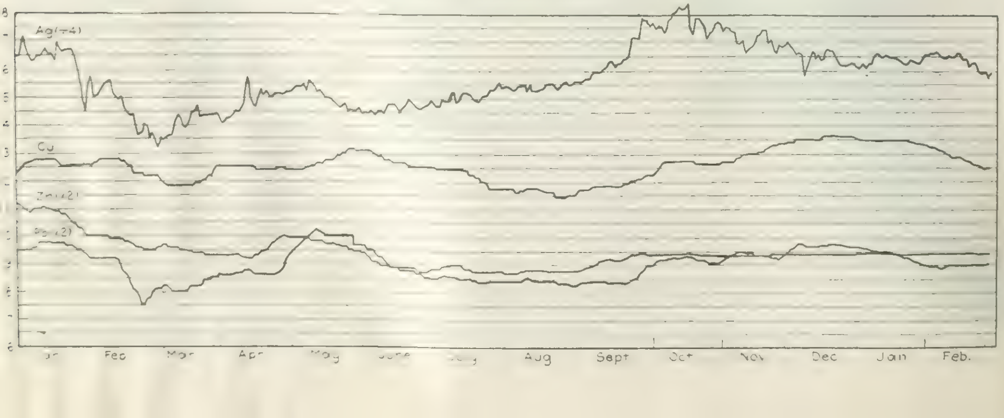
The prices at which contracts are concluded fluctuate with the market quotations in New York and London. It can, however, be noted that prices quoted by the large dealers, apart from the Copper Import Company, are frequently a fraction lower than those of the latter, especially when buying is slack. For this reason the Copper Import Company has not been able to establish control of the import market. In trading circles it is estimated that about half of the imports are handled by the Copper Export Association and the other half by independent sources.

The outlook upon the current year is unanimously considered to be fair, although business to the extent of that transacted last year is not expected. The electrical works are still employed to their fullest capacity with orders booked last year, especially for vast new hydro-electric plants which are being built, and for extension works, but new orders are coming in sluggishly. The requirements of copper, as far as the work in hand is concerned, is presumably covered by last year's purchases. The state railroads and the telegraph administration have also made all copper purchases for renewals and extensions, and are now buying only for their normal requirements.

A strong propaganda has been started in favor of aluminum as a wiring material, but no effects are so far noticeable of an increased use of this metal. Metal-working industries are noticeably holding back with orders, pending the outcome of the Genoa conference, which it is commonly believed may have serious consequences on market conditions if it should result in an improvement or stabilization of the rate of exchange. Much of the copper business of this year will depend on the future exchange situation. A decided improvement of the mark will no doubt react strongly on business, and in the first instance produce a slump. If, on the other hand, concerted action should succeed in stabilizing the mark, this will promote business, as a strong latent demand is kept in check by fluctuations.

Two other open questions of vast import will also have a strong bearing on the copper market—the reconstruction work for France and the opening of Russia. In the latter respect expectations are twofold. A vast amount of copper scrap is supposed to be lying idle in Russia, and efforts are being made at present to utilize it. A Berlin firm of copper merchants is working in conjunction with the Soviet government for conveying metal scrap of all descriptions to the German smelting works, and although no copper scrap has so far crossed the frontiers, considerable quantities are expected in the course of the year. On the other hand, the opening of Russia, especially the reconstruction of her transportation system, would call for an immediate supply of copper which could not nearly be covered by the scrap still in Russian possession. Moreover, opinions are strongly divergent as to the estimates of the quantities of scrap available. Those able to judge from personal observation are not optimistic.

Prices of New York Copper, Silver and Lead, and St. Louis Zinc 1921 and 1922



COMPANY REPORTS

Barnes-King Development Co.

A report of operations of Barnes-King Development Co. for 1921 states that the net profit for the year was $35,764.28, compared with $2,739.39 for the year 1920. The Shannon mine was operated continuously during the year, with slightly lower costs per ton of ore than in the previous year. The opening of an ore shoot on the lowest level, the 600, with the indication of its going down, was an encouraging development for the year. The Piegan-Gloster mine was not operated. The North Moccasin mine was operated by leasers. Work on three new properties was done, under option, during the year. On two of these, work has been stopped. Quite a number of other new properties were examined, but owing to either unfavorable conditions or terms, or both, nothing further was done regarding them. No dividends were paid during the year.

General profit and loss account follows:

INCOME FROM OPERATIONS			
Profit, Shannon property			$82,444.90
Less, North Moccasin and Kendall power plant	$7,285.78		
Less profit on sale of supplies	285.35		
		$7,000.43	
Loss Piegan-Gloster property		11,035.59	
Loss Kendall mine		485.74	
			18,521.76
Property net earnings			$63,923.14
Interest received		$1,474.49	
Interest received on Liberty Loan bonds		2,125.00	
Recovery from used materials		321.93	
			3,921.42
Total earnings			$67,844.56
EXPENSES			
Development of Strawn option	$7,779.85		
Development of Black Hawk option	6,024.91		
Betsy Baker option and development costs	7,093.86		
		$20,898.62	
Examination of new properties		$4,962.77	
Taxes paid:			
Net proceeds		2,628.95	
Capital stock tax		443.00	
Metal mines license tax		819.48	
Extraordinary expenses		2,327.46	
Total expenses			32,080.28
Net profit for year 1921			$35,764.28

Surplus account follows:

Surplus:			
Balance Dec. 31, 1920	$41,317.45		
Deduct depletion for 1920	6,421.95		
		$34,895.50	
Add tax adjustment		10.00	
Surplus as adjusted, Dec. 31, 1921		$34,905.50	
Net profits for year 1921		35,764.28	
			$70,669.78

Current liabilities on Dec. 31, 1921, were $22,738.67; current assets, $220,150.69. The company is capitalized at $2,000,000, consisting of 400,000 shares of $5 par value. Production of the Shannon mine was 36,570 dry tons of average assay value of $9.74.

Arizona Copper Co., Ltd.

A report of operations of the Arizona Copper Co., Ltd., for the year ending Sept. 30, 1921, states that the transfer of the company's business in the United States to Phelps Dodge Corporation, on the terms set forth in the agreement which was confirmed by the shareholders at the extraordinary general meeting on Oct. 3, 1921, was carried through on Oct. 5.

The dividend on the A preference shares of the company for the half year to Sept. 30, 1921, was paid prior to the transfer of the business on Oct. 5. In terms of the agreement, Phelps Dodge Corporation placed the company in funds to meet the dividend on the preference stock for the half year to Sept. 30, and that dividend was paid on Nov. 1, 1921.

On Jan. 4, 1922, Phelps Dodge Corporation paid a dividend of 1 per cent to its shareholders for the quarter to Dec. 31, 1921, making the dividend for the year to that date 4 per cent. The company's share of this quarterly dividend, being the first dividend it is entitled to under the agreement, was $50,000. The sterling equivalent received was £11,918 19s., which amount is subject to payment of British taxes. By the agreement, Phelps Dodge Corporation became bound to retire both the A preference shares and the preference stock within five years. The corporation has already retired the A preference shares; the necessary resolution reducing the capital of the company in respect of these shares has been passed and confirmed by the shareholders; and a petition to confirm this has been presented to the court.

For the present, and so long as the preference stock is outstanding, the company must continue, but the expenses of management will be materially reduced. The directors estimate that these expenses will not exceed £3,500 per annum, which would include the running of the office, the transfer department, the directors' fees, and the fee to be paid to the company's representative on the board of Phelps Dodge Corporation.

After the preference stock has been retired, the shareholders will be in a position to consider whether the company should be continued, or the Phelps Dodge Corporation shares disposed of en bloc, or distributed among the shareholders.

The revenue account for the year to Sept. 30, 1921, was as follows:

Copper company's operations						
Loss on copper and stores, less rents received				£182,028	17	4
Shut-down expenses exclusive of interest and taxes				27,165	5	3
				£209,194	2	7
Add						
Expenses of administration at Clifton	£18,430	14	4			
Interest paid in the United States, less received	49,800	19	1			
Taxes in the United States, paid and accrued	98,481	3	0			
	£166,712	16	5			
Public subscriptions in Arizona	2,103	19	8			
	£168,816	16	1			
Charges and expenses in Edinburgh (less received for transfer fees, £279, 9s. 0d.	10,977	10	0	179,794	6	1
				£388,988	8	8
Deduct						
Sums received in respect of holdings in other companies, interest and dividends for the year				21,516	17	9
				£367,471	10	11
Interest received, less paid				3,857	19	5
				£363,613	11	6
Add						
Amount carried to reserve for contingent liabilities				9,056	3	11
Amount carried to reserve account capital				12,000	0	0
Deficiency				£384,669	15	5
Dividend on A preference shares for year to Sept. 30, 1921	£2,344	0	0			
Dividend on preference stock for year to Sept. 30, 1921	22,187	2	0	24,531	2	0
Deficiency for year, after paying preferential dividends				£409,200	17	5
Deduct						
Balance to the credit of the profit and loss account Sept. 30, 1920				65,110	5	10
Balance to the debit of profit and loss Sept. 30, 1921				£344,090	11	7

MINING STOCKS

Week Ended March 11, 1922

COPPER

Stock	Exch.	High	Low	Last	Last Div.	
Ahmeek	Boston	63	61	62	Sept. '20, Q	$0.50
Alaska-Br. Col. Metals	N. Y. Curb	2¼	2	2		
Allouez	Boston	26	25	25	Mar. '19	1.00
Anaconda	New York	49¾	48	49¼	Nov. '20, Q	1.00
Arcadian Consol.	Boston	2¾	2½	2½		
Arizona Com'l	Boston	9	9	9	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*23	*18	*22		
Bingham Mines	Boston	13½	13¼	13¼	Sept. '19, Q	0.25
Calumet & Arizona	Boston	59	57½	59	Dec. '21, Q	0.50
Calumet & Hecla	Boston	280	277	279	June '20, Q	5.00
Canada Copper	N. Y. Curb	*21	*15	*15		
Centennial	Boston	10	10	10	Dec. '18, SA	1.00
Cerro de Pasco	New York	35	34	35	Mar. '21, Q	0.50
Chile Copper	New York	17¼	16¾	17¼		
Chino	New York	27¼	26½	27¼	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*30	*30	*30		
Con. Arizona	N. Y. Curb	*2	*2	*2	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	1⅝	1½	1⅝		
Copper Range	Boston	44	42	43½	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	*57	*52	*57		
Davis-Daly	Boston	8	7¾	7¾	Mar. '20, Q	0.25
East Butte	Boston	11¼	10¾	11¼	Dec. '19, A	0.50
First National	Boston Curb	*65	*61	*65	Feb. '19, SA	0.15
Franklin	Boston	12	11¼	12		
Gadsden Copper	Boston Curb	*50	*50	*50		
Granby Consol.	New York	29	28½	29	May '19, Q	1.25
Greene Cananea	New York	27½	26½	27½	Nov. '20, Q	0.50
Hancock	Boston	2¼	2¼	2¼		
Howe Sound	N. Y. Curb	3¼	3	3⅛	Jan. '21, Q	0.05
Inspiration Consol.	New York	40½	39¼	40	Oct. '20, Q	1.00
Iron Cap	Boston Curb	†8	7¼	7½	Sept. '20, K	0.25
Isle Royale	Boston	24½	23½	24	Sept. '19, SA	0.50
Kennecott	New York	29	28	29	Dec. '20, Q	0.50
Keweenaw	Boston	1½	1½	1½		
Lake Copper	Boston	2¾	2½	2½		
La Salle	Boston	1¾	1⅝	1⅝		
Magma Copper	N. Y. Curb	30¼	29½	29¾	Jan. '19, Q	0.50
Majestic	Boston Curb	*8	*8	*8		
Mason Valley	Boston	2¼	1¾	2¼		
Mass Consolidated	Boston	2½	2¼	2¼	Nov. '17, Q	1.00
Miami Copper	New York	27¾	27	27¾	Feb. '22, Q	0.50
Michigan	Boston	2	1¾	2		
Mohawk	Boston	59¾	57	59½	Feb. '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	8	7⅞	7⅞		
Nevada Consol.	New York	14½	14	14½	Sept. '20, Q	0.25
New Cornelia	Boston	18	17¾	17¾	Feb. '22, K	0.25
North Butte	Boston	12⅝	11¾	12⅝	Oct. '18, Q	0.25
North Lake	Boston			*25		
Ohio Copper	N. Y. Curb			*9		
Old Dominion	Boston	25¼	24	25	Dec. '18, Q	1.00
Osceola	Boston	34¼	32	33	June '20, Q	0.50
Phelps Dodge	Open Mar.	†171	†168		Jan. '22, Q	1.00
Quincy	Boston	44	43½	44	Mar. '20, Q	1.00
Ray Consolidated	New York	14½	14	14½	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*4	*3	*3		
St. Mary's Min. Ld.	Boston	46	44½	46	Dec. '21, K	1.00
Seneca Copper	Boston	14¼	13½	14		
Shannon	Boston	*90	*80	*80	Nov. '17, Q	0.25
Shattuck Arizona	New York	8	7¾	8	Jan. '20, Q	0.25
South Lake	Boston			*80		
Superior & Boston	Boston	1¼	*99	1⅛		
Tenn. C. & C. cfs.	New York	11	10¾	10⅞	May '18, I	1.00
Tuolumne	Boston	*50	*49	*50	May '13,	0.10
United Verde Ex.	Boston Curb	28½	27½	28½	Feb. '22, Q	0.25
Utah Consol.	Boston	2	1¾	2	Sept. '18,	0.25
Utah Copper	New York	64¼	62¼	64¼	Dec. '21, Q	0.50
Utah Metal & T.	Boston	1¼	1⅛	1¼	Dec. '17,	0.30
Victoria	Boston	2¼	2⅛	2⅛		
Winona	Boston	*35	*35	*35		
Wolverine	Boston	12	11½	11¼		

NICKEL-COPPER

Stock	Exch.	High	Low	Last	Last Div.	
Internat. Nickel	New York	13⅜	12	12¼	Mar. '19,	0.50
Internat. Nickel, pfd.	New York	67¼	64¼	65	Feb. '22, Q	1.50

LEAD

Stock	Exch.	High	Low	Last	Last Div.	
National Lead	New York	89¼	89	89½	Dec. '21, Q	1.50
National Lead, pfd.	New York			112	Dec. '21, Q	1.75
St. Joseph Lead	New York	13¼	12¾	12¾	Dec. '21, Q	0.25

QUICKSILVER

Stock	Exch.	High	Low	Last	Last Div.	
New Idria	Boston	*40	*40	*40		

ZINC

Stock	Exch.	High	Low	Last	Last Div.	
Am. Z. L. & S.	New York	13½	13¼	13¼	May '20	1.00
Am. Z. L. & S. pfd.	New York			37¼	Nov. '20, Q	1.50
Butte C. & Z.	New York	5¼	5¼	5¼	June '18,	0.50
Butte & Superior	New York	26¾	25½	25½	Sept. '20,	1.25
Callahan Zn-Ld.	New York	6⅛	5¾	6⅛	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	146	139	146	Feb. '22, Q	2.00
Yellow Pine	Los Angeles			*50	Sept. '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills, Spokane, Pohlman Investment Co., Salt Lake, Stock and Mining Exchange. Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

GOLD

Stock	Exch.	High	Low	Last	Last Div.	
Alaska Gold	New York	½	⅜	½		
Alaska Juneau	New York	¾	⅝	⅝		
Carson Hill	New York	13¼	12½	13		
Cresson Consol. G.	N. Y. Curb	2 11/16	2⅝	2 11/16	Jan. '22, Q, X	$0.10
Dome Extension	Toronto	*85	*85	*85		
Dome Mines	New York	24¼	24	24½	Jan. '22, Q	0.25
Florence Goldfield	N. Y. Curb	*25	*22	*24		
Golden Cycle	Colo. Springs	*77	*77	*77	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*4	*4	*4	Dec. '19,	0.05
Hollinger Consol.	Toronto	9.15	8.75	9.05	Feb. '22,	0.05
Homestake Mining	New York	61	60⅝	60⅝	Feb. '22, M	0.25
Kirkland Lake	Toronto	*39½	*35	*38		
Lake Shore	Toronto	1.85	1.65	1.80	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	14.80	14.55	14.65	Jan. '22, K	0.05
Porcupine Crown	Toronto	*27	*23	*25½	July '17,	0.03
Porcupine V. N. T.	Toronto	*26	*25	*25½		
Portland	Colo. Springs	*36	*35	*36	Oct. '20, Q	0.01
Schumacher	Toronto	*47½	*45½	*46½		
Silver Pick	N. Y. Curb	*6	*6	*6		
Teck Hughes	Toronto	*38½	*36	*37½		
Tom Reed	Los Angeles	*78	*73	*75	Dec. '19,	0.02
United Eastern	N. Y. Curb	2 1/16	1 15/16	2 1/16	Jan. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*21	*20	*21	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb			*3		
Yukon Gold	N. Y. Curb	1⅛	1 1/16	1⅛	June '18,	0.02½

SILVER

Stock	Exch.	High	Low	Last	Last Div.	
Batopilas Mining	New York	⅝	½	⅝	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*31	*29	*30¾	May '20, K	0.03
Coniagas	Toronto	1.37	1.32	1.35	May '21, Q	0.12½
Crown Reserve	Toronto	*22	*17½	*20	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3⅛	3	3	Jan. '22, Q	0.12½
La Rose	Toronto	*58	*47	*55	Apr. '18,	0.02
McKinley-Dar.-Sav.	Toronto	*22	*18	*19	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.10	1.00	1.09	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6½	6⅛	6⅜	Jan. '22, Q, X	0.30
Ontario Silver	New York	5¼	5¼	5¼	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb			*12	Jan. '12,	0.10
Temiskaming	Toronto	*33	*31	*32¾	Jan. '20, K	0.04
Trethewey	Toronto	*5	*4	*5	Jan. '19,	0.05

GOLD AND SILVER

Stock	Exch.	High	Low	Last	Last Div.	
Boston & Montana	N. Y. Curb	*49	*39	*44		
Cash Boy	N. Y. Curb	*5	*5	*5		
Dolores Esperanza	N. Y. Curb	*98	*81	*98		
El Salvador	N. Y. Curb	*4	*2	*4		
Jim Butler	N. Y. Curb			*5	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb			*3	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*7	*5	*6	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1¾	1⅝	1 11/16	Jan. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*61	*50	*61		
Tonopah Extension	N. Y. Curb	1⅝	1½	1 9/16	Jan. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1 13/16	1 11/16	1 11/16	Oct. '21, SA	0.05
West End Consol.	N. Y. Curb	*78	*75	*78	Dec. '19, SA	0.05

SILVER-LEAD

Stock	Exch.	High	Low	Last	Last Div.	
Caledonia	N. Y. Curb	*5	*5	*5	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	1.00	1.00	1.00	Dec. '20,	0.15
Chief Consol.	Boston Curb	†3⅝	†3½	3½	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	19⅜	19⅜	19⅜	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†3.00	†1.00		July '20, Q	0.10
Daly-West	Boston	2¾	2¾	2¾	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†3	†2⅞	2½	Apr. '21, K	0.05
Electric Point	Spokane	*6	*4⅞	*6	May '20, SA	0.03
Federal M. & S.	New York	†12	†8		Jan. '09,	1.50
Federal M. & S. pfd.	New York	38	38	38	Dec. '21, Q	1.00
Florence Silver	Spokane	*23	*23	*23	Apr. '19,	0.01½
Grand Central	Salt Lake	*45	*45	*45	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	5¾	5½	5¾	Dec. '21, Q	0.17
Iron Blossom Con.	N. Y. Curb	*20	*18	*19	Dec. '21, Q	0.02½
Judge M. & S.	Salt Lake	†3.00	†2.65	3.00	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*5	*5	*5	June '21, I	0.02
Prince Consol.	Salt Lake	*11	*9¼	*9½	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*6¼	*5½	*6	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*9	*7	*8		
South Hecla	Salt Lake	†*60	†*35		Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*15	*15	*15	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*4	*2	*4	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.27½	2.20	2.20	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.05	1.95	1.95	Dec. '21, Q	0.05
Utah Apex	Boston	3⅞	3⅛	3½	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb			*2	Nov. '17,	0.01

VANADIUM

Stock	Exch.	High	Low	Last	Last Div.	
Vanadium Corp.	New York	37⅜	34¾	37½	Jan. '21, Q	1.00

ASBESTOS

Stock	Exch.	High	Low	Last	Last Div.	
Asbestos Corp.	Montreal			54½	Jan. '22, Q	1.50
Asbestos Corp., pfd.	Montreal	74	74	74	Jan. '22, Q	1.75

SULPHUR

Stock	Exch.	High	Low	Last	Last Div.	
Freeport, Texas	New York	20¼	16⅝	19¾	Nov. '19, Q	1.00
Texas Gulf	New York	44⅞	43¾	43⅞	Dec. '21, Q	1.00

MINING, SMELTING AND REFINING

Stock	Exch.	High	Low	Last	Last Div.	
Amer. Sm. & Ref.	New York	50¼	47¼	50⅛	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	92	90¼	91⅛	Mar '22 Q	1.75
Am. Sm. Sec. pf. A.	New York	89¾	89¼	89⅞	Jan '22, Q	1.50
U. S. Sm. R. & M.	New York	36⅞	34½	36⅞	Jan '21, Q	0.50
U.S. Sm.R.& M. pf.	New York			43½	Jan. '22, Q	0.87½

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Engineering and Mining Journal

A Weekly Journal of the Mining and Mineral Industries
METALS NON-METALS PETROLEUM

[illegible]

Volume 113 New York, March 25, 1922 Number 12

The Fight of Independent Journalism

THE *MINING AND SCIENTIFIC PRESS* is an institution whose departure from a separate existence all will view with regret. The principles of competition, of different views and policies from different centers, is one dear to our hearts. But the principle of competition has been overdone, and that in a time of great business depression. We refer to the society-supported publications, which beginning under the guise of being society organs boldly hew their way into the field of mining journalism as business ventures, quite superimposed upon and unnecessary to the work of the societies—such publications as that issued by the American Institute of Mining and Metallurgical Engineers. Against this outbreak of subsidized journalism, independent journalism has had to consolidate, for it exists upon its own merits only, and has not, like *Mining and Metallurgy*, thousands of unwilling engineers written into the class of subscribers without their consent and unwarrantably presented to its advertisers as readers—not a valid claim.

We wonder if the mining industries realize what they lose if independent journalism should suffer further injury? The policies of a journal conducted by a society cannot be free; they are determined by the little group which dominates the society. They should really be determined, before expression, by a vote of the society; any other practice is an assumption that the members of the society are not capable of self-determination. The utterances and the policies of *Engineering and Mining Journal-Press* will be as free as air, determined upon by conference and consultation among the editorial staff, East and West. There is no superior influence whatever, financial, society, organization, or social, which affects its integrity and its fearlessness. Moreover, it reflects the will and the mass opinion of the mining industries. It is representative of them. And in this it belongs to a class quite distinct from society-owned journalistic ventures.

And by the same token, and to show the consistency of our attitude, we do not resent the competition of other independent journals, such as the *Mining Magazine* of London or the *Canadian Mining Journal*. They are fair competitors whom we respect; just as there has been a mutual sportsmanlike respect and frequent extension of courtesies between *Engineering and Mining Journal* and *Mining and Scientific Press*, now consolidated for self-preservation and for a bigger manifestation of the independent journalistic principle.

The Crisis on the Rand

TROUBLE LONG BREWING on the Rand has finally reached a climax. The strike which since the first of the year has kept the gold mines closed has steadily assumed a more sinister aspect, finally culminating in violence that has seemed to be an attempt at revolution. Actual fighting between the strikers and the government forces has occurred along the reef. Strategic points are reported to have been seized by the former, as if a war were actually under way, and many casualties to have taken place. It is well to remember here that sensational reports of this nature are likely to be overdrawn. A feature of the strike has been the formation of "commandoes," both infantry and mounted, of strikers. The greater part of Johannesburg was dominated by these commandoes for a short space of time, it is said, and desperate efforts were made to gain control of the town before the government troops arrived. So much we glean from dispatches appearing in the press.

All mining men are familiar with the economic difficulties that have beset the gold-mining industry on the Rand and elsewhere. But the "gold premium," arising from the differences in exchange, has alleviated the situation abroad to a considerable extent, and, unwisely perhaps, the workers on the Rand were permitted to share in this premium in the past, when the operators would have done better to have conserved their resources, more especially because it was not explained and stressed that the premium was only a temporary advantage. Exchange has risen, the "premium" dropping correspondingly, and the companies have been brought face to face with the urgent necessity of cutting costs and the impossibility of granting further increases or, indeed, of maintaining the existing scale.

Linked with this, and a factor in the situation, has been the discussion over the possibility of removing the "color bar," thereby permitting the employment of native (black) labor on many operations hitherto restricted to Europeans. All in all, the situation has been steadily souring, so to speak, for a long time.

Radicalism flourishes under such conditions. The agitator has been busy and has gained and organized for violence his followers. But it is probable that many, if not the majority, of the white workers, although desirous of improving their condition, have too much sense to think that they can do so by turning things upside down. As an illustrative incident, our correspondent reports that on Feb. 1 the Germiston strike committee passed a resolution suggesting the appointment of an arbitration court to settle the strike and expressing a desire to meet General Smuts to lay their proposal before him. This excited opposition among some of the strikers, who waited on the committee in their offices and refused to allow them to leave until they had promised not to go to Pretoria to meet the Premier.

A sketch of the situation that has culminated in the present lamentable disorder was given last November by Prof. J. G. Lawn, joint managing director of the Johannesburg Consolidated Investment Co. The hours of work for white labor had been shortened and regular holidays had been granted, amounting to four weeks per year for underground workers, without reciprocal loyal service on the part of the men. Agitation was constant and unending; grievances were hunted; executives harassed, and sectional strikes were frequent. The mines had made concession after concession, until they had come into an almost impossible position, and were sustained only by virtue of the gold premium. More white workers were employed than were necessary, owing to government regulations and to agitation and threats on the part of European employees. In addition to this and immediately preceding the present disorder there have been many incidents where the commandoes have visited properties and "pulled out" workers engaged on critical operations, such as pumping, and threatened the management.

The community's loss is enormous. As estimated for the first week of the strike, it included £35,000 per day in employees' loss of wages, an additional £35,000 daily in employers' direct loss, standing charges and natives' expenses, and a loss of £9,000 daily to the community. In 1920, almost £14,000,000 was spent on the Rand alone for supplies to the gold mines. Some of the properties now closed will never reopen.

There is no school like experience. The strikers will surely lose, for it is impossible for them to win. Conceivably they might take over the gold mines, in which event they would be worse off than they have been, as every operator knows. But things will hardly go as far as that. And when it is all over, it is reasonably safe to guess that wages will be lower and the color bar down, and that more than one of the mines will be closed for good. Thus the working man elevates himself by his bootstraps.

Secrets of the Ball Mill Shown by Motion Pictures

ONE OF THE MOST INTERESTING features of the recent meeting of the Canadian Institute of Mining and Metallurgy held at Ottawa was the presentation, by motion pictures, of what goes on in a ball mill. The pictures, it is true, did not show a great deal that has not been known or suspected for some time by those familiar with the subject, but they were intensely interesting nevertheless and attracted a great deal of attention even from those who are not directly concerned with milling problems. The work was done under the direction of H. E. T. Haultain, professor of mining engineering at the University of Toronto, and has occupied the attention of several of the more advanced students for two or three years.

Professor Haultain used a small model, of which the end was made of glass, for his photographic work. A great deal of difficulty was found in getting a proper material for the balls, but the most effective pictures were made when the balls used were of a special composition painted white, with a small black radial line so that rotary motion of the individual spheres could be shown. Other pictures were made with the balls represented by peas and grape seeds. The ultra-speed camera was used, the pictures being taken at greatly accelerated speed, but thrown on the screen at the ordinary rate, thus making the action sufficiently slow to illustrate the operation in detail, though at the same time preventing the flicker which would be inevitable if the pictures were made at normal speed and the reproducing camera were operated slowly.

Using peas and grape seeds in the mill, and revolving at slow speed, so that the "balls" rolled down on each other, there was an evident segregation of the smaller seeds in the center of the mass. As the speed increased a good mixture was obtained, and as the critical speed was approached the grape seeds seemed to gather at the periphery.

With the painted composition balls the part that attrition plays in grinding was plainly evident. Practically all of the balls were constantly rotating. It was evident also that the balls near the periphery were not traveling nearly so fast as the mill; this slippage was particularly evident when the mill was operating dry. Furthermore, the large balls showed a much greater tendency to slip than the small balls. Professor Haultain gave it as his opinion that slippage more than anything else affects what goes on in a ball mill. It is the irregular slippage that causes the surging when the critical speed is approached. This was also beautifully illustrated by the pictures. Many millmen and operators have noticed the fluctuating indicator of the wattmeter, especially at the higher speeds, but have had to imagine just what was going on inside the mill.

The presence of a wet pulp visibly decreased the activity within the mill. Much of the bounding of the balls as they fell disappeared. The balls also followed the lining of the mill better, showing less slippage. At the higher speeds there was a tendency for the fine ore pulp to segregate. This was remedied and the balls and pulp were well mixed up as the speed was reduced.

After the reel of film was run off it was reversed through the same machine, giving the pecular effect of the balls rising in the mill instead of falling; it was then again run through in the normal way, thus giving the audience three opportunities to see the phenomena. Indeed, the film would bear several repetitions.

Just how much a millman can improve his work by seeing something of this kind is not possible for us to say. It is evident that at slow speeds fine grinding by attrition is promoted and that the limits of speed are somewhat narrow within which the maximum crushing effect of the falling balls on the larger pieces of ore can be obtained. Doubtless Professor Haultain will later offer a paper in which he will present definite conclusions from his work.

It is to be hoped that men in operating centers will have an opportunity to see this most interesting film. Possibly some of the local sections of the A. I. M. E. and the C. I. M. M. can arrange to borrow the picture for local presentation. We are sure that it will provide many points for discussion.

Metal Prices Worrying Australians

OUR ESTEEMED Australian contemporary, *Chemical Engineering and Mining Review,* is much perturbed as to whether the price of metals will improve. The editor is rather pessimistic as to the immediate future of copper. "The existence of 150,000 tons in the hands of American financiers and dealers does not make for confidence. They are too cute to suit most people, and they may get a strangle hold on the market when the outsider least contemplates anything of the kind." We assume that the editor uses "cute" in its colloquial meaning of "clever, sharp, shrewd, or ingenious," rather than its more common meaning (at least in this country) of being "attractive by reason of daintiness or picturesqueness in manners or appearance, as a child or small animal." However, we do not look upon our copper financiers as particularly "cute" on either score. No great shrewdness was exhibited in amassing the surplus stocks, and the ingenuity shown in disposing of them and in cultivating markets has not been outstanding. To be sure, the situation has not been entirely allowed to take care of itself, but we would hardly select the handling of the copper industry, either previously or now, as an example of the shrewdness of American financial giants.

And as to the prices of metals generally, we fear we must ask our Australian friends to consider a reduction in costs rather than any marked increase in prices. The idea is hard to assimilate in Australia, of course, where the labor unions rule supreme, and wages must be maintained whether any business is done or not. No one is more anxious than we are for a remuneration that will permit all to live decently, but the wage scale and the amount of work to be done must be co-ordinated.

Mechanical Shoveling

CONSIDERABLE ATTENTION has been given to types of mechanical mucking machines and to an understanding of their mechanism, but the physical characteristics of the pile of rock in which they operate have received practically no discussion, although it is highly probable that users and operators have given some study to this subject. If we assume a conical pile of rock fragments, it is evident that the whole mass is in equilibrium, but that the outer conical shell approaches more nearly to unequilibrium than any other part of the mass. Greatest equilibrium is at the center and bottom of the mass, and the equilibrium diminishes in degree as the surface is reached.

The apex of the pile is in least equilibrium, for a comparatively small force is required to flatten it. Similarly, it is easy to rake down the sides. If the cone is on a flat surface it is easy to force a "square point" shovel along the surface under the pile. If on an uneven surface, the "square point" is not as easily driven into the pile. A "round point," on the other hand, will penetrate more easily, whether on the bottom or the sides. If the pile is confined on two sides and the back, as is the condition in mucking from the end of a drift, only the face of the pile approaches unequilibrium.

A pile confined on four sides is in maximum equilibrium. This condition prevails in unloading a car with a clamshell bucket. The penetrability of the pile is thus a factor of the degree of equilibrium and the kind of edge forced into the pile. How far will the clamshell bucket edge penetrate under various conditions of equilibrium? Are other types of edges better under maximum equilibrium conditions?

If we vary the nature of the material in the pile, starting at one extreme with sand and at the other with the steam-shovel ore pile, it is a well-known fact that the sand pile is penetrable with slight force, whereas the toothed edge of the steam shovel requires a relatively large force to drive it into the pile. It is thus evident that in the successful application of the mucking machine it is necessary to know quantitatively the magnitude of the forces required to secure penetration as well as the best type of edge to accomplish this.

The question may well be raised as to the direct influence upon penetration resulting from a greater degree of fineness in the pile of muck. By using more explosive and a greater number of drill holes, the broken rock can be made finer and the resistance to penetration lessened. Here, in our opinion, is an important line of inquiry, and we would be glad to have some of our engineers enlighten our readers on this subject if investigations have been made and the results are accessible.

Gas Detectors for Mines

THE CONSERVATISM of the miner is exemplified by the fact that for many years the devices for testing air and gas underground were limited to the candle and safety lamp, the former for testing for a sufficiency of oxygen and the latter for the presence of combustible gases. By the use of varying heights of the flame cap, the approximate quantity of methane could be estimated, but small percentages required the method of gas analysis to determine them quantitatively. Other gases, such as carbon monoxide and carbon dioxide, could not be readily detected, although the taste of carbon dioxide is believed by some to be a means of identification.

During the last few years both combustible gas and carbon monoxide detectors have been perfected, and it is now possible by their use to determine quantitatively both of these gases quickly and readily. A portable tester for carbon dioxide has been in use for some time. There is therefore available for the mining engineer standardized testing apparatus of a portable nature for determining carbon dioxide, carbon monoxide, and combustible gases.

The amount of moisture in mine air can be determined by the readings of the sling psychrometer and the air quantity by the anemometer. Thus, essentially all of the important characteristics of a ventilating current can be quantitatively ascertained.

Value of a Mining Education

THOUGH IT IS TRUE that mining engineers in the years that immediately follow graduation are not offered pecuniary compensation such as is possible in many lines of business and commerce, the student of mining engineering should not feel that on this account he is on the wrong track. A college or technical education is per se worth while—worth while for the mental training and comprehension of the world which it gives.

Many a mining engineer, when he decides for one reason or another to put the soft pedal on his mining life, or to drop it altogether, finds that the years he has spent in study and practice have been an excellent preparation for his new activity, whether this be real estate, orange growing, or machinery selling. The educated man by and large is better equipped than the uneducated; and this is especially true if the studies involved tend toward some definite and utilitarian end, such as mining.

A complete course in mining engineering—including, of course, the cultural studies, taken before, after, or with the technical studies—affords as good a training for any walk of life as can be had. Such a course should be chosen in a college where the study of economics and the general principles of business is stressed as much as convenient. And this is an additional reason why mining schools should teach more and more the business of mining—the economics of the mining industry: mine examination, promotion, financing, operation, marketing, the principles of political and commercial geology, the relation of legislation, the mining laws.

WHAT OTHERS THINK

Air-Receiver Calculations

W. S. Weeks' reply in the Dec. 3 number of the *Engineering and Mining Journal* to my discussion in the Aug. 13 issue teaches a lesson that every writer on technical subjects should learn at the earliest opportunity. That is: "Make all your statements so complete as to render misinterpretation absolutely impossible. Do so even at the risk of being branded too elementary."

I consider the subject of air receivers, suggested by Mr. Weeks, an important one, and hold that a more thorough discussion of it in technical papers cannot but prove helpful and interesting to students and engineers engaged in such work. This is what prompted me to present the subject from a point of view differing from that taken by Mr. Weeks in his original paper in the June 11 issue of the *Engineering and Mining Journal.*

In one paragraph of that paper Mr. Weeks says: "The receiver will supply 1,000 cu.ft. of free air above 70 lb." Now, we know that a receiver does not really supply "free air" and that there is no such thing as free air above 70 lb. Nevertheless, most of the readers of the article, no doubt, understood, as I did, what Mr. Weeks meant; namely, that the receiver supplies compressed air at a pressure above 70 lb., in amounts equivalent to 1,000 cu.ft. of free air. He took it for granted—and reasonably so—that we should interpret it that way, although he didn't say so. Now, I think I was equally justified in taking it for granted—unwisely, however—that my readers would understand that when, for brevity's sake, I said: Volume V_1, the free air occupied in the receiver before being withdrawn, is:

$$V_1 = \frac{V P_3}{P}$$

I meant: "Volume V_1, which the free air occupied in the receiver in the form of compressed air before it was withdrawn and converted into its free-air equivalent, is . . ."

Though the formula itself and the meaning of the symbols given in the legend of my article should have prevented a wrong interpretation, Mr. Weeks, by taking the abbreviated statement literally, was nevertheless entitled to call it incorrect, just as I would have been justified in calling his abbreviated statement above referred to incorrect, although I didn't do so. All of which shows how important it is that the writer on technical subjects make himself clear beyond all possibility of misunderstanding—a requirement that cannot be emphasized too strongly.

I do not altogether agree with the criticism in the editor's footnote that my deductions would have been clearer had I used pounds instead of volumes. This much we all admit, of course: that the pound is the only definite measurement of a quantity of air, because a pound of air is a pound of air, no matter what the volume and pressure of that pound of air may be at any particular instant.

Unfortunately, however, in the majority of calculations for practical air problems, it is not the weight of the air that directly counts, but the volume and pressure of a quantity (weight) of air at any particular instant. To compress to a certain pressure a pound of free air in Butte, for instance, takes less power in winter (as much as 8 per cent) than it does in summer. Again, a pound of air having a pressure of 80 lb. can do more work than a pound of free air, for instance. On the other hand, to compress to a certain pressure 1 cu.ft. of free air per minute at a certain locality always takes the same number of horsepower, winter or summer, no matter what that cubic foot of air may weigh at any particular time. It is this constant energy that must be supplied and therefore calculated once for all, and not an amount that would change every day and every hour of the day, were it calculated according to the number of pounds of air being compressed at any particular moment.

For this reason the principal formulas expressing power required to compress air and power available for doing useful work do not state quantities of air in pounds but always in volumes and pressures. This is why I thought it might prove interesting to show how the final formulas used in numerical problems may be developed more directly by disregarding weight and temperatures to begin with, as these quantities do not appear in the final formulas, at least not in those presented by Mr. Weeks, in the original paper.

In his answer in the Dec. 3 issue Mr. Weeks also calls attention to an important fact that makes comprehensive and intelligent writing on certain subjects extremely difficult. He states: "The hoists consume and the compressors deliver air at constantly reducing pressure . . ." In other words, the performance extended over a certain time is not uniform, but is constantly changing. It cannot, therefore, be expressed by a single simple mathematical formula that would hold good for every instant of the performance. Obviously, it requires some imagination on the part of both the writer and the reader to picture to himself just what happens.

In the particular problem of my discussion I said that "The hoists during a period of thirty-six minutes consume a volume of 108,900 cu.ft. of compressed air." Now, as Mr. Weeks intimated, the statement as such is incomplete, although from what went before, I expected the reader to infer that the pressure of the air coming to the hoists during that period varies from a maximum of 102 lb. absolute to a minimum of 89 lb. absolute. During the first minute the hoists take a certain volume of air at 102 lb. absolute. During the thirty-sixth minute they take air at a pressure of 89 lb. absolute, and to do the same amount of work they must take a larger volume than they did during the first minute. The sum total, however, of all the air taken during the thirty-six minutes, expressed in equivalents of 102-lb. compressed air, amounts to 108,900 cu.ft. This is what I intended to convey, and, as Mr. Weeks demands, I should have so stated. It is clearly another example of throwing the burden of correct interpretation upon the reader, which, I admit, is unwise, to say the least. I did it to avoid being "too elementary," a criticism that I have heard on former occasions. The old advice, "Remember the reader," cannot be followed too closely.

My equation (8) should be inverted, as pointed out by Mr. Weeks. I am sure the editor of the *Journal* will plead guilty[1] for this accident, as the manuscript submitted to him contained the formula in its correct form. This becomes evident from the numerical problem, following the equation. My equation (7), after substitution of equivalent symbols, is identical with that given in the catalog of the H. K. Porter Company, to which Mr. Weeks refers. It is used there for computing the storage capacity of a one-locomotive compressed-air haulage system, and is accompanied by the remark: "When two or more locomotives are to draw on the same stationary storage system, its capacity should be somewhat increased."

The remark seems to indicate that for multiple-locomotive systems, which are by far the most frequent, the H. K. Porter engineers do not use that formula, at least not in its general form. This again proves that it is almost impossible to propound rules or deduce simple mathematical equations that are applicable to all problems. As a matter of fact, almost every problem requires special calculations to fit special requirements and local conditions.

This being so, it would be of great help to the profession if engineers with wide experience in compressed-air installations could be induced to contribute to the technical press accounts of their experiences with reference to special problems and special calculations. Now that Mr. Weeks has set the ball rolling, it is hoped that other contributions on the subject will be forthcoming.

Butte, Mont. Theodore Simons.

The Pas Region of Canada

Incited thereto by an editorial in the last issue of the *Engineering and Mining Journal* on prospecting possibilities, which mentions The Pas region, in Canada, I am setting down a few facts as to that country.

Extending eastward from the boundary line between Saskatchewan and Manitoba at Amisk Lake for 125 miles is an area approximately twenty to twenty-five miles wide, composed of pre-Cambrian rocks essentially of a mineral-bearing character. Irregularly on the south this region is bounded by the northerly limits of the overlying limestone; and the district itself is composed of large granite areas, massive and intrusive greenstones, schists, conglomerates, and other rock formations. The country has been glaciated: it has many lakes, and the land areas are covered, generally, either by moss, soil, or swamp. There are no railways, no near bases for supplies, no traveled routes other than those used for a hundred and fifty years by the fur trader, and before him by Indians. To the northward, toward the Barren Grounds and Reindeer Lake, lies a great area of banded gneisses, delimiting the more promising formation above noted. It has been reported that in this gneiss there are bands of schists and other rocks, showing mineral possibilities, but as to this little is yet known.

No thorough prospecting of the 2,500 square miles of the region has been conducted—it has been utterly impossible. The finds that have been made have been where routes of travel or game-running have accidentally led to discoveries.

It seems unreasonable to believe that all or any considerable part of the probable discoveries have been made. One will not find here, as he does in Colorado or Arizona, for instance, the prospect holes of forgotten and ubiquitous sourdoughs dotting every hillside and exposed in the most difficult or unpromising localities. The quartz veins stick up out of the swamps; the sulphide bodies are soft and were eroded by glacial action until they are hidden for the most part by swamp moss or by lakes; so one finds that the number of gold discoveries is far in excess of the number of copper finds. Scores of gold-bearing quartz veins have been found and opened, many of them of a character that will make a profit to their owners when facilities for development and treatment are at hand. Two important copper sulphide bodies have been found so far, Mandy and Flin Flon. The first of these is comparatively small, but from it there have been shipped thousands of tons of wonderfully rich ore. The latter is large, but of low grade, and can be worked only when there are railway connections and smelters adjacent. Mandy ore was hauled thirty-five miles on sleighs through the forests, loaded into scows, towed down wild northern lakes and through shallow and narrow channels, and shot down rapids to The Pas, and thence railed half across a continent to a smelter.

An area covering about 1,600,000 acres of country whose general geological character is favorable to mineralization cannot be said to be explored when a few scores or hundreds of prospectors have paddled up its lakes, shot its rapids, and portaged across its connecting trails during a comparatively brief period. It is a difficult region to examine. Cumberland House, the Hudson's Bay post down on the Saskatchewan, is the nearest outfitting point. The trails were made more than a hundred years ago by fur traders for the benefit of their brigades. Swamps and rock ridges and dense growths of forest and brush discourage all wanderings off the paths.

It would be unfair to the region to presuppose that Mandy and Flin Flon are the only important copper bodies likely to be opened in that area; as stated above, erosion probably has reduced the croppings of such deposits to an extent that hides them in the depressions filled by swamps, muskegs, and the like, and it will be by intensive prospecting only that they will be unearthed, and it may be that during a period of many years important discoveries will be made. Even the harder quartz ledges are found but slowly, in unexpected localities, and somewhat continuously.

The Mining Corporation of Canada now owns a majority interest in Flin Flon, having bought the shares held by most of the minor holders. Arrangements may be made for connection by railway, which railway would run through and open a considerable extent of the district. This would facilitate exploration and increase activity throughout the region.

One consideration should not be forgotten, and that is that news stories originating at The Pas and printed by newspapers outside are likely to be exaggerated. People there are so anxious for a boom in the region and so ignorant of what constitutes a mineral discovery of economic possibility that they play up whatever chances to sound well; and they are misled, innocently enough, by the preposterous tales of prospectors.

Duluth, Minn. Dwight E. Woodbridge.

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[1] The original manuscript not having been preserved, it is impossible for us to determine the responsibility for this error.—Editor.

Gold Mining in Colombia

Description of Operations in Cordillera Central Dredging on Nechi River Hydraulicking in Anori District Native Milling Methods Crude La Clara's New Elevators Legal Procedure To Acquire Title

By Eric K. Craig
Written for Engineering and Mining Journal

MINING FOR GOLD is the oldest industry in Colombia. From the founding of Cartagena, in 1533, by Pedro de Heredia, and the raids which followed into the gold regions of the Sinu and San Jorge, the lure of the great auriferous gravel areas was the inducement to Spanish settlers. These men pushed farther and farther into the interior, until today there is scarcely a gulch which has not its boulders piled beside the watercourse. The gold fields of the Cordillera Central, in Antioquia, produced by far the larger proportion of the great wealth which found its way through Cartagena to Spain.

Topographically, the western half of Colombia is divided into three sections by the west, central, and eastern cordilleras. The western cordillera slopes to the valley of the Atrato, thence over a low coastal range to the Pacific. The eastern cordillera slopes to the valleys of the Amazon, Orinoco, and the Laguna de Maracaibo on the east, and to the valley of the Magdalena on the west.

The best known of the three ranges is the Cordillera Central, lying between the valleys of the Magdalena and the Cauca. The northern slopes and valleys of this spur of the Andes yield the major part of the gold and silver of the country. Gold is also produced from the valleys of the Atrato and the San Juan, but it is mainly the byproduct in the recovery of platinum by dredges. Although some gold is found by natives, little is known of the mineral resources of the eastern range.

There are no maps of the country based on actual surveys. The courses of the Magdalena and Cauca rivers have been mapped by a river pilot of long experience, the results being reliable as far as the river banks are concerned. Most of the departmentos have individual maps based on local estimates collected by a cartographer. The government has lately sent out parties to locate the principal cities and villages by astronominal observations, and the collected data should be an improvement over the present guesswork.

The Cordillera Central rises abruptly from the savannas, near the village of La Roya on the Cauca, about 160 miles above Barranquilla. The first mines of consequence are situated sixty miles southeast of La Roya in the Guamoco district, although gold is won from the beds of many streams nearer the Cauca village.

The most successful mine in the district is La Libertad, owned and operated by two Americans. This had a free-milling, gold-quartz vein, which has yielded a comfortable fortune to its owners in the last ten years. The oxidized ore has now given out, and the attempts to amalgamate the sulphide rock have been unprofitable. Shaft-sinking and erection of a cyanide plant are now in progress.

A few leagues from La Libertad is the Chicago mine, also owned and operated by Americans. A ten-stamp mill and cyanide plant have been in operation intermittently for more than ten years, but little is known about the output.

Frontina and Bolivia's New Plant Giving Good Results

Forty miles south of El Guamoco lies the important mining district of Segovia. The principal mine is the Frontina and Bolivia, an English owned and operated property, which has been worked for more than thirty years. Owing to a narrow, flat and badly faulted vein system, in hard granite walls, profits have been small. Under the present efficient managership of John Reed, the various plants have been consolidated in one building. The new mill consists of ten 1,050-lb. and thirty 450-lb. stamps, with a duty of ninety tons per day through 20 mesh. The pulp is treated in hydraulic classifiers for a rough concentration of the sulphides in the underflow. The overflow passes to a Dorr classifier, the underflow from which passes to cyanide leaching tanks, and the overflow to thickeners and agitators of the Dorr type, where it is joined by the reground concentrate. The slime from the agitators passes to an Oliver filter for final treatment. The mill heads, after passing a circular picking table, assay 18 dwt. per ton. The extraction is said to be slightly better than 98 per cent.

TOWN OF SEGOVIA, COLOMBIA

The shaft has been sunk 1,700 ft. on a dip of 28 deg., with a good grade of ore in the bottom levels, insuring reserves for several years. Power is obtained from a hydro-electric plant on the Poconé, eight miles away. All equipment must be dragged or carried on mule back forty-five miles over a bad trail from Zaragoza, on the Nechi River. In one instance a heavy motor cost-

FRONTINO AND BOLIVIA MILL, SEGOVIA DISTRICT, COLOMBIA

ing £400 in England required the expenditure of £700 to transport it from Zaragoza to the mine! An indisposition on the part of former managers to attempt to provide transportation for efficient machinery largely explains the poor showing of an intrinsically good mine.

In the same district as the Frontina and Bolivia mine are three others operated by Englishmen with small stamp mills, but the ores had little persistence in depth.

Pato and Nechi Companies Dredging Under Same Management

The Pato Mines, Ltd., and Nechi Mines, Ltd., lie about forty-five miles west of Segovia, on the Nechi River. The associated companies operate two dredges under a single management. The history of these enterprises is too well known to readers of the mining journals to require mention here.

The gravel areas at Pato are situated at the widening of the Nechi valley, a few miles below the junction of the Porce and Nechi rivers. These two rivers drain an immense area, similar in general topography to the areas drained by the Feather and Yuba rivers in California. Bench or terrace gravels occur at and extend for twenty miles below Pato. Although the larger *vegas* (flats) of the Nechi below Pato have been extensively drilled, no deposit rich enough to warrant a dredge has been found. One small, Diesel-powered dredge was erected by a French company eighteen miles below Pato at El Real, but was abandoned after a few months' unprofitable operation.

The gold in the Nechi ground is derived from the concentration by the Nechi itself, and from reconcentration of the local and older bench gravels. The dredging area is formed of a loose, porous gravel, with little clay and soft bedrock. The proximity of the river insures ample, fresh pond water, making ideal dredging conditions. The dredge was started in 1916, but owing to war-time difficulties was not efficiently operated until 1919. With a new dredge master in charge, the 8-cu.ft. boat dug an average of 2,381,882 cu.yd. for the next two years, with a gross yield of over 80,000 oz. of bullion.

The Pato dredge has been operating since 1912. The same type of clay bedrock prevails as at Nechi, but the gravel is of older origin. The gold is a reconcentration of the low-grade bench gravels of the surrounding foothills, containing enough clay so that the banks stand in front of the dredge without caving. Pond water is obtainable only from Pato Creek, and during the dry season is insufficient to wash the clay from the gravel. With buckets of the same capacity as those of the Nechi company, Pato dug 2,993,537 cu.yd. in the same period of time, with a yield of 62,000 oz. of bullion.

Power Shortage Has Curtailed Operations

The yearly running time of the Pato and Nechi dredges has been unusually low, owing to the small storage capacity of the power dam. During the dry season the boats are shut down for weeks at a time, owing to power shortage. In 1920, a timber-and-fill dam was constructed above the other, which is expected to store sufficient water for the operation of both boats through the dry season.

Pato and Nechi are the only large placer mines found to be profitable in the district, although many hundreds of square miles are covered by low-grade auriferous gravel. Practically all of the small gulches and streams have been worked by the Indians and early Spaniards. The gravel foothills extend for seventy miles west, to Caceres, on the Cauca, where unsuccessful drilling was done, but no gravel deposits of commercial importance have yet been found.

Pato Deposits Possibly Derived From Glacial Erosion

The origin of the great gravel deposits of the Pato district are obscure, owing to the dense jungle covering them. It seems reasonable to believe, however, that they were formed by the streams carrying the morainal deposits of the receding glaciers. The Cordillera Central in Tolima shows distinct evidence of glacial erosion, with extensive deposits of morainal gravel forming the foothills of the Magdalena valley. La Nevada Tolima, forty miles northwest of Ibague, is covered by glaciers and perpetual snow to this day.

South of Pato, the topography becomes more rugged, resembling the western slope of the Sierra Nevadas of California, in that the foothills rise gradually, with ridges of uniform elevation, to the main backbone of the cordillera, suggesting a formed peneplain. Outliers of old gravel deposits still exist on the ridges. Natives wash the ridge deposits in rain-pits, and get fair wages in coarse gold. The gravel on many ridges lies 1,000 ft. above the present streams. The smaller gulches of the high table land have been placer-mined from Pato to Santa Rosa on the south, and from Yolombó to San Andres in an east-west direction, an area eighty by fifty miles.

PATO CAMP, COLOMBIA

Although the Nechi below Pato and the Cauca at Caceres have not proved profitable, there are many *vegas* in the intermediate valleys which have been mined long ago, but never been explored by engineers. It is highly probable that other areas suitable for hydraulicking or dredging will be found in this district; but owing to difficult transportation and malarial conditions their exploration will be slow and expensive.

TRACTORS TO BE USED FOR FORTY-FIVE MILE HAUL

La Constancia, a gold-quartz mine owned by the Colombian Corporation, Ltd., and a subsidiary of the Pato company, is situated forty-five miles south of Pato, near the pueblo of Anorí. Present transportation is by mule trail from the head of navigation near Pato. Ten to fourteen days are required for pack trains to make the round trip. The company is now building a sixty-mile road to reduce the cost of importing equipment. Tractors with trailers will be used.

In addition to an 800-kva. hydro-electric plant, the company is planning a 300-ton mill. The secondary crushers are to be Chilean mills, with amalgamation, followed by table concentration. The concentrate is to be roasted, reamalgamated, and cyanided. Whether the table tailings are to be cyanided has not been decided. Roasting of the concentrate is required, because of the large percentage of arsenical sulphide contained.

NEW TIMBER-AND-FILL DAM, PATO MINES, LTD., COLOMBIA

The history of La Constancia dates before 1800, and the mine has been worked more or less continuously ever since, by Colombians. The old open cuts extend, with one break, along the strike for a distance of two miles. In sections the cuts are 50 ft. wide in the bottom, and attain a maximum vertical depth of 150 ft. All ore and waste was removed by hand methods in small native wheelbarrows called *carretas*. Arrastres were used for crushing, the pulp being washed for the free gold and concentrate, and the latter was then reground and panned for its gold held mechanically. It is not known just when the present shaft was started, but in 1898 the mine was reported upon by Señor Tobón. His maps and report show that the shaft was then down 250 ft., and a large body of ore had been taken out at that time. The mine was then owned by Don Pantaleón Sanchez. Señor Tobón found 86,000 tons of ore reserves, from which he anticipated, with a modern stamp mill, a yield of $216,000. Medellín people then took over the mine, and erected a twelve-stamp, individual-mortar mill, with amalgamating tables and, later, Wilfley tables. This mill was still in operation when the mine was taken over by W. A. Prichard for the Colombian Corporation, in 1918, and is now being used as a test mill for development.

MUCH ORE OVERLOOKED BY EARLY OPERATORS

The mine consists of two parallel quartz veins in schist, dipping 65 deg. north. The hanging-wall vein was the richest, and the most easily worked by the Colombians, who were unable to break the harder quartz on the foot-wall vein. The latter attains a width of 20 ft. in places, showing three distinct periods of mineralization. The former operators considered the second zone of mineralization, which was extremely hard, to be the foot wall. Under the management of Mr. Prichard, crosscuts were run into the old "foot wall," and ore was found to exist for additional widths of 15 ft. Occasionally the veins cross, forming orebodies up to 30 ft. wide, of better than average value.

In sampling the lower levels a year ago, a diorite dike between the two veins was noted, which assayed from 0.5 to 1.5 dwt. in gold. Microscopic examination proved that silica, probably gold bearing, permeated the diorite before complete solidification took place. Permeation of the walls by the gold- and pyrite-bearing silica is so extensive that only by the most careful sampling can the limits of the ore and waste be determined. The dike is exceptionally fine-grained for a diorite, and from the fact that it does not penetrate to the surface it is evident that erosion has not been extensive. Persistence of the ore in depth is therefore a conservative conclusion.

The mine has been developed laterally to a distance of more than 1,000 ft. on each side of the shaft, and to a depth of 400 ft., with good ore in all faces.

MACHINE DRILLS TO BE TRIED IN ANORÍ DISTRICT

Labor in the Anorí district is plentiful and of fair quality for hand methods of mining. What the men will do when machine drills are installed is problematical, as the Colombians are not mechanical. The present cost for driving a 5 by 7-ft. drift in ordinary ground, including timbering, is $16 per meter. Miners receive from 70c. to $1 per day, but often make as much as $1.70 per day on contract work. When the new road is completed, all costs will be materially lowered.

There are two other quartz mines in the Anorí district, formerly worked by Colombians. The Arroyave mine, now under option to the Colombian Corporation, is similar in strike, dip, and schistose wall rocks to La Constancia. It also has two parallel veins with a dike of igneous rock between. The former operators went after the rich spots which were easiest to get out, letting the ground cave after them. The company is now driving adits at favorable points along the strike of the vein and expects to develop a second Constancia. The other mine seems to be too small to warrant exploration.

Near the pueblo of Anorí, and ending near the Constanzia mine, are the remains of a Tertiary river channel. Its course is characterized by a large proportion of "bull-quartz" gravel, called *vaca blanca* by the peons. Colombians have mined the channel in eight different pits, in a distance of twelve miles. Some of the larger pits show the removal of several million cubic yards. The channel lies in a high table land, so that the natives had only the storm water and the smaller streams for use in their washing operations.

HYDRAULIC OPERATIONS IN PROGRESS

There are three hydraulic mines in operation on the channel today. The Anorí Mining Co. has been operating a single 3-in. monitor for the last year and a half at a small profit. The 150-ft. bank is said to yield 11c. per cu.yd., at a cost of 5c. per cu.yd. Water shortage is the principal difficulty.

The Pat Dempsey mine, four miles below the Anorí, is shut down most of the time for lack of water.

The San Benigno Mines Co. operates one 3-in. monitor in conjunction with an hydraulic elevator. The gravel, as worked by René Hazzard, averages from 35c. to $2 per cu.yd., but owing to the necessity of having to use nearly all his water for elevating, he is able to wash only about 2,500 cu.yd. per month. New capital is required for driving a grade tunnel 1,000 m. long to carry the tailings to the edge of the Porce gorge.

LA VIBORITA WORKING CHANNEL EAST OF PORCE RIVER

East of San Benigno is a five-mile break in the continuity of the old channel, caused by the Porce River cutting it at right angles by a canyon 4,000 ft. deep. The continuation of the same channel is mined on the east side of the Porce by La Viborita Mining Co. Three 3-in. monitors and one 5-in. monitor are operated against a 65-ft. bank under a 65-ft. head. The company drove a 350-ft. grade tunnel to carry away the tailings some years ago, before determining bedrock. Since that time, test holes have been sunk 90 ft. below the present pit bottom, but no bedrock has yet been found. Despite the fact that the bedrock is not worked, the gravel averages 10c. per cu.yd., and a good profit is being made. All gravel along the old channel, though it has to be well under-cut to cause caving, washes readily and contains few boulders which cannot be moved by hand.

The channel, with its characteristic bull-quartz gravel, can be traced for more than twenty miles beyond La Viborita. It has been mined by natives in a small way, wherever its course is cut by later gulches, but owing to the low topography of the surrounding plateau, large volumes of water are difficult to bring in under a sufficient head.

VEINS IN ANDESITE WORKED BY COLOMBIANS

North of La Viborita and the town of Amalfi, near which it is situated, lies an extensive area of andesite in which there are several mines operated by Colombians. The largest is known locally as La Justicia, but is called by the enterprising owners La Mina Comstock Antioqueña. The series of veins, of which there are four, are walled by graphitic and gray mica schist. The most promising of the veins is cut by gulches along the strike, and has been worked continuously for more than twenty years. Adits have been driven on various exposures for a distance of more than a mile and more than 600 ft. in elevation. Owing to the Colombian practice of tramming ore in small *carretas* holding only 150 lb., when the face of the stope reaches more than 3,000 ft. from the mill either the mill must be moved closer to the face or a new face must be opened nearer the mill.

La Justicia has had five mills, of which but two remain within economical distance of the stopes. The most efficient of the two crushes 250 tons per month through a screen made by punching holes in a five-gallon oil can with a fourpenny nail. The primary crusher is a 14-lb. maul, wielded by a 110-lb. peon. The ore is fed to the battery of ten stamps by a flat, triangular shovel in the hands of the same peon.

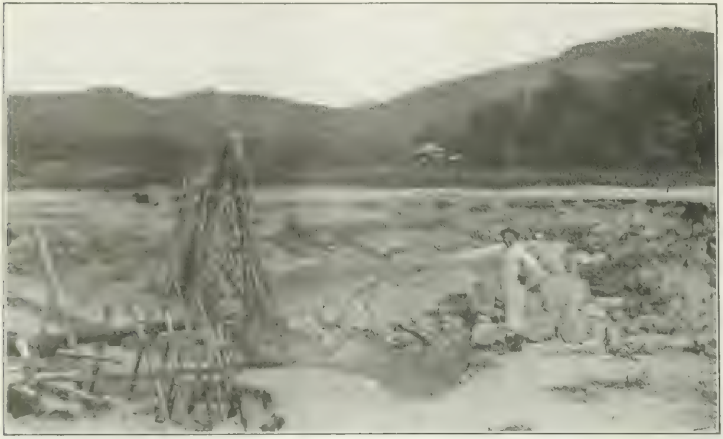
The *pisones*, or stamps, are of exceedingly hard and heavy wood, with cast-iron shoes, weighing about 300 lb. each. The *pisones* are raised by wooden cams and an overshot water wheel. Amalgamation is not practiced. The coarse gold and sulphide is caught in wooden "stops" placed two feet apart in the sluices. The pulp in the "stops" or baffles is kept agitated by a peon with a rake, in order to settle as much of the heavy mineral as possible. Once each day the gold and concentrate is cleaned from the baffles, and separated by the *capitan* in a *batea*. The skill with which the clean-up peon can part the gold from the sulphide is marvelous.

A WEEK'S CLEAN-UP OF SPONGE

GOLD LOST BY CRUDE METHODS

The concentrate, after being parted from the free gold, is then reground in a closed arrastre, repanned for its mechanically held gold, and again reground and panned, after which it is stored. All samples of the stored concentrate taken still assayed more than 100 dwt. per ton. Samples of the tailings below the sluices gave startling results in flour gold, with careful panning. The peon, however, was working for his daily wage of 70c., and was not interested in improvements in his flow sheet. Despite technical shortcomings, the mine yields a small profit.

There are several other smaller mines in the district, but little development has been done on them. Inadequate transportation has been the principal drawback. All supplies must be imported in mule loads limited to



LA CLARA MINE. WILLIS McGUIRE IN FOREGROUND

200 lb., and requiring eight days each way from the Medellín railroad. Fifteen miles of new road would connect the district to launch navigation on the Mata, the largest tributary of the Porce.

VALLEY OF MATA RIVER UNEXPLORED FOR DREDGING

The Mata River drains an extensive basin, once covered by gravel. The climate is said to be particularly unpropitious for white men, although natives work many of the tributaries for placer gold during the dry season. No exploring for dredging areas has ever been done in the valley.

The bed of the Porce River is mined by natives for a distance of seventy miles. In the lower reaches, wing dams are built at the beginning of the dry season, forming back waters in the swift stream. The dam builder then leases areas 30 ft. square to peons, who erect temporary stagings in the water of their area. The men work in partnerships of from three to five. One peon dives to the bottom with a *batea*, fills it with gravel, climbs up a ladder to the staging and empties it into other *bateas*, where the gravel is washed for gold by the other men. Ten feet is the average depth at which the men work, and they are able to remain under water for a full minute. An average recovery of $1.50 per day per man is unusually good. The owner of the dam, from whom the lessees must purchase their food supplies, makes an interesting profit; but he gambles that there will be no floods to wash out his dam.

Forty miles above the confluence of the Mata, the Porce gorge widens near the station of Porcecito, on the Antioqueña railroad. The *vegas* from this point, for a distance of five miles or so, have proved to be unusually rich.

LA CLARA MINE USING NEW TYPE OF ELEVATOR

The most important mine of the district is La Clara, owned by the McGuire brothers. The three brothers were miners in Nevada during the boom days of Tonopah and Goldfield. Eventually Willis McGuire found his way to the placers of the Porce and sent for his brothers. The first work was done above water level, but, finding rich gravel below the river level, the brothers experimented with hydraulic elevators. The standard type of elevators gave unsatisfactory results, so they evolved a new type of nozzle and throat which was far superior. Finally, their first elevator reached bedrock and their dreams were realized. Two machines have now been in continuous operation for nine years. The total production of gold is not available, but during 1921 a yield of $25,000 per month from 30,000 cu-yd. was not unusual.

The exploitation of the La Clara mine involved the moving aside of the Porce River. Levees were thrown up with the elevators, leaving one side of the bed free for mining. Several times the river has broken through, completely covering the elevators and monitors in the pit. But new levees were immediately thrown up with additional machines, and the pits pumped out again. With a 200-ft. effective head of water, the two elevators with 8-in. throats and 10-in. "raiser" pipes can elevate a maximum of 3,000 cu.yd. per day, to a height of 45 ft. The capacity is strongly affected by the quantity of seepage from the river. With the gravel at La Clara, which is unusually free from clay, a levee 25 ft. wide is required to prevent excessive seepage.

With money won from La Clara, the McGuires have developed other properties. El Hormiguero, three miles below the first mine, produces nearly as much bullion, and has reserves for more than six years. Harry McGuire is developing a gold-quartz property in the mountains behind the pueblo of Barbossa, on the Medellín railroad.

From Barbossa to Medellín the flats of the Porce valley are composed of shallow gravel, which was extensively mined by slave labor in early years, but which are said to be of too low value to pay under modern conditions.

GOLD AREAS EXIST ON EAST SIDE OF RANGE

Auriferous gravel areas exist in the valley of the Nare, in the east side of the Cordillera Central from Barbossa. Mackay Smith is successfully operating an elevator plant at La Creadora mine in one of the tributaries. Another mine called La Playarica is operated at a profit by peons with hand labor. There are said to be large areas suitable for dredging, below La Creadora, but no drilling has as yet been attempted.

South of the Nare, on the same side of the cordillera, lies the Rio Miel. The sides of the valley are composed of bench gravel, in which mining was done long ago. Several American parties have prospected the Miel, but although the deposits contained gold, their average value was said to be too low to be of commercial interest.

The Mariquita mining district, in the Department of Tolima, is situated southeast of the Miel. The mines of this district are noted for their production of silver. Although one or two of the mines have been worked by English capital to a depth of more than 1,000 ft., there is little activity about the place now.

The mineral deposits of Tolima were reported on by

John C. F. Randolph in 1889 for the governor of the department. At that time the English silver mines at Mariquita were promising and the whole eastern slope of the cordillera from Mariquita to Ibagué was in the throes of a boom. Many prospects were yielding oxidized ore, rich in silver and gold. Thousands of denouncements were recorded, and two schemes were being promoted to erect smelters, one at Mariquita and the other at Ibagué. Mr. Randolph made a personal inspection of each prospect in all the districts. He found that the rich ore was only in the oxidized zones, already beginning to change at shallow depths. His contract did not call for assays, so he was unable to determine whether the values persisted in the unoxidized zones or not. His report pointed out that transportation over the poor trails was next to impossible, that no steady production of smelting ore was in sight, and no fuel had been developed if there was. Enthusiasm for smelters soon cooled.

The Colombian method of treating the silver-gold ores was by crushing with wooden stamps and saving the free mineral in sluices with riffles, and occasionally quicksilver was used. Iron pyrite, rich in silver and gold, was the principal sulphide, and when the regrinding of the concentrate in an arrastre did not suffice to save the values, the mine was abandoned.

An interesting reconnaissance trip was made into the old La China district, twenty miles north of Ibagué, and abandoned since 1900. The trail was so overgrown that a peon with a machete was required to cut out the brush so that the mules might pass.

A few *fincas* (cane plantations) still exist in La China valley, where shelter for a hammock and peon food can be obtained.

The adits of the old mines, with one exception, were completely caved. The country is composed of diorite, gneiss, and ultra-basic rocks. The topography is steep and densely covered by a scrub growth. There are many siliceous veins, containing silver-gold, galena, sphalerite, and copper minerals, measuring as much as 1 ft. in width at the outcrops. Careful inspection of the dumps of the caved adits yielded fairly representative specimens of the hidden section of the veins. Some of the outcrops assayed from 5 to 20 dwt. in gold and 31 oz. in silver. A selection from one dump assayed 15 dwt. in gold and 122 oz. of silver. Evidence remains of three mills of the wooden-stamp, Antioqueñan type, which apparently gave fair results with the oxidized ore, but failed hopelessly upon the more complex and lower-grade unoxidized material.

La China is representative of the condition of all the districts from Ibagué to Mariquita. Access for examination is difficult, but not impossible. Although most of the openings are caved, careful inspection of the dumps and outcrops should yield sufficient information to determine the advisability of reopening the old adits.

CLIMATE HEALTHFUL IN TOLIMA DISTRICTS

The elevations of the Tolima mining districts vary from 3,000 to 6,000 ft. The climate is free from the fevers of the lowlands, and is particularly pleasant. Water power and timber are available in abundance throughout the cordillera, but the labor supply, though adequate in quantity, is lacking in quality.

Ibagué was once the center of an extensive, small-scale mining district, of which all that remains are the gold placers of the Coello and Anaime streams. The auriferous gravel was formed partly from the reconcentration of the morainal deposits of the region and partly from the erosion of gold-quartz veins in the upper valley of the Anaime River.

Several veins have been mined for gold, but only two, El Recreo and El Porvenir, appear to have any promise. These two veins have been worked for twelve years, with a wooden, ten-stamp mill, yielding approximately $150,000. Faults cut through the graphitic and chloritic schists, causing large displacements of the veins. The development was carried on in a careless manner, and the drifts were permitted to cave, making expensive the acquisition of information for the solution of the faults. Exploration of the ore has been carried to a depth of only 150 ft. Further development in depth would require the installation of pumps, for which capital has not been available.

South of Ibagué there are gravel deposits on the Coello and Saldaña rivers, known to contain gold. Attempts have been made by English capitalists to exploit the deposits by means of hydraulic equipment and dredges. The machinery is now lying abandoned. In the cordillera above the gravel deposits are said to be veins carrying copper minerals, and a deposit of hematite iron ore, but no examinations have been made.

SINKING THE ELEVATORS, LA CLARA MINE

South of Medellín, on the west side of the Cordillera Central, are several gold-quartz mines which have been worked for many years by Colombians. One, near Zancudo, is equipped with seven Antioqueñan mills on the various silver-gold veins of the property. Another, near Aguadas, has been favorably reported on by an American engineer, but the large amount of money required to open the caved workings has thus far deterred foreigners from undertaking development.

South of the Ibagué, on the east, and Manizales, on the west, of the Cordillera Central, little is known of the mineral possibilities, owing to difficulties of transportation.

Colombian mining laws are extremely liberal; so much so that they are detrimental to foreign exploitation. A denouncement consists of three *pertenencias*, measuring 240 by 600 m. each, with vertical side and end lines, measurements following the slopes of the surface. As many denouncements as desired may be made by a single person. Legally, the corner monuments must be inspected by the local recorder, or *alcalde*, with payment of a small fee. In practice, the recorder seldom takes the trouble to do this. Proper registration in the capital of the department gives final possession.

As the laws work out, denouncements are made, some work is done upon the claims, and then they remain idle. A newcomer, wishing to take up the same property, must first ascertain if it has already been denounced. Permanent monuments are seldom erected, so he must have the records searched at the capital. The descriptions, unless based on a rarely made survey, seldom tally with the actual claim. The newcomer must take his chances, if a probable description is not found in the records, of a lawsuit if a rich strike is made. Most of the mineral-bearing land has been denounced at some time or other, and if no previous record can be found it is well to keep in mind that an adverse claimant may turn up at any time.

The best method for a foreigner to employ is to purchase the rights of Colombians, after a careful search of their titles by a competent Colombian lawyer has been made. Lode, placer, and agricultural claims take precedence in the order named. Occasionally claims are found with three owners, the agricultural owner being followed by a placer claimant, and later the lode rights being taken up by a third party. A prior lode claim gives right to all three. Once a clear title is established in Colombia, the owner is singularly safe.

An article on mining in Colombia would scarcely be complete without a few words about the government. The elections have been held regularly, every four years, since the last revolution, in 1903. The party in power has changed several times without recourse to arms. At present a new party, the Liberales, is coming into power. It is composed of the younger generation and the college students in particular. Their tendency is to break away from the Catholic Church and to adopt methods to encourage foreign capital.

An interesting sidelight on Colombian character is the fact that although the larger mining companies must ship their bullion for distances requiring many days on mule back, with only two peons in attendance, but one hold-up has ever been attempted.

The most feasible method for mining exploration in Colombia is to purchase a small going mine for a base of operations. The superintendent of the property should have a capable assistant, whom he could leave in charge for months at a time, while he is away on examination. Months are required to weed out the more unlikely prospects offered, to find faithful legal talent, and to train a reliable crew for exploration work. And this work cannot be done properly from outside the country, or by a newcomer. When the preliminary work can be done while operating a going mine, the excessive cost of prospecting can be kept to a minimum, and large areas can be explored with bright chances for success.

Surface-Tension Measurements

Surface-tension concentration and adsorption curves by two methods have been made by the U. S. Bureau of Mines at Moscow, Idaho, on Burgess Green Camphor and G.N.S. No. 5 oils. Conclusions drawn from these curves are: (1) The film method is better for oils that do not give a steeply dropping surface-tension concentration. (2) Where the surface tension is only slightly lowered by the addition of a substance, the film method has an advantage. (3) For concentrations of from 50 mg. per 100 c.c. of water up, the drop-weight methods have an advantage.

Owens Lake and the California Big Trees

By Gordon Surr

Written for *Engineering and Mining Journal*

OWENS LAKE, which is in Inyo County, Cal., is of great interest in many respects, and it is believed that the age of the older Big Trees, or Sequoias, of the Sierra Nevada Mountains may correspond closely with the time that has passed since Owens Lake ceased to overflow, being another instance, on a grand scale, of the application of botany to geology.

In August, 1921, I visited Owens Lake and was informed that a ton of the water then yielded, upon evaporation, up to 600 lb. of salts, which puts the lake on a par with the Dead Sea in concentration of salts. Careful surveys of the lake and of Owens River were made previous to the building of the Los Angeles aqueduct, which takes water from the river above the lake. Since the building of this aqueduct the lake has shrunk much; in fact, soda is said to have crystallized out spontaneously (probably largely as trona, a hydrous carbonate and bicarbonate of soda). The recovery of sodium carbonate from Owens Lake water has long been an industry on the lake shore.

In a bulletin of the U. S. Geological Survey, by H. S. Gale, on "The Salines of the Owens, Searles, and Panamint Basins," the movements of the waters are discussed. It seems that Owens Lake formerly overflowed into Searles Lake, which, in turn, overflowed into the Panamint basin, the Panamint Lake probably overflowing into Death Valley. The potash and other salts in the bed of Searles Lake were mainly contributed by the overflow from Owens Lake, the silt and suspended matter having apparently settled out to a large extent in a former shallow lake in Indian Wells Valley, between the Owens and Searles basins. Basing his calculations upon the amount of chlorine now in Owens Lake, and the quantity annually contributed by Owens River, Mr. Gale estimates that the lake ceased to overflow about 4,000 years ago.

In all probability, Owens Lake stopped overflowing after the glaciers of the Sierra Nevada and Inyo Range had largely melted, thus cutting down the supply of water from the melting ice. The melting of the ice signified a milder climate, and conditions became more favorable to vegetation. An impressive feature in the high Sierras is the freshness of much of the glacial work; in fact, the remains of some of the glaciers are still in existence, one, in the neighborhood of Mount Whitney, being the most southerly glacial remnant in the United States. Counts of the annual growth rings show that some of the big Sequoias, still living, are 4,000 years old, and it seems highly probable that these giant trees began to grow soon after the melting of the ice. The Sequoias grow at elevations of between 5,000 and 8,500 ft. above sea level, and are not, therefore, trees of the Alpine zone, but they can nevertheless endure low temperatures. In any event, Mr. Gale's estimate of the time that has elapsed since Owens Lake overflowed and the age of the ancient Sequoias correspond closely. Finally, it is of great interest to note that practically no visible change has occurred in the surface of the land upon which many Sequoias stand during all the years of their long lives, showing that time here is by no means "of the essence" in earth sculpture.

The Power-Load Curves of Ball Mills

A Simple Laboratory Apparatus for Experimental Work Described Power Varies Directly With the Charge, Up to Half Load, Reaching Maximum at 60 to 75 Per Cent of Mill Capacity Some Conflict With Davis' Formulae

BY A. O. GATES
Mining Mechanical Engineer, Salt Lake City, Utah

Written for *Engineering and Mining Journal*

MILLMEN GENERALLY WILL AGREE that the more power a mill can be made to take the more tons of ore it will grind, other things being equal. Of course, it is all a matter of getting the other things to be equal and to remain equal, which is not always easy or possible of accomplishment. In recent years surprising increases have been made in capacities of crushing machines; rolls, Chileans, and ball and pebble mills all show remarkable increases due to manipulation of the feed, sufficient power being available. I have no intention of discussing matters of tonnage in this short article, but wish to indicate something of the variation of power with variation of speed, diameter, and ball or pebble load. This data should apply to rod mills as well.

The mechanics of the ball and pebble mill are simpler than for any other type of crushing machines; the power-consuming elements may be divided into two types capable of rather simple treatment. In crushers, rolls, roller types (Huntingtons, Chileans, and a multitude of variations), the differences in the crushing resistance of the mass being crushed affect the friction load in a variable and rather uncertain degree. In some types of crushing machines it will be conceded that high resistance against crushing, frequently or regularly, squeezes the lubricant from the bearings so that there is metal-to-metal contact at times; and this is a condition extremely difficult, if not impossible, of mathematical analysis.

I hold no brief for any purely theoretical school of reasoning; but if the application of theory will make it check with what experience has shown to be good practice, wider fields of application will be open. It is well to be able to predetermine some things about crushing machines, and about the only way this can be done is by the use of formulæ obtained by theoretical reasoning held in check by the results of practical work. A theory always ought to be checked against practice.

POWER CONSUMED IN TWO WAYS

Power is consumed by ball and pebble mills as (a) friction losses in bearings and gearing, and (b) energy spent upon the free balls or pebbles within the mill, and by them spent upon the ore, or other pebbles, or on the lining, or returned to the mill.

The variations in thickness of oil films in the bearings differ only slightly from no load to full load, and, except possibly in the main bearings, they are nearly constant for constant speed. Experience with steam engines under all load conditions has shown that, for constant speed, the friction loss is nearly constant at all loads; any statement by an engine manufacturer as to the mechanical efficiency of his engine at different loads will be based upon this fact. As the weight of the combined charge in ball mills is usually less than that of the mill parts carried by the trunnions, in the absence of specific data to the contrary one cannot be far afield in assuming that the friction load of these mills is practically constant for all loads at constant speed. There remains, then, the internal power consumption to be considered.

Some years ago in casting about for a method of studying the action in pebble mills without great outlay for apparatus it was found that some quantitative results of reasonable accuracy could be obtained from apparatus which at first was intended only for superficial and qualitative work. The average man without a laboratory at his disposal finds that to do experimental work in which variations in speeds are necessary a lot of pulleys are required, or a variable-speed motor is essential, and many difficulties are encountered which detract from the enjoyment, if not the accuracy, of the work. My apparatus eliminated all outside difficulties, as well as the friction in the driving mechanism, and I was able to measure power relatively, if not actually, in an entirely satisfactory way.

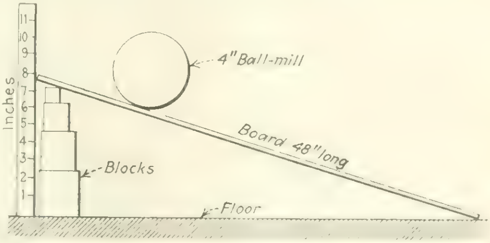


FIG. 1 ARRANGEMENT FOR ROTATING EXPERIMENTAL BALL MILL

The ball mill itself was 4 in. in diameter and about 3 in. wide. It was made of a marshmallow box, the glass from a small picture frame, and a sack of marbles. With a can opener, one side of the box was cut out and the glass inserted, through which the action could be studied. The power plant consisted of a straight plank 4 ft. long; and the auxiliary apparatus comprised a ruler and a watch with a second-hand. The general plan of this apparatus is shown in Fig. 1. The most interesting thing about the device, and one which made quantitative measurements possible, was the fact that when the mill was partly loaded with balls, and the power plant was tilted up to make the balls roll over, cascade or throw over as in practical mills, the mill rolled down hill *at a constant speed* at which no variation in internal movements could be discerned. With the mill running down hill at a constant speed, the speed conditions of a practical mill are present, and it can easily be shown that with constant speed on a constant incline the power is constant, as in practical machines.

If the mill were empty, or were entirely filled with balls, or if the power plant were tipped up so that the speed increased to the extent of making the balls cling to the periphery, the mill rolled down hill at an accelerating speed, which of course was useless for power comparisons.

The matter of determining whether the speed was constant in such a simple apparatus may perhaps be questioned. Determinations were made by sound, character of the falling stream of balls at different points, and a little appreciation that certain laws of mechanics which will not be stated here would apply. The appearance of the falling stream of balls was obtained by taking a definite position opposite the path of the rolling cylinder and winking the eyes as it passed, getting about the same image one would get by a similar procedure opposite a mill rotating on a fixed axis.

Of course great accuracy and absolute assurance of constant speed could have been obtained by using a board or incline of considerable length for the power plant and with two or more observers, but the results came out in such a satisfactory manner that a more elaborate test seemed of little importance at the time.

Nothing new was found to add to that which has already been published with regard to the way in which the balls distribute themselves in falling. At slower speeds they rolled down over each other; at higher speeds they threw over, and at still higher speeds they clung to the rim, all of which is in accordance with the laws of mechanics.

In these tests it was usually necessary to start the mill with a shove. Record was kept of the height of one end of the 4-ft. plank, of the number of balls (marbles) in the mill, and the time taken to roll the four feet down the incline. To make the work easier, the end of the board was adjusted to make the time a fixed quantity, and five observations under each condition were made and averaged. The relative power was proportional to $\frac{hM}{t}$, in which;

h = height one end of plank was raised above other,
M = number of marbles in mill (all of same size), and
t = time in seconds to roll four feet at constant speed.

The critical speed for the rim of this mill (such that centrifugal force equals gravity) is about 2.2 revolutions per second, or about 131 r.p.m. Its circumference is 13 in.; it would travel down the four feet in 1.55 seconds at the critical speed of the rim, if at constant speed; as indicated before, this could not be determined experimentally. As the marbles had a diameter of about ½ in., the effective critical diameter was ½ in. less than the nominal diameter, so that the critical speed was somewhat nearer to one that would make it travel the four feet in almost two seconds.

Fig. 2 shows the relative power-load curves for this little mill, with times which approximate those of the speeds in practice. Consistent curves were obtained, and they indicate interesting results, most of which, it must be admitted, have been determined by operators by testing large mills (at considerable expense, even if it were worth it, which I do not deny).

The power is maximum with a load between 60 and 75 per cent of the mill capacity, apparently depending slightly upon the speed at which the mill is run. Hardly enough data are available, however, to warrant the statement that at higher speeds somewhat heavier pebble loads may be carried for maximum capacity. With loads used in practice the power consumed is a direct function of the ball load. (Note how all the curves, if extended, apparently would pass through the zero of the diagram.) For a given mill, the power consumed increases a little more rapidly than directly proportional to the speed. Of course, as the pebbles begin to cling to the rim when the critical speed is exceeded, it is to be expected that the power consumption would decrease. The apparatus used could hardly determine that point, which, after all, is of minor importance, practically.

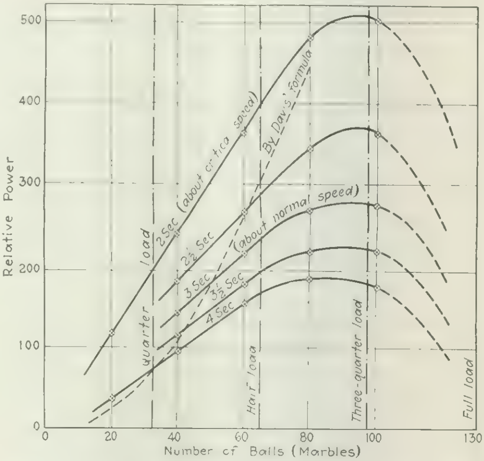


FIG. 2. POWER-LOAD CURVES FOR A CYLINDRICAL MILL

Various Speeds. Bearing Friction Eliminated. Dry Conditions. Ball Load Only

The data show that up to above half load, the power varies directly as the ball charge; in Davis' paper (*Trans.* A. I. M. E., Vol. 61) he derives some mathematical formulæ for the power and shows that it increases much more rapidly than is proportional to the ball charge. One of the values in his table given below (Table I) is plotted dotted on Fig. 2. There appears to be a marked discrepancy.

TABLE I HORSEPOWER REQUIRED PER FOOT OF MILL LENGTH

Internal Diameter of Mill	—— Portion of Mill Volume Occupied by Charge ——					
Feet	0 1	0 2	0 3	0 4	0 5	0 6
1	0 0023	0 0099	0 022	0 042	0 065	0 093
2	0 0255	0 110	0 254	0 46	0 73	1 04
3	0 1087	0 463	1 07	1 94	3 07	4 38
4	0 288	1 24	2 87	5 22	8 25	11 78
5	0 64	2 72	6 29	11 43	18 07	25 74
6	1 20	5 16	11 88	21 47	34 14	48 69
7	2 06	8 85	20 43	37 06	58 61	83 53
8	3 26	14 12	32 54	59 08	93 46	133 32
9	4 96	21 32	49 09	89 31	141 24	201 33
10	7 13	30 81	71 06	129 00	204 07	291 10

For most efficient calculated speed, charge weighing 325 lb per cu ft
(The above is Table 16 in Davis' article referred to in the text)

Davis' formula for horsepower, which can best be understood from his paper already referred to, is of form hp.$=Wr^{\frac{2}{3}}$ times the summation of A, B, and C, in which W is the weight of ball charge, r is the radius of the mill, and A, B, and C are constants depending upon functions of the ratios of diameters of the charges. Now, for a given ratio of ball charge to mill volume, W per foot of length varies as r^2, so that for constant ratio of load to mill volume, hp. $= r^{\frac{7}{3}}$ times a constant.

About the time I made the ball-mill studies I also determined a formula for the horsepower of a ball mill, deriving it as follows:

Weight of balls per foot of length = r^2 times a constant; height of ball rise in mill = r times a constant; speed of rotation of mill = constant divided by $\sqrt{r}$.

This will check with Davis' derivation, as well as with a number of others. All other conditions being constant, the product of these three factors is a measure of the horsepower absorbed by the mill in raising the balls, thus:

hp. = $r^{\frac{5}{2}}$ times a constant.

There is also another formula (?) for the horsepower of a ball mill, and it probably is the best of the lot: that of the manufacturers who have built a number of these mills. This formula is based on one big guess, plenty of grief, and a caution, or play-it-safe, factor. For the power consumption of commercial mills, where it can be measured with wattmeters by operators who are on the lookout for betterments and perhaps for come-backs at the manufacturer, the manufacturer's tables are likely to be close to the correct values. In Table II are given the power requirements of mills of various diameters, one foot long, by Davis' formula, by the five-halves formula, and the actual horsepowers from manufacturers' catalogs, each column being for the length of mill for which the most data were available. No apologies are offered to other manufacturers; the catalogs of the two named happened to he handiest, and they are about representative figures.

TABLE II. RELATIVE POWERS

1	2	3	4	5	6	7
	Theoretical H P per Foot of Length		From Catalogs of Manufacturers			Horsepower
Diameter of Mill in Feet	Davis' Formula	Five-Halves Formula	10 Ft Long A. C. Pebble	5 Ft. Long A. C. Ball	5 Ft. Long A. C. Ball Pebble	22 In. Long Hardinge Ball
1	1	1	..	...	..	.
2	11	5.7	.	. .		
3	47	15.6		15	15	
4	126	32	19	.	26	
5	278	56	28	50	45	30
6	524	88	43	80	71	50
7	900	129	63	110		75
8	1,240	181	83	150		110
9	1,870	243		.		
10	2,700	317		.		

The difference between the two formulæ are particularly noticeable in the table as the diameters increase. In the manufacturers' tables there is agreement in the upper part of columns 5 and 6; column 4 has values throughout a little over half the values in column 5. Column 7 appears to increase more rapidly with diameter than do the others, and this may be explained by the characteristics of the mill. For columns 4, 5, and 6, the formula has the form: hp. = $r^{2 \text{ to } 2.25}$ times a constant. For column 7: hp. = $r^{2.75}$ times a constant.

If, in using the horsepower values of columns 5 and 6, the diameter be reduced by six inches to get the true mill diameter, and this value used in the horsepower formula, the following will show the relation: hp. = r^5 times a constant. This checks with my calculated formula.

Here are several formula for the horsepower of a ball mill, in which the effect of one factor varies to a considerable extent. The manufacturers' tables check more closely with my five-halves formula, and of course I am inclined to think, that it is ppproximately correct. But any one who runs through the mathematics whereby Davis derives his formula will believe *it* to be correct. Apparently there is no error, unless in assumptions as to the use of the energy inside the mill.

Davis bases his expression for horsepower upon the kinetic energy of the balls as they strike the side of the mill or the other pebbles at the end of their fall through the mill; I base mine upon the energy required to lift them to the point from which they start upon their free course through the mill. There cannot be much difference between these two assumptions. One method is a somewhat practical way of determining the power, and it checks with practical experiences; the other is a purely mathematical process, and looks logical throughout; but it does not check with experience, or at least it does not appear to do so.

It should be noted that in the experimental tests and in all the mathematical work outlined no consideration was given to the fact that in an operating mill there would be rock and probably water, in addition to the balls; however, there appears to be nothing in either the rock or the water that would not conform to the same theory as outlined for the balls.

Now, having taken the gentle reader out into the wilderness (at least those who were willing to come this far), let me tell him that we are lost; that I don't know which of the two roads leads out and that if he gets out safely, please to send someone back for me.

The Fluorspar Industry in 1921

The fluorspar shipped from mines in the United States in 1921, according to the U. S. Geological Survey, amounted to approximately 35,600 tons, valued at $708,000, a decrease of 81 per cent in quantity and of 85 per cent in value as compared with 1920.

The general average selling price per ton f.o.b. cars at shipping points for all grades of fluorspar in 1921 is estimated at $19.89, which is $5.37 less than the average price in 1920. Total shipments in 1921 were the lowest recorded for any year since 1908. Shipments from Kentucky exceeded those of Illinois for the first time since 1904.

The stagnation in the fluorspar industry in 1921 was due principally to the curtailment of operations in the industries that consume fluorspar, although even if reasonable activity had prevailed the demand would have been small, because the aggregate stocks in the hands of users on Jan. 1, 1921, were the largest that had ever accumulated—sufficient to meet normal requirements for about six months.

The imports of fluorspar into the United States in 1921 showed a decrease of 75 per cent in quantity and 74 per cent in total value as compared with 1920. The value at the foreign ports of the shipments made to the United States in 1921 averaged $11.13 a ton, a slight increase over that in 1920.

Zinc Milling Experiments of the Bureau of Mines

In the study of the milling problems of the Missouri-Kansas-Oklahoma lead and zinc district being conducted at the Mississippi Valley Experiment Station of the U. S. Bureau of Mines, at Rolla, Mo., experimental work has been done to ascertain if rougher jig tailings, after being given a tumbling in a ball mill, would not be more amenable to jigging on a chat jig. These tests indicated that ball milling would make possible a tailing 0.50 per cent lower in zinc than otherwise could be obtained, and that ball milling should increase profits. Laboratory work at the same station on the milling problems of Hancock County, Tenn., zinc ores is practically completed. These were found to contain barite.

Platinum in Quartz Veins

Occurrences Noted in California, Brazil, British Columbia, New Zealand, Ural Mountains, and Colombia, in Association With Other Minerals—Amounts Are Usually Small, but Often Recoverable as Byproducts

By Henry W. Turner
Written for Engineering and Mining Journal

PLATINUM occurs chiefly in ultra-basic igneous rocks, and nearly all of the commercially valuable deposits are detrital deposits deriving their platinum contents from this source. Nevertheless, original platinum deposits, sometimes of commercial value where associated with other metals, are found even in quartz veins. Such is an occurrence in a narrow gold-silver vein in the West Point mining district in California.

The West Point area is situated in Calaveras County (see Jackson and Big Trees sheets of the U. S. Geological Survey) just south of the Mokelumne River. The country rock is granodiorite cut by greenstone dikes, and the numerous quartz veins contain gold as their valuable constituent, usually with much pyrrhotite and lesser amounts of pyrite and chalcopyrite.

Quartz Veins in Diorite Show Platinum

In recent years a number of claims have been under exploitation by J. B. Stapler; among others the Keltz group, situated northeast of the village of West Point. The country rock of the Keltz claims is chiefly a basic diorite, a facies of granodiorite into which it merges. The diorite is cut by greenstone dikes, and in some of the diorite molybdenite and tourmaline were noted. There are several quartz veins in the claims, one of which at the time of my visit, in 1920, was opened up to the depth of about forty feet by a shaft, known as the New shaft. Three small shipments of ore had been made from this shaft, averaging about $156 per ton in gold and silver. The ore of one shipment contained 0.11 oz. per ton in platinum. A sample of the ore from this shaft which I took showed on assay a content of 10 oz. gold and 7 oz. silver per ton, no test for platinum being made. These figures are given to show the metal associates of the platinum. There is no serpentine or peridotite or other ultra-basic igneous rock near the New shaft. Two other veins in the same district, also in granodiorite or diorite, are said to contain platinum, namely the Zacateria and the Star of the West.

Occurrences in Brazil Quartz

Prof. C. F. Hartt, in his "Geology and Physical Geography of Brazil" (page 448) quotes E. Williamson as recording the occurrence of platinum in quartz veins in Parahyba Province. The country rock consists of schists and gneisses of presumably pre-Cambrian age, with lenticular veins of a semi-opaque white quartz, usually lying parallel to the strike of the inclosing schistose series. These veins in general contain native gold, with sulphides and arsenides of iron and sulphides of copper, lead, and zinc. In addition, in the Boa Esperanca veins grains of platinum are found.

About 1826, Boussingault[1] investigated an area of syenitic rocks at Santa Rosa about thirty miles northeast of Medellín, in Colombia. In this area there are numerous quartz veins with gossan outcrops, and in some of this gossan Boussingault found platinum. He also states that the syenitic area extends into the Choco district; but it is now known that there are ultra-basic rocks in the Choco district, and these basic rocks are probably the source of the platinum now being mined there.

Evidence of Platinum in American Deposits

In his bulletin on platinum (1902), Prof. J. F. Kemp in a footnote states that "since this paper was written, the writer, with David T. Day and A. W. Johnston, has accumulated proof of the presence of platinum in pyrite and in quartz veins from several American localities. The notes are in preparation for publication." However, these notes do not appear to have been published, and it is to be hoped that Professor Kemp will yet place the facts on record.

In 1904, Brock[3] records the presence of platinum in a quartz vein carrying about $3 per ton in gold, at Burnt Basin, three miles west of Coryell, in the Grand Forks mining division, Yale district, British Columbia. The vein (mother lode) is in a greenstone formation between two porphyry dikes and contains pyrite, chalcopyrite, galena, and sphalerite with a little molybdenite. Assays showed a content of 0.06 to 0.1 oz. of platinum per ton.

O'Neill,[3] in his paper on "Platinum in Canada," mentions platinum as occurring in a quartz vein (Cable claim) in granodiorite in the Ainsworth mining division, British Columbia, and in the Union mine, in the Grand Forks division, British Columbia, in quartz veins containing also lead, gold, and silver.

Pond[4] records the occurrence of platinum in a quartz vein in the Thames gold fields of New Zealand.

In 1905, Bell[5] discovered platinum in quartz veins in the South Island of New Zealand, and describes the occurrence as follows: "During the past season a number of platiniferous quartz veins were discovered by the writer near the Teremakau River, in the district of Westland, in the South Island, in close proximity to sheets of altered magnesian eruptives—apparently originally dunite and situated parallel to the stratification of the inclosing phyllites. The quartz is somewhat vitreous, and in general very 'hungry' looking in appearance. Iron pyrite is fairly common and iron oxides derived from its alteration. In three analyses made of the platiniferous quartz, the platinum was found to occur associated with silver. The following is a characteristic result showing the amount of platinum and silver: Platinum, 0.0 oz., 3 dwt., 8 gr. per ton. Silver, 1.0 oz., 4 dwt., 9 gr. per ton. Many analyses made of the magnesian eruptives failed to show any platinum existing in them."

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[1] U. S. Geological Survey Bulletin, No. 193, p. 64, 1902.

[2] *Engineering and Mining Journal*, Feb. 18, 1904.

[3] *Summary Report*, 1918, Part G, Geological Survey of Canada, p. 8G.

[4] *Transactions* New Zealand Institute, Vol. 15 (1883), p. 419.

[5] James Mackentosh Bell, *Economic Geology*, Vol. 1, 1905, p. 749.

De Launay[6] states that platinum is found in the gold-quartz veins of the Beresevsk district in the Ural Mountains, and Lindgren[7] mentions a similar occurrence in northern Finland.

Platinum has been found in numerous epigenetic deposits other than the quartz veins here referred to. It appears, therefore, that though the larger part of the platinum of commerce comes from basic igneous rocks of which it is an original magmatic constituent, its occurrence as an epigenetic metal is not at all uncommon, and where associated with other valuable metals it can often be recovered as a byproduct.

The Zonal Theory of Ore Deposition

By J. E. Spurr

Written for Engineering and Mining Journal

THE ZONAL THEORY of ore deposition was proposed by me in 1907[1] as follows:

"I now submit further that there are results from the consolidation of the pegmatites and the pegmatitic quartz veins, practically all the accumulated water in the magma. . . . I submit that from such a residual magma quartz veins of later origin than the quartz veins closely allied to pegmatites are deposited, and that in them valuable metallic minerals are deposited; that from these veins a further residue results, still fluid under such conditions, but subject to partial consolidation (or, to phrase it differently, precipitation) at a later period, under different conditions, involving chiefly a lowering of temperature; and that many successive stages of precipitation follow. . . . The successive stages, according to the theory I present, are marked by differences of earthy minerals, but more delicately, perhaps, by changes in the metallic minerals. . . . This is the origin of most mineral veins and other forms of ore deposits, including ores of lead, zinc copper, silver, gold, bismuth, antimony, arsenic, and other metals. . . . Thus, while pegmatites and pegmatitic quartz veins usually occur in or very close to the earlier-consolidated rocks, the successive stages migrate further and further away from the metallic hearth (the zone of differentiation); which, in general, means that they are successively deposited nearer and nearer the surface. Thus the successive stages can be recognized as successive vertical zones of ore deposition."

These zones were defined as follows; 1, The pegmatite zone, including tin, tungsten, molybdenum, and like minerals; 2, the free-gold auriferous pyrite zone; 3, the cupriferous pyrite zone; 4, the galena-blende zone; 5, the rich silver-gold zone, and 6, the zone of earthy gangues.

"Within the zones which have been defined, of course, precipitation is not continuous, but is influenced by local conditions; so that there may result in a vertical section orebodies or zones of deposition separated from one another by barren intervening spaces. Yet in many veins the passage of one zone into a lower one is indicated with increasing depth, such as the change from the silver-gold zone to the lead-zinc zone. . . . An especially valuable record is afforded along certain fissure zones which have been repeatedly cemented and reopened during the mineralization period. Since such a mineralization period is usually of considerable duration, at any given point the ascending waters will grow cooler and cooler, with the downward progress of the cooling of the parent magma, and the consequent sinking of the metallic source; thus the successive zones of mineralization will migrate downward, and successive cementations of successive openings at a single horizon will show the superposition of one zone upon another originally distinctly lower. . . . Summing up, this theory proposes that metalliferous fluids, from which most ore deposits are precipitated, are extreme differentiation phases of rock magmas; that most ore deposits and 'mineral veins,' as a class, represent one or the other of the extreme products of magmatic differentiation; and that the most striking chemical difference between ore deposits is due (in the more important class representing the siliceous extreme) to successive precipitation in theoretically vertical zones, as the fluid migrates toward the surface, and with diminishing heat achieves more and more mature crystallization."

In 1912, I proposed a slightly modified column[2], as follows: 1, The pegmatite zone, including tin, tungsten, molybdenum, and like minerals; 2, the free-gold auriferous pyrite zone; 3, the cupriferous pyrite zone; 4, argentiferous pyrite and auriferous arsenopyrite zone; 5, blende zone; 6, galena zone, and 7, the rich silver-gold zone.

This theory postulated an original magmatic solution containing within it all the metals represented in the whole vein sequence above, which were successively precipitated as the solutions moved further and further away from their point of origin and as temperature-pressure conditions grew less.

There have been various observations in different parts of the world that have strengthened the probability of this theory. For example, Lindgren observed in 1915 in regard to the ore deposits of Tintic, which are genetically connected with a monzonite intrusion, that gold and copper occur near the monzonite, lead and silver mainly further away[3]. This change is more marked in the field in a horizontal section than it is in a vertical section. The change of the character of mineralization in veins as the distance from a monzonitic contact increased had also been shown in Utah by Butler. In Cornwall, there is copper in the upper part of lodes which in depth carry only tin.

Recently, Prof. J. F. Kemp[4] has cited the studies made by Sales, Billingsley, and Grimes at Butte, which show vertical transitions from gold quartz to silver and silver lead below, then still further below to increasing zinc, and still further down into cupriferous pyrites. Professor Kemp also cites from his own experience the case of Carr Fork, in Bingham Canyon, near the Utah Copper Co.'s property. Nearest the intrusive monzonite the ores consist almost entirely of copper (carrying silver). Further out, copper fails, and galena and zinc blende takes its place. "The lead and zinc sulphides remained in solution to lower temperatures and pressures."

"We would infer, furthermore, that as the igneous masses reached lower and lower temperatures, the physical conditions near the intrusives were in the closing stages similar to those which had prevailed at a distance in earlier maximum stages of ore deposition."

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[6] "Traité des Gîtes Minéraux et Metallifères," Vol. 2, p. 999.

[7] W. Lindgren, "Mineral Deposits," first edition, p. 746.

[1] *Economic Geology*, Vol. 2, No. 8, December, 1907; pp. 781-795.

[2] *Economic Geology*, Vol. 7, No. 5, August, 1912; p. 489.

[3] *Economic Geology*, Vol. 10; p. 228

[4] *Economic Geology*, Vol. 16, No. 7, November, 1921; p. 475.

Operations in the Cariboo, British Columbia

Prospectors and Operators More Active Interest Shown in Dredging Ground of District Numerous Hydraulic Projects Under Way —Work Of Perkin's Gulch Mining Co. May Demonstrate New Channel System

By DONALD D. FRASER

Written for Engineering and Mining Journal

MORE ACTIVITY was visible in the Cariboo district of British Columbia in 1921 than in any other year since the beginning of the World War. The general decline of prices, together with the prevailing unemployment, has offered a greater incentive to the prospector. For the last five or six years practically no prospecting has been done, but last fall a large number of men started prospecting on the various creeks.

Reports of strikes are continually coming in. Probably the most important one of the year was on Cedar Creek, in the Quesnel Forks country. This stream is supposed to have been the first creek worked in the district. In 1862, it is said, about $20,000 was recovered from a small area. Although it has been well prospected, little was found until a strike was made last fall on a bench about 500 ft. above the creek bed.

An interesting fact is to be noted in this discovery. The gold was coarse and was lying on the bedrock. The material covering the bedrock carried no "wash," but was composed of fine sediment and crushed bedrock. The general rule in the district is to find 1 to 20 ft. of wash on the bedrock. Advocates of the chemical deposition of placer gold claim this strike as an argument in their favor. The ground lies low and is from 8 to 30 ft. deep. The presence of water makes it unfavorable for the small operator. A Vancouver syndicate, organized by Captain E. Crowe Swords, and known as the Cariboo Gold Syndicate, has secured six leases, and it claims to have interested a California dredging company in the proposition. This syndicate is said to have about 5,000,000 cu.yd. carrying about 50c. in gold which is both coarse and flaky.

HYDRAULIC OPERATORS ACTIVE

The Cariboo syndicate has secured a lease on the ground held by the Roses Gulch Mining Co., Ltd., and has built about two miles of ditch to bring in water for hydraulic mining. This ground is supposed to be an old channel of the Quesnel River.

The new Cariboo Goldfields, Ltd., has secured several leases on the Clearwater and installed a new hydraulic plant. The company will work an old channel buried about 175 ft. deep. The reported values are about 65c. a cu.yd. in coarse gold.

On a bench of Slough Creek near the Catch, McDougall and Houser are opening an hydraulic pit on what is claimed to be an old channel of Burns Creek. The ground worked was commercially profitable, and should it prove to be an old channel, as supposed, it would pay well if worked by hydraulic mining. A 50-ft. dump could be had with a short flume throughout the whole distance.

Mosquito Creek and Lowhee Creek, belonging to John Hopp, were worked as usual throughout 1921, and it is claimed with fair returns. The same can be said of the Point ground, on Slough Creek, a large hydraulic mine held by Chinese interests of Vancouver.

The New Waverly Hydraulic Mining Co. continued its pit in 1921, making good headway. Several years ago this company secured considerable ground on Grouse Creek, which had been worked in a small way, yielding good results. The new company is undertaking to open the old channel at its mouth. It has a well-equipped plant, and is using a No. 6 and a No. 3 monitor under a 200-ft. head. During the two and one-half years it has operated, it has moved over 600,000 cu.yd. of material, much of which has been a hard clay, which has required considerable powder for blasting operations. As soon as the old channel is reached the property should be one of the largest producers of the district.

PERKIN'S GULCH COMPANY OPENING OLD CHANNEL

The Perkin's Gulch Mining Co. has opened, in a new pit near the mouth of its creek, what appears to be an old channel of Lightning Creek. This ground lies in the middle of the stretch of Lightning Creek, about 10,000 ft. long, which is credited with a production of $13,000,000. The progress of this work is watched with interest, for if it proves to be an old channel it may add another channel system to the systems now recognized. On Lightning Creek, as elsewhere in the district, there are three recognized channel systems. There is a high channel, which is the oldest. Remnants of this are found above the present drainage system.

Through a tilting of the upper country or through the lowering of the streams in the lowlands, the channels were next cut deep below the level of the high channel. Much of the gold was reconcentrated into the deep ground. This low channel was in turn buried fairly deep and marks the present level of the creeks. The channel opened at Perkin's Gulch lies between the present stream gradient and the gradient of the old high channel.

The work being done on the old La Fontaine ground, about two miles downstream, appears to be based on similar reasoning. Some years ago English capital worked this ground. The channel then followed lay about 150 ft. below the creek bed. The operators recovered about $50,000, but finally gave up the undertaking. The ground has been secured by others, who at present are financing drilling operations which are being conducted by the provincial government. It is claimed by the promoters that the old workings were not in the deep channel and the drilling is to prove or disprove this theory.

The Kitchener mine, on Keithley Creek, financed by Philadelphia capital, has completed its water system and has piped off the ground to the head of the drifted ground. Next season it should be in good pay.

Considerable interest has been shown in the dredging ground of the district. J. B. Tyrrell and others have examined the deltas of Keithley, Harvey and Duck creeks, all on Cariboo Lake, for English capital. A California company has drilled dredging ground which it holds on the Lower Cottonwood River. The results are not known. On the Upper Cottonwood and the Lower Swift, a number of dredging leases have been staked. It is said that the Pat Burns interests are to drill the dredging ground which they control on the Quesnel River.

The completion of the Great Eastern Railroad to Quesnel has greatly facilitated the transportation problem of the district. Heavy freight can now be landed in Quesnel by the railroad, which is within easy hauling distance of the gold belt.

AN ENTERPRISE OF ANOTHER SORT

On Lower Lightning Creek there is a property controlled by the Lightning Creek Gold Gravels & Drainage Co., around which appear to be numerous satellites, among them the Standard Finance Co., the Great Cariboo Gold Co., and the Mines Operating Co. It is rather difficult to determine just the function of these various companies, for they have all come into being through the financing of one piece of ground. The first-named company was organized in 1896 for $3,000,000 in $5 shares. Through a private act, the company holds twenty miles of the Lower Lightning, about 2,040 acres. Those in control claim to have spent $1,400,000 on development and equipment. On the ground is an elaborate collection of machinery, together with all the necessary buildings. At various times during the life of the company some money has been spent in shaft work. One shaft was lost while attempting to break out into the channel; others were lost in sinking. The mining work done has been negligible.

Operations have been managed from New York by Charles H. Unverzagt, who has control of the company. The minority stockholders of the company have been fighting him for some time, and have finally succeeded in having the property placed in the hands of a receiver.

Applying the Cementation Process to a Stamp-Battery Foundation

The following notes on a novel application of the cementation process to a battery foundation were contributed by B. Schlesinger at a recent meeting of the Chemical, Metallurgical and Mining Society of South Africa, and have been published in the *South African Mining and Engineering Journal:*

When starting up a new stamp battery in the Heidelberg district it was found after forty-eight hours' work that the foundation, and with it the whole of the superimposed construction, began to rock so dangerously that operations had to be suspended. An inspection pit was sunk to the underlying shale foot, and by washing the face of the concrete block so exposed, it was found that a thin horizontal crack had developed, completely severing the top three feet from the lower nine-foot portion of the block. The cause of the mishap was badly prepared and badly stamped concrete. Stones the size of a man's fist were seen lying loose in large cavities in the body of the foundation.

For further investigation the mill was restarted, with the result that portions of the concrete began dropping out of the block into the inspection pit, in much the same fashion as if the stamps were pounding on tightly packed rubble. Repairs seemed quite out of the question, and it appeared that the entire plant might have to be dismantled and re-erected upon an entirely new foundation, at a cost prohibitive to the mine owners. However, it was decided to attempt to save the foundation by pumping pure cement into it under high pressure, and this work was entrusted to the Francois Cementation Syndicate. The plant to carry on this work consisted of a steam pressure-pump with a 9-in. diameter steam cylinder and a 2-in. water delivery, a small wooden mixing barrel for cement, which served as an intake for the pump, and a pressure gage capable of registering pressure up to 10,000 lb. to the square inch. The pump was served by a boiler delivering steam at 100 lb.

In carrying on the work nine holes of ⅞-in. diameter and 5 ft. depth were drilled into the foundation. The top 9 in. of each hole was enlarged to take a 2-in. pipe 24 in. long, and screwed at one end. Such pipe was cemented into each of the holes and the cement allowed to bind over night.

The next morning hole No. 1 was connected to the delivery end of the pump, and clean water forced through before the actual cementing operation was begun. Thereupon a thin mixture of pure cement and water was pumped into the foundation. At first the liquid entered the concrete block without encountering any resistance whatever, and seventeen bags of cement were absorbed before any showing was made on the pressure gage. The indicator then gradually rose to 100 lb. and 200 lb. per square inch. Simultaneously, with the increasing pressure a tiny stream of water and cement could be observed oozing out of the thin crack previously mentioned.

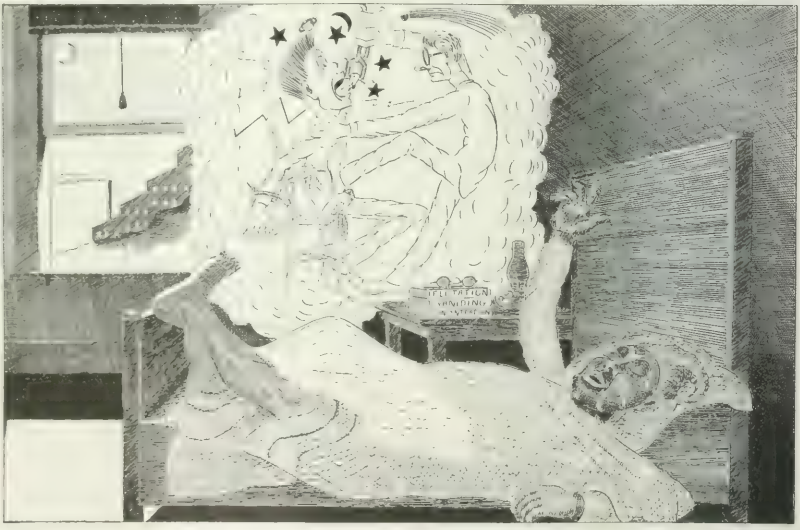
At this stage pumping was discontinued to allow the cement to settle, and hole No. 2 was put into operation and subjected to the same treatment as hole No. 1. After allowing a practically free passage to five bags of cement, the pressure rose rapidly to 800 lb., when pumping was stopped for twelve hours. Before injecting the remaining seven holes, hole No. 1 was re-treated after freeing it from partially solidified cement by drilling. Two bags of cement sufficed to send the pressure up to 1,000 lb., this being considered the dangerous limit above which the block might have burst. Though it required twenty-six bags of cement and twenty-two hours of work to complete the first two holes, the remaining seven holes absorbed only fifteen bags of cement and required eighteen hours' work. After completion of the foundation proper it was decided, as a matter of safety, to solidify the ground around the block. For this purpose six 8-ft. holes were drilled about 18 in. from the foundation, and injected in turn by a mixture of one to one cement and slimes. Some interesting phenomena could be noticed. When the pressure on the first outside hole rose to 150 lb. the gage indicator suddenly dropped to nothing, and it was found that the cement solution had broken through to the surface about ten yards from the position of the hole.

One bearing-block of the line shaft, which was only 24 in. in the ground, became injected from one of the outside holes 12 ft. away. In proof of this, cement solution forced its way 6 in. above the surface through a tiny crack in the block. It took six days to complete the whole of the process, and forty-eight bags of cement were used. The total cost amounted to roughly £200; inclusive of the charges of the Cementation Syndicate. After allowing ten days for the injected cement to harden, the stamps were again dropped, with entirely satisfactory results. The plant has been in full operation for some time, and the foundation is as firm as can be desired.

BY THE WAY

The Accuracy of Art

"Naow, m'son," said Cap'n Dick, "jus' for to settle h'all these h'arguments baout this 'ere h'Engineer statue o' Missus W'itney, I mus' tell 'ee tha story o' 'ow h'it come abaout. In tha days afor' tha minin' professors 'ad learned to take 'eed o' tha practical h'edication o' tha young chaps h'as they do now-a-days, many a young h'engineer came forth from college not nawin' a bal dag from a bull dog, though 'ee might naw h'all baout ge'hometry an' surveyin'. Missus W'itney's h'engineer wuz one o' they chaps, an' 'ee gaws to tha North Star to learn h'all there wuz to naw baout minin'. The firs' moornin' 'ee come daown on tha cage some o' tha boys were layin' for 'ee, as tha shifter 'adn't got theer yet. So they took tha young chap back in a flat stope that 'ad been worked h'out but wuz not filled. In one o' they chutes h'under this 'ere stope wuz 'baout thirty ton o' wet, sticky gob, an' 'ere they give tha chap a broken-'andled shovel an' starts 'ee to work a-muckin' tha gob back h'up h'into tha stope. W'en tha shifter foun' tha poor chap, jus' a'for' noon, 'ee looked 'zactly as Missus W'itney shows 'im. 'Ow she h'ever got tha statue so h'accurate be more than I can tell 'ee."



A METALLURGIST'S NIGHTMARE—POOR EXTRACTION

By I de L.

The Worm Turns

Government inefficiency has had many a rap in the past, sometimes deservedly and sometimes not. When, therefore, the Government official takes down his hammer and starts knocking some one else for the same fault it is only fair that he should have respectful attention. Inefficiency on the part of a certain publisher recently aroused the ire of George Otis Smith, Director of the U. S. Geological Survey, who thereupon wrote:

"You have doubtless heard the repeated charge that the Government needs to adopt business methods in order to secure greater economy and efficiency.

"I have within twenty-four hours received three separate communications from you bringing to my attention an opportunity to examine and purchase Prof. Grabau's 'Comprehensive Geology.' Is it out of place for me to suggest that, even with the franking privilege, I would consider the adoption by a Government bureau of such shot-gun methods of publicity both uneconomic and inefficient? The United States Geological Survey has addressograph mailing lists aggregating 250,000 names, though not for purposes similar to your mailing lists, but I know that a real saving can be effected between the cost of one correct address and of a postage stamp, not to mention the cost of the matter to be mailed."

Can You Beat It?

There is no such thing as luck. The first issue of the *Engineering and Mining Journal-Press* will be No. 13 of Volume 113 and will appear on April 1. The first editorial page will be page 513. To add a further felicitous touch, we might add that the issue will be run off on the press on Friday of each week.

A Voice From the City

BY PAUL H. KEATING

Take me far from locomotives, take me far from plumbers' bills; take away the smoky cities and the doctor's liver pills. Take away the crash and fury of The Street's exciting game; I can live without the millions or the hope of gaining fame. Take away the labor troubles of an agitated crew, and replace them with the bubbles of a prohibition brew.

Take me to a distant country where the skies are free from smoke, where primeval forests flourish, where no axe has made a stroke; where the night wind gently whispers through the pine trees and the brush and then ceases for a moment, 'till you almost feel the hush and sense the Greater Presence. Feel the beauty of it all! Then you even doubt the story of the Sin and Adam's Fall. I'd love to chuck this city life, and when I square my bills, I think I'll take the kid and wife and beat it for the hills.

CONSULTATION

Grading of Asbestos

"Will I be asking too much if I request you to answer the following questions in your 'Consultation' page? I am interested in asbestos mining and preparation. What is the correct definition of 'crude semi-fiberized, and fiberized asbestos'? What are the lengths of fibers of the different grades as sold in America? Are these grades standardized? Is asbestos fiber washed before being sold? What are the tests, mechanical and otherwise for (a) textile asbestos, (b) compressed sheet fiber, (c) cement stock, (d) paper stock? Are these mechanical tests standardized? Is any notice taken of analysis? Are there any special uses for asbestos with an iron alumina base? Where can I obtain literature on the machinery used to clean and fiberize?" [Inquiry from South Africa—EDITOR]

The term "crude semi-fiberized and fiberized asbestos" is misleading. Asbestos as mined in Canada is divided into two distinct and separate groups "crude and fiber," and although a few years ago one of the companies made what it called a semi-fiberized crude, a material that passed through a disintegrator in which the screens had been taken out, this grade of asbestos is only in limited demand.

The length of asbestos fiber of different grades as sold in America varies with the mine producing the crude. No two mines produce exactly the same grades, although they use the same marks at times, which is also misleading and causes confusion.

No general agreement regarding the classification of asbestos exists among producers which specifies what every grade of asbestos shall include and designate. Physical tests are relied upon to a much greater extent than chemical, because in the use of the mineral its physical properties are the more important. Such simple characteristics as length of fiber, color, and tensile strength are of paramount importance and control the price for which asbestos can be sold. The Canadian mines generally employ a screen test to determine the grade of an asbestos product, and use a set of shaking screens consisting of four separate trays about 16 x 26 x 5 in. The No. 1, or top screen, sizes to ½-in. mesh; the No. 2, or second screen from the top, is screened to ¼-in. mesh; No. 3, the third tray, is screened to ⅒-in. mesh, and No. 4, the bottom tray, receives the product falling through the first three screens. A suitable mechanical device shakes the set of screens 300 times per minute with a small throw —1½ in.

In the ordinary test one pound of asbestos fiber is placed on the top tray and the screen mechanically shaken for two minutes, during which time the mineral naturally distributes itself on the various screens according to size. At the end of the test the amount of fiber remaining upon each screen is carefully weighed, and the result is expressed in a formula that always contains four terms with a hyphen between each. Thus the designation 0-9-5-2 shows that no fiber remained upon the top or coarsest screen, 9 oz. on No. 2 screen, 5 oz. on No. 3, and 2 oz. on the bottom tray. Of course the sum of the four terms should add to 16 oz.

The principal grades of asbestos are No. 1 Crude, No. 2 Crude, long spinning fiber, medium spinning fiber, magnesia and compressed sheet fiber, shingle stock, paper stock, cement stock, and floats, which are the grades used in our market quotations. Crude No. 1 is asbestos greater than one-half inch in length. It should be silky and of sufficient tensile strength to permit its use for making asbestos yarn, tape, cloth, carded fiber, and other asbestos textiles. Owing to the different characteristics of asbestos produced by the several centers in Quebec, a variation will exist among the grades ordinarily sold in this class.

Crude No. 2 asbestos is generally referred to as mineral that has not been milled and which is less than ½ in. long. It must be of good tensile strength. Frequently it is mixed with Crude No. 1 in the manufacture of asbestos textiles. Color is also a consideration in determining the price at which it can be sold. Although some companies produce what they term a No. 3 Crude, this classification is not generally recognized by the trade as standard.

Long spinning fiber used in asbestos textile manufacturing tests anywhere from 4-7-4-1 down to 1-9-4-2, but the standard tests may be taken as 4-7-4-1 and 2-8-4-2.

Medium spinning fibers are generally required to test 0-8-6-2, and may be mixed with the better grades for textile manufacture.

Magnesia and compressed sheet fiber averages 0-5-8-3. These fibers are used in the manufacture of magnesia pipe covering and compressed sheet packing.

There are various grades of shingle stocks—each mine having a different method of determining what constitutes a shingle fiber. The best-known material, however, tests 0-1½-9½-5. Some mines make 0-3-9-4; 0-2-10-4; 1-11½-3½, although the standard shingle stock calls for a test of 0-1½-9½-5. This material, as its name applies, is used in the manufacture of asbestos shingles, corrugated asbestos lumber, and switchboard panels, and is used in conjunction with portland cement.

Paper stock tests are the nearest standardized tests among the miners. They test either 0-0-10-6 or 0-0-11-5. The common designation for paper stock is "X.X." fiber. This material is used for making asbestos paper and millboard and is sometimes mixed with the longer grades of shingle stock.

Paper stock tests on the average 0-0-10-6 and is used in making asbestos paper or mixing with shingle stock.

Cement stock, a cheap grade of merchantable asbestos, may test 0-0-5-11 or 0-0-6½-9½. It is used in the manufacture of asbestos boiler and roofing cements and for making millboard.

Floats or shorts are sold on color and used in the manufacture of flooring. The grade is usually pulpy or sandy in nature.

No notice is taken of chemical analysis. Iron in asbestos is detrimental, especially if for electrical purposes. The analysis of asbestos depends on the district in Canada from which the material comes, and varies to a considerable extent. There is no special use for asbestos with an iron alumina basis; in fact, this is a detriment to the material.

Canadian asbestos is not washed before being bagged and sold, so far as we can ascertain. In early issues of *Engineering and Mining Journal-Press* we shall publish two articles with a more extended description of the occurrence, mining, and preparation of asbestos, and the marketing of the product.

We are indebted to B. Marcuse, president of the Asbestos Crude & Fibre Corporation, and of the Asbestos Crude & Fibre Mining Corporation, Ltd., for valuable aid in preparing the above statement.

HANDY KNOWLEDGE

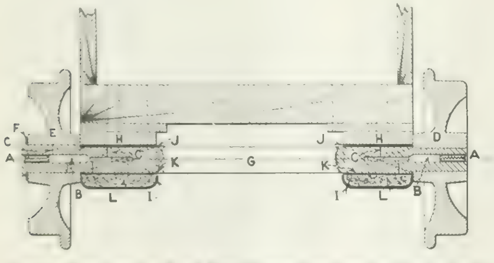
Mine Car Axle and Bearings

By H. A. Sutliffe

Written for Engineering and Mining Journal

The mine car axle and bearings here described, which are used by the Northwestern Improvement Co., of Cle Elum and Roslyn, Wash., one of the largest coal mine operators in the Northwest, may possibly be found useful by some metal-mine operators. This axle and journal has recently been patented by Messrs. Scott and Cadwell, master mechanic and assistant, respectively, of the company named. Its advantages are low first cost, simplicity of construction, and great economy of lubrication.

Referring to the sketch, the bearings *H* are bolted to the plank floor or bed of the car. These are cast iron, babbitted journal bearings. *D* is a tight wheel pressed on to the axle *G*. *E* is a loose wheel. *B* is an oil chamber which is drilled into the axle; *C* oil channels for supplying the lubricating oil to the loose wheel, as well as to the waste packing *L*, in the oil cellars *I*; *A* an oil ball spring check, preventing loss of oil from chamber *B*. *K* is a No. 20 $\frac{3}{16}$-in. wire-mesh screen which holds the waste in the oil cellar, preventing it from being picked up by the revolving axle, and as the cellars are packed tight with a good grade of wool waste, thoroughly saturated with oil, dirt and coal dust are prevented from getting into the bearings, thus reducing the wear to a minimum.



A MINE CAR AXLE AND BEARINGS FOR WHICH ECONOMY OF LUBRICATION IS CLAIMED

To replenish the oil it is only necessary to use a squirt gun or an oil gun, pressing the ball check *A* back and shooting the chamber *B* full of oil, which will then flow through the oil channels *C*, saturating the waste in the cellars *I*. A good grade of dark lubricating car oil of 95 to 100 deg. Saybolt viscosity at 100 deg. F. should be used.

A car equipped with this axle and bearings operated thirty days without re-oiling, showing no wear. One of the claims—and I can bear out this claim—is that, owing to the presence of the wire screen between the axle and the waste packing, the waste never becomes glazed, thus losing its capillary attraction, which would occur if the waste were in direct contact with the revolving axle. Another advantage of the wire screen, as mentioned before, is that it prevents the revolving axle from picking up the waste, which happens rather frequently unless great care is used in packing the cellars. As a lubricating engineer, I have had an opportunity to watch the successful operation of these cars for the last eight months.

Turning Down Commutators

By Charles Labbe

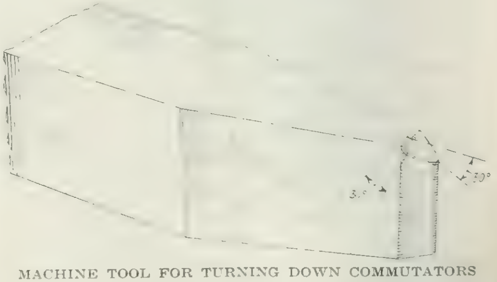
Written for Engineering and Mining Journal

When sparking cannot be avoided at the commutator of a d.c. machine, being caused by roughness and hard service, it is proper to turn the commutator down. The best practical way is on a lathe. Handled with due care, the commutator is placed between centers. First, one must be certain that the shaft is not sprung and that the centers of the shaft are true with the journals. Also it must be ascertained that the nut holding the commutator bars is as tight as it must be in operation. Often motors will wear shafts on one side, due to vibration or to the armature being out of balance.

When the journal part is not true with the centers, before starting on the commutator, either the shaft must be turned down just enough to true it up or the shaft centers must be bored true by holding the armature shaft in clutch and steady-rest. This is left to the judgment of the experienced machinist doing the work, because, if the shaft is turned down, new bearings will have to be made, or if the shaft centers are corrected to suit the journals the whole armature may be thrown out of balance.

For turning down commutators the best kind of tool I have used is the one shown in the illustration. It is made of regular tool steel, nearly like a straight threading tool, the cutting end slightly rounded and beveled sidewise and endwise to an angle of about 30 deg., the highest part being toward the toolpost. This tool absolutely obviates digging into the commutator and will not chatter. It is set at the same height as the lathe's center or a trifle lower.

The smallest cut possible must be taken off, as probably a second light cut will be necessary to get the commutator straight and smooth. To obtain a good polish while cutting, it is advisable to use some light oil such as thinned linseed oil, corn, or coal oil. This will prevent the adhesion of shavings to the tool, which often causes little circular grooves that are hard to polish. To obtain the proper finish, sand or glass paper is used, but not emery paper or cloth.



MACHINE TOOL FOR TURNING DOWN COMMUTATORS

Types of Hoists

Written for Engineering and Mining Journal

Continuity of service, availability, and economy in operation control the selection of the power agent for hoists. Steam is preferred by many engineers, although it is not economical under average conditions. It has the important advantage of being self-contained with respect to the source of power. Electrical hoisting apparatus has been developed to a point where it can be safely controlled and economically applied. Electricity is one of the most convenient power agents for hoisting and lends itself to the control of power-station operation. When compressed air is cheaply produced, it is as satisfactory as steam and can be applied in a similar manner. Gasoline hoists are used for initial operations in prospecting and development. Water power has been used and presents no insurmountable mechanical difficulties.

Steam- or compressed-air driven hoists are of two types, the direct-connected, in which the drums are mounted upon the crankshaft, either keyed or by friction clutches, and the gear-driven hoist, in which one gear reduction is used between engine and drum shaft. Simple, cross-compound, or tandem-compound steam engines are used, and invariably one or more pairs of engines.

The electrically driven hoist also may be classified into two broad types, the direct-current motor-driven hoist with one or two motors mounted upon the drum shaft and the gear-driven motor, in which one or two sets of gears are interposed between the motor and the drum shaft. The second type admits of the use of the alternating-current motor.

Gasoline hoists are invariably gear-driven, and in the types ordinarily seen a single cylinder gasoline engine with heavy flywheels operates the drum shaft through a single reduction gear. The drum is thrown into action by a friction clutch. In a few instances multicylinder gasoline engines with gear changes have been used.

Hoisting drums fall into several classes. The most frequently used is cylindrical. In the simplest type a single drum is keyed to the shaft. For two-compartment hoisting in balance a single, long drum, keyed to the shaft, is used in common by the two ropes. A more elastic and more common arrangement is two drums revolving upon a common shaft and thrown into or out of action by friction clutches. Either drum can be used independently of the other, or both may be used simultaneously. In place of the cylindrical drums, flat-rope reels, cylindro-conical drums, or conical drums have been used. All have the advantage of reducing the starting moments.

Accessory equipment of hoists are: post or band brakes, position indicators, control apparatus, and overspeed and overwinding safety stops.

For supplementary hoisting in winzes, raises, and underground shafts, small induction-motor hoists and small compressed-air-driven hoists of the reciprocating-engine-driven type, as well as stretcher-bar compressed-air hoists, are much used. The stretcher-bar hoist is driven by a compressed-air engine of 2 to 6 hp. The drum diameter ranges from 5 to 9½ in. and the length from 5 to 17 in., with a rope capacity from 300 to 1,000 ft. of ¼ to 5/16-in. wire rope. The hoisting capacity is from 500 to 2,000 lb., hoisting speed 60 to 100 ft. per minute, and the weight of the hoist from 200 to 800 lb. For handling scrapers, pulling cars, and auxiliary hoisting service they are indispensable.

A Novel Cupelling Furnace

By CHARLES FLURY

Written for Engineering and Mining Journal

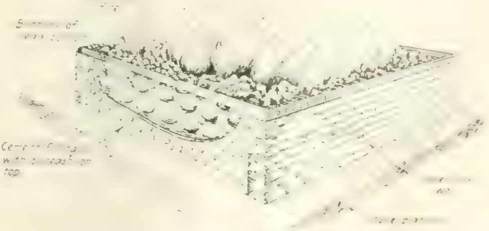
A furnace used by Koreans for refining gold and silver is described here, not only because it is a curiosity, but because I have found it useful where modern equipment for cupellation was lacking. Having used this furnace several times, I am in a position to speak of its efficiency in making practically pure gold-silver bullion.

The furnace may easily be constructed in half an hour in the following way:

The bottom of a large frying pan is covered with wood ash or cement, which is piled high at the circumference, the pan thus being lined with an ample layer of bone ash. This cupelling bed is then pressed down, the bone ash thus being shaped as in a mold. A few pieces of brick placed around the edge of the pan make a support for a number of iron bars, which form a grate. Before these bars are set in position, the cupelling bed is charged with the lead buttons obtained from the fusion of the precipitates. The bars are then spaced about a half-inch apart, resting on the brick supports.

A fire is then built of coarse pieces of charcoal directly on the bars. Note here that the essential feature of this furnace is in the fact that the fire is just above the cupellation charge. At the start, the charcoal is tightly piled, thus keeping the heat in, which helps accelerate the melting. Once the charge is liquefied, some pieces of the coal are removed with tongs so as to create channels for air to oxidize the base metals. On account of the fumes from the lead and zinc, it is best that this be done outdoors.

During cupellation, the bullion may be skimmed easily with an iron rod or a piece of green wood, which is introduced beneath the fire grate, so that small particles of ashes may be removed from the bullion surface. Once the cupellation is ended, the fire and grate are removed to get access to the cupel-cake, which is now ready to be melted into bars.



CUPELLING FURNACE USED IN KOREA

For cupelling on a large scale, the "frying-pan furnace" becomes too small. In such operations the furnace may be built on a stone platform, with a square of bricks forming the cupel bed. The side of the square will adjust itself to the size of the batch to be cupelled. The inside of the square is filled with cement and bone ash, as already described, and the bullion is charged on the grate. The cupellation is done exactly as in the operation of the "frying-pan" furnace.

THE PETROLEUM INDUSTRY

Continuance of Oklahoma Oil Tax Sought

WASHINGTON CORRESPONDENCE

In asking that Oklahoma be allowed to continue its gross production tax on oil produced on Indian lands, Senator Harreld, of that state, made the following statement on the floor of the Senate:

"The State of Oklahoma levies a tax known as a gross-production tax of 3 per cent on all oil produced in the state. In lieu of all other forms of taxation that 3 per cent tax is levied by the state, and paid.

"They have been collecting that tax from the lessees of restricted Indian lands until recently, when the Supreme Court of the United States held, in the Gillespie case, that that could not be done under the terms of the leases as they have been heretofore executed. The court held that the lessee of restricted Indian land was the agent of the Indian, and therefore that he could not be taxed.

"The result of that is this in a nutshell: If I have a lease on a tract of land, we will say of 100 acres, from some man who is not restricted, and somebody has a 100-acre tract immediately adjoining it, which is restricted land, I have to pay the gross production tax of 3 per cent on my production, but the man who has the Indian lease adjoining me does not have to pay the 3 per cent tax. It seems to me that that is manifestly unfair. This amendment does not propose to make any levy upon the restricted Indian at all; it is upon the production of a man who has a lease upon the restricted land.

"When the Gillespie case was decided, the Governor of the state took up the matter with me, and I called a meeting of the Congressional delegation from my state, which my colleague [Mr. Owen] attended, and we agreed that we would attempt to get this amendment on the Indian appropriation bill, so that the state may be able to collect this 3 per cent gross-production tax from the man who takes oil off the restricted land on leases that are made hereafter. I repeat, it does not affect the interests of the restricted Indian at all; it affects only the production which a man gets from a restricted Indian lease.

"It is a matter of immediate importance to the state. If we had to wait to procure legislation on this subject, it would defeat the purposes for which we are striving, because many people who are now producing oil on these restricted lands would escape taxation during all of that time and during all of this year.

"I ask that this provision be incorporated in the pending measure, because it is a matter which needs immediate attention, and it should be remedied at once, so that the taxation of the state may be just and equitable."

Need of Mazout in Rumania

SPECIAL CORRESPONDENCE

On account of the reduced production of crude oil in Rumania the refineries are no longer able to supply the demand for mazout (residues). The Rumanian railroads are burning 800 metric tons of petroleum daily, and with the new engines already received, or to be received soon, it is expected that 900 to 1,000 tons will be necessary.

If the result of the December operation be considered, of the 17,500 tons of residues disposable at the refineries, 12,500 tons was used by the railroads, 1,200 by the water works of Bucharest, and 750 by the government plants. For private industries only 930 tons was available. This supply is inadequate, and it is not surprising that part of the factories are shut down, as are also the paper mills, on account of fuel shortage.

There are no indications that this situation can soon be relieved. Indeed, before the war, between 100,000 and 120,000 meters were drilled in the oil fields, and for the last three years only 8,000, 10,000, and 15,000 meters respectively were drilled.

The present production of about 100,000 metric tons monthly is due to the unusually large number of flowing wells with big productions.

Oil-Well Drilling Active in Texas

SPECIAL CORRESPONDENCE

The production of the Mexia field, in Texas, is holding up steadily, and many new wells are being brought in. The average initial production of 31 wells recently was about 2,100 bbl., and the largest well of the group, 8,000 bbl. During February, 110 wells were completed, of which 82 were producers and 28 were dry holes. The initial production of the wells averages 2,120 bbl.

Development work throughout Texas is on the increase. The great success of the Mexia field has stimulated wildcat drilling operations for hundreds of miles along the lower side of the Balcones fault. A new development campaign has also been started in central west Texas. The chief interest is centered in the north central part of Stephens County, where three flowing wells were completed recently in the Eliasville district. Drilling is also increasing in Desdemona and Ranger. In the Panhandle, one pumping well has been completed by the Gulf Producing Co. in Carson County, and large tracts have been leased in this and adjoining counties by several of the largest oil companies operating in the state. The discovery of natural gas in considerable quantity at a depth of 130 ft. in drilling near McAllen, Hidalgo County, has started a deep drilling campaign there.

Recent drilling in Young County indicates the existence of a deep lime oil-bearing stratum of great extent. The Konova Oil Co. recently completed its No. 1 Stovall well at 3,600 ft. in this lime, making 300 bbl. of oil. This well is four miles southwest of South Bend, and is ten miles from the Cosden Oil Co.'s No. 1 Parsons well. It is believed that hundreds of old wells in this section, now producing from shallow sands, will be deepened.

Bureau Making Oil-Shale Studies

A new oil-shale investigation, to be conducted at the Intermountain Experiment Station of the U. S. Bureau of Mines at Salt Lake City, in co-operation with the University of Utah, has as its object the development of melting-point apparatus for oil-shale products. It is the purpose of the Bureau to develop an accurate method for determining the settling point of shale oils and their products. The investigation will be made by L. C. Karrick, assistant oil-shale technologist, with the assistance of F. W. Parry, fellow of the University of Utah.

Technical Papers

Tennessee Mineral Resources—The Geological Survey of Tennessee has recently issued Bulletin 26, "Mineral Resources of the Waynesboro Quadrangle, Tennessee." The Waynesboro quadrangle embraces 974 square miles in south-central Tennessee. Brown iron ore is the chief mineral product mined, and a number of limestone and flint quarries are included in the area. Copies may be obtained from the State Geological Survey, Nashville, Tenn.

Gold Mining and Milling—Many interesting papers relating to the gold-mining industry were presented at the recent meeting of the Canadian Institute of Mining and Metallurgy at Ottawa. These may be obtained for 25c. each from the offices of the Institute, 503 Drummond Building, Montreal. They include: "Mining and Milling Methods at the Hollinger Mine," twenty-nine pages, giving many details of operation but in general neglecting to give the names of the machines used; "Mining Operations at the McIntyre Porcupine Mines, Ltd.," twenty-eight pages, with the additional feature just noted as missing in the previous paper; a thirteen-page paper by André Dorfman describing the efforts to find a method of treating the carbonaceous ores in the McIntyre mine; "Ontario Gold Deposits, Their Character, Distribution, and Productiveness," sixteen pages, which should prove especially valuable to prospectors in giving them an idea of the kind of formations in which gold is found in Ontario; "Gold-Dredging Possibilities in the Barkerville Area, British Columbia," seventeen pages; "The Probabilities of a Stable Gold Production From Northern Manitoba," six pages; and "The Economic Relations of Canadian Gold Production," six pages.

Potash—The latest monograph of the Imperial Institute is devoted to potash. Like the others in this series it covers the occurrences and commercial utilization of the mineral under discussion, with particular reference to the British Empire. The chapters discuss "Deposits of Soluble Potash Minerals"; "Salt Lakes and Pans"; "Potassium Nitrate Deposits of Mineral Origin" and "Potassium Nitrate of Organic Origin"; "Sea Water as a Source of Potash"; "Insoluble Potash Minerals"; "Flue Gases as Sources of Potash"; "Vegetable Sources of Potash"; "Residues From Beet-Sugar Manufacture"; "Animal Sources of Potash"; and references to literature on potash. The book, which is of 122 pages, may be obtained for 6s. from John Murray, 50A Albemarle St., London, W. 1.

Winnipegosis, Manitoba—The Canadian Geological Survey, Ottawa, has issued Memoir 128, forty-two pages, on the Pleistocene and Recent deposits of the Winnipegosis and Upper Whitemouth River areas of Manitoba. Obtainable on request.

Mineralogy of Black Sand—The U. S. National Museum, Washington, D. C., has published a separate of a thirty-three-page paper by E. V. Shannon entitled "Mineralogy of Some Black Sands From Idaho, With a Description of the Methods Used for Their Study."

New Mexican Mines—J. R. Finlay, with a corps of engineers and an accountant, has spent five months working in the field and investigating the books of the various coal- and metal-mining companies of New Mexico. An exhaustive survey and appraisal of the mines of the state was thus made, and his report has just been published. Every mine and many prospects are given individual attention, and much of the matter is of general interest. The report is issued as a cloth-bound book of 154 pages, and may be obtained from the State Tax Commission of New Mexico, Santa Fe, price not stated.

Economic Geology—The January-February issue of *Economic Geology* (41 N. Queen St., Lancaster, Pa.; price, 65c.) contains articles on the "Paragenesis of the Martite Ore Bodies and Magnetites of the Mesabi Range"; "Structural Factors in the Accumulation of Oil in Southwestern Oklahoma"; and George Otis Smith's recent address presented at the Amherst meeting on "Plain Geology." The estimation of petroleum reserves receives extended editorial treatment, and there are comprehensive reviews of Leith's new book, "Economic Aspects of Geology," and of "The Tin Resources of the British Empire," by N. M. Penzer.

Tin—*Compressed Air Magazine* for February (11 Broadway, New York; price, 35c.) contains a six-page article, including many illustrations, which covers briefly the mining, smelting, and marketing of tin.

Book Reviews

Magnetic Concentration of Iron Ore. By Edward W. Davis. Paper; 6 x 9; pp. 138; illustrated. Published as Bulletin No. 9, University of Minnesota, Minnesota School of Mines Experiment Station, Minneapolis.

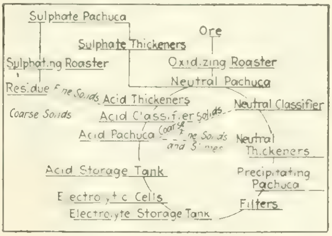
The author remarks in his preface that from a scientific point of view, much has been omitted from this bulletin, and the attempt has been made to describe simply and directly the fundamental principles of iron-ore concentration, the physical laws of magnetic attraction, and the manner in which the magnet may be utilized in the concentration of iron ores. Which, we take it, is the purpose of the book. Many publications of this nature fly off at a tangent, as it were, and cover a mass of detail that is unessential to the subject in hand. Professor Davis is recognized as an authority, and his careful studies in the field of magnetic concentration are well known. He has added a valuable treatise to the discussion and study of the subject. D. E. A. C.

Recent Patents

Mercury Extraction—No. 1,402,741. M. K. Codding, San Francisco. A composition for the extraction of mercury from sulphide ores, comprising an aqueous solution of Chile saltpeter containing a small amount of sodium carbonate and potassium carbonate. Patent No. 1,402,742 covers the process and method of using the reagent mentioned.

Concentration—No. 1,402,740. M. K. Codding, San Francisco. Before concentrating by gravity methods, the ore is violently agitated, in a finely powdered state, with a solution containing a neutral electrolyte and an alkaline electrolyte, for a time sufficient to effect physical changes in the granules. This is a process which has caused considerable discussion owing to the extreme claims of the inventor. A testing laboratory is maintained in Denver, and it is understood that steps are now being taken to test out the process on a commercial scale.

Hydrometallurgy of Zinc—No. 1,399,020. F. E. Lee, A. L. McCallum, and S. G. Blaylock, Trail, B. C., assignors to the Consolidated Mining & Smelting Co. of Canada, Ltd., Montreal. A process of treating zinc-bearing material which consists in oxidizing the zinc compounds, extracting the soluble zinc, and then heating the residue in a sulphating atmosphere to convert the remaining zinc into soluble compounds.



Sulphur Extraction—No. 1,406,905. A. K. Sedgwick, Chicago. Sulphur ore and oil are introduced into a bath of sulphur, when, after mixing, the solid particles will be carried to the top of the bath.

Hydraulic Classifier—No. 1,406,177. L. H. Falley, Kansas City, Mo. A multiple-unit separating and classifying apparatus fitted with baffles to maintain the desired current flow.

Hydrometallurgy—No. 1,403,463. John Allingham, Los Angeles. Ores containing gold, silver, zinc, lead, and copper are crushed and mixed with a solution of sodium chloride and sodium sulphate and subjected to electrolytic action. The chlorine and sulphuric acid formed thereby attack the ore, forming chlorides and sulphates which dissolve in the solution. This is subsequently treated to recover the metals.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

Government and Industry Co-Operate in Standardization

At the request of Herbert C. Hoover, Secretary of Commerce, the American Engineering Standards Committee has designated A. A. Stevenson, the retiring chairman of the committee, as a special representative to work with the Department of Commerce in the co-operation between the department's Division of Simplified Practice and the American Engineering Standards Committee.

The Division of Simplified Practice is a co-ordinating unit of the Department of Commerce assisting in those reductions of excessive variety and other simplifications which many industries are undertaking to decrease the cost of production and distribution of manufactured articles. The work of the division was organized in the latter part of 1921 and is now under way.

The American Engineering Standards Committee, which serves as a national clearing house for a broad field of engineering and industrial standardization, has offered Secretary Hoover the use of its machinery in carrying out the detailed work on technical projects initiated in the simplification program of the Department of Commerce.

Mr. Stevenson, who is a past president of the American Society for Testing Materials and has had a most extensive experience in standardization work, is vice president of the Standard Steel Works Co.

Utah Chapter, A. M. C., Elects Officers

The Utah Chapter of the American Mining Congress at the annual meeting March 12 elected officers as follows: Fred Cowans, governor; J. William Knight, first vice-governor; V. S. Rood, second vice-governor; D. D. Muir, Jr., third vice-governor; and A. G. Mackenzie, secretary and treasurer. Announcement was made that G. W. Lambourne, of the executive committee of the local chapter, had been appointed by the national organization as vice-president for Utah of the American Mining Congress. The executive committee here consists of G. W. Lambourne, L. S. Cates, Fred Cowans, Imer Pett, and E. G. Raddatz. Additional directors were elected as follows: L. S. Cates, Moroni Heiner, J. William Knight, J. C. McChrystal, Imer Pett, Solon Spiro, D. D. Muir, Jr., O. J. Salisbury. Directors still in office are: J. M. Bidwell, M. R. Evans, H. M. Hartmann, C. E. Loose, F. J. Westcott, J. B. Whitehill, Ernest Bamberger, Fred Cowans, R. C. Gemmell, G. W. Lambourne, Duncan MacVichie, E. J. Raddatz, and V. S. Rood.

F. A. E. S. Reports Increasing Interest in Activities

Steady advancement of engineering ideals here and abroad and a growing sense of the need and importance of professional unity were outstanding features of the meeting in Chicago on March 10 of the executive board of the American Engineering Council of the Federated American Engineering Societies. President Mortimer E. Cooley stated that in every city visited by him, in a recent trip through the South and Southwest, he found engineers zealous to aid in expanding the influence of the Federation. The report of the executive secretary, L. W. Wallace, presented highly encouraging evidence of the favor with which the idea of engineering federation is being received in this and other countries.

One of the liveliest discussions of the meeting of the executive board arose from a resolution presented by Philip N. Moore, of St. Louis, "that the president of the F. A. E. S. be authorized to offer the Secretary of War the service of a committee of disinterested, distinguished, and skillful engineers, to be selected by a committee of its executive board, for the purpose of making a thorough investigation of the geological, engineering, and manufacturing possibilities of the Muscle Shoals Power Project; this committee to serve without compensation, save for necessary expense." The resolution was voted down.

The Great Lakes-St. Lawrence Waterway project came before the board, which decided that at present it was undesirable to take any action. This matter has been under consideration by the Public Affairs Committee of the council for a considerable period, and the board's decision was reached after opportunity had been provided for a careful study of the report of the International Joint Commission.

The proposal to urge the elimination from the Fordney Bill of the tax on foreign books in English met with a divided report from the Committee on Public Affairs. Prof. Arthur M. Greene, of Rensselaer Polytechnic Institute, asserted that engineers should take a broad view of public questions and consider other interests fairly. The resolution was tabled.

The board adopted appropriate resolutions, presented by Colonel A. S. Dwight, of New York, on the death of Prof. J. W. Richards, of Lehigh University, and Colonel F. A. Snyder. A resolution dealing with a national auxiliary language was tabled. President Cooley's report chronicled gratifying progress and an encouraging outlook. The treasurer's report showed an improved financial situation.

Mining Department of Lehigh University Offers Unique Summer Auto Tour

The Department of Mining Engineering of Lehigh University is arranging a summer automobile tour for the students in the mining engineering course. The party will leave Bethlehem early in July on a 3,000-mile circuit, which will include the principal mining districts of northeastern United States and Ontario, Canada.

The object of the tour is to afford an opportunity for the students in mining to broaden their conception of the industry which they expect to follow in the future. Actual contact will be had with the mining and preparation of the ores in all the more important districts in the territory covered. Considerable attention will be paid to the geological features along the route, as well as to the quarrying and mining of non-metallic minerals.

Arrangements are now being made with prominent mining companies and individuals with a view to securing their co-operation in enabling the students to see the interesting features of each district visited.

The unique feature of the tour is that the party will travel in automobiles, five men to a car, and will carry full equipment for camping and the preparation of meals, making the students and instructors independent of hotel and garage housing.

The students will leave Bethlehem the early part of July and follow a route covering approximately 3,000 miles, the entire trip lasting about five weeks.

The route followed will include the following points of interest:

Cornwall Ore Banks—Iron ore mining by both open-pit and underground methods; hoisting and crushing, and study of geology of the ore deposit.

Bituminous coal mining of western Pennsylvania.

Oil and gas wells through western Pennsylvania, eastern Ohio, Indiana, and Illinois.

Clay working industry in Ohio.

Limestone quarrying and fabrication Bloomington, Ind.

Southern Illinois bituminous coal mining.

Long-wall mining of bituminous coal in northern Illinois.

Lead and zinc mining and milling at Galena, Ill., and at Platteville, Wis.

Iron mining on the Gogebic and Marquette ranges in Michigan. The ore-loading docks at Marquette, Mich., will also be visited.

Copper mining and milling in the Lake Superior copper district.

Michigan School of Mines.

Nickel district of Sudbury, Ont.

Silver mining at Cobalt, Ont.

Salt mining in New York State.

MEN YOU SHOULD KNOW ABOUT

R. K. Neill has returned to his home in Spokane from an eastern trip.

D. E. Sutherland has returned from a six weeks' vacation at Palm Beach, Fla.

Andrew Larsen, mining engineer of Spokane, is making a professional visit to Arizona.

A. A. Richie has resigned as foreman of the Simon Silver-Lead mine near Mina, Nev.

Joseph Irving is now engaged in heap-leaching experiments in the Jerome district of Arizona.

G. W. Voelzel has completed special sampling work in Fresnillo, Zacatecas, Mexico, and will return to Tyrone, N. M.

William Watters, superintendent of the Tonopah Divide mine, returned to Tonopah on March 11 from San Francisco.

A. H. Burroughs, Jr., managing director of the Armstead Mines, Inc., Talache, Idaho, recently spent a few days in New York.

Frank P. Short has gone to Keno Hill, in the Mayo district of the Yukon Territory, on consulting work for the Keno Hill, Ltd.

H. H. Hartzell has been made manager of the Huttig Lead & Zinc Co. in the Joplin-Miami district, succeeding **B. E. Brown.**

Cornelius F. Kelley, president of the Anaconda Copper Mining Co., was in Montana last week inspecting the properties of the company.

James R. Robbins, district manager of the Montana Power Co. at Great Falls, Mont., has been made assistant to **Cornelius F. Kelley**, president of the Anaconda Copper Mining Co.

Benjamin B. Thayer, vice-president of the Anaconda Copper Mining Co., has returned to New York from a visit to the company's properties in the West.

L. P. Barrett, State Geologist of Michigan, is making his annual inspection of mining properties in the Lake Superior district for appraisal purposes.

Stanley T. Wood, manager of the Montana-Morning mine near Troy, Mont., has returned to the Northwest after spending some time in the East.

A. C. Munro, formerly with the San Francisco Mines of Mexico, Ltd., is now mill superintendent of the Britannia Mining & Smelting Co., British Columbia.

John D. Ryan was elected a director of the American Brass Co. at the last regular meeting.

P. B. Goudkoff, former professor of geology at the Tomsk Institute of Technology, is in New York. He is the author of many works on mining geology dealing with Siberia.

Karl A. Bernsen, of the General Engineering Co., Salt Lake City, who has supervised construction of the new 150-ton all-flotation mill of the Armstead Mines at Talache, Idaho, left for Salt Lake City about the middle of March. Mr. Bernsen expects to go later to supervise mill construction in Missouri.

W. J. Rolfe and **K. C. Browne** have resigned from the staff of the International Nickel Co. at Creighton Mine, Ont. Mr. Rolfe has accepted the position of superintendent at the Associated Goldfields mine at Larder Lake, Ont. His position at the Creighton mine has been filled by the appointment of **Charles E. Lively.**

Mining engineers who recently visited San Francisco included: **P. M. Simon**, Mina, Nev.; **C. A. Heller**, Philadelphia, Pa.; **W. W. Avery**, Gold Hill, Nev.; **W. J. Quigley**, El Paso, Tex.; and **J. Kinnear**, McGill, Nev.

Mining and metallurgical engineers visiting New York City last week included **George A. Osborn**, Fresno, Cal.; **Carl M. Smith**, Little Rock, Ark.; **L. D. Osborne**, Lang, Cal.; and **P. E. Nolan**, Maracaibo, Venezuela.

OBITUARY

Thomas J. Carrigan, pioneer railroad and mining man, aged sixty-five years, died in Los Angeles, Cal., on March 8.

Charles E. Hart, mining operator of Nevada, who was spending the winter with his brother, H. H. Hart, in Redlands, Cal., died there March 8. Mr. Hart was fifty-six years old.

Henry Cecil, of Barrie, Ont., died in Toronto on March 14 as the result of injuries received in an elevator the previous day. Mr. Cecil was at one time prominently connected with the Tough Oakes and Hunton-Kirkland mines. He had also had considerable mining experience in South Africa and Australia.

C. C. Burger, president of the Copper Canyon mine, in Nevada, and the Woodstock lead mine, in Oklahoma, died on March 10 in New York City. Mr. Burger was born in Philadelphia fifty years ago, and started his mining career as consulting engineer for John Hays Hammond, following his graduation from the University of Pennsylvania. He was a member of the University, St. Nicholas, The Lambs, Ardsley Country Club, the Midday Club and the Bankers' Club.

William Thomlinson, a British Columbia mining man, died recently at his home at New Denver, Col. Mr. Thomlinson went to British Columbia thirty years ago and became interested in mining. After completing a course of mineralogy at Queen's University, Kingston, Ontario, he was employed by the provincial government in the collection of mineral specimens for exhibition purposes. He served as the British Columbia representative on the mineralogical staff of the Canadian Government Commission at the Panama Pacific International Exposition at San Francisco, as well as the Panama International Exposition at San Diego, Cal. Later he became identified with the Munition Resources Commission.

Philip B. Argall, a mining engineer and metallurgist of international reputation and an expert in the cyanide process, died of influenza at Denver on March 19. Mr. Argall was born near Belfast, Ireland, in 1854, and his first position in his chosen work was with the Tigroney mines, on his native island. Following this engagement he was employed by various companies in Ireland, Wales, and England, finally going to New Zealand in 1884 as manager of the Kapanga mine. The next year he was appointed superintendent of a group of mines in the Barranca district of Sonora, and soon after went to Colorado as manager of the La Plata smelter, at Leadville. When the cyanide process first became of commercial importance Mr. Argall became interested in it and acted as consulting metallurgist to the American McArthur-Forrest Co. From 1894 to 1901 he was manager of the Metallic Extraction Co., which built the first large plant to treat Cripple Creek ore by cyanidation. He acted as consulting engineer to the Dolores Mining Co., to the Golden Cycle Mining Co., and to Stratton's Independence, Ltd., among many other companies, after entering the consulting field in 1901. His wife died in 1903. Two of his five sons have been in partnership with Mr. Argall in his metallurgical activities. Mr. Argall leaves a host of friends among the older members of the profession. He is survived by ten children.

PHILIP B. ARGALL

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

Conditions on the Rand are much improved. The strike has been called off, the radical leaders have been captured, and the government is in control of the situation.

A special session of the Colorado Legislature next month will consider legislation looking to the protection of Pueblo against floods and to the creation of tunnel districts empowered to issue bonds, this latter to make possible the construction of the Moffat tunnel.

The Copper Queen Branch of the Phelps Dodge Corporation announces interesting changes in personnel.

Senator Stanfield's new bill for suspension of assessment work, recently introduced, stands little chance of passing, it is said.

Those interested in prospecting in Siberia will find of value the information given in this issue by a correspondent in that country.

The Tariff bill, it is thought, will be reported soon by the Senate committee. Delay has been caused by the large number of protests received.

Legislation to permit prospecting on private lands in the East is talked of in Washington.

Strike at Gold Mines on Rand Called Off

Leader of Radicals Arrested—Government Forces Recover All Points—Bolshevist Plot Alleged

After several days of fighting between the striking gold miners on the Rand and the government forces, the general strike was called off on March 18 by the old South African Industrial Federation, as distinguished from this organization's "augmented executive." It was announced that the latter was also to take similar action. Haste was made to repudiate complicity in the revolution against the government. It was reported that the police claimed to have abundant evidence showing a Bolshevist plot to be responsible for the trouble. Joe Thompson, president of the "augmented executive," was arrested.

Short work was made by the troops of recovering the points on the Reef that had fallen into the hands of the strikers at the start. In all about 6,000 prisoners were taken. Fordsburg, where many strikers had congregated, was taken after a brief bombardment. Fisher and Spindiff, two of the strike leaders, were found dead there afterward.

The following figures were published on Feb. 8 by the Transvaal Chamber of Mines, as an appeal to the intelligence of the general public and particularly to the strikers. Number of white men employed before the strike: Luipaard's Vlei Estate, 158; Geldenhuis Deep, 552; Roodepoort U. M. R., 130; Durban Deep, [illegible]; New Goch, 130; East Rand Proprietary Mines, 1,419; Robinson, 390; Randfontein, 1,348; New Kleinfontein, [illegible]; Aurora West, 93; Wolhüter, 310; Knight Central, 276; Simmer and Jack, [illegible]; Nourse Mines, 539; Village Deep, 546; West Rand Consolidated, 365; Ferreira Deep, 356; Rose Deep, 529; Witwatersrand Deep, 360; New Unified, 86; Witwatersrand, 343; Van Ryn Estate, 324; New Primrose, 160; Consolidated Main Reef, 654. Total number of white employees on above-named gold mines, 10,598.

Krupps Reported Negotiating for Ural Mines

By Cable From Reuters to "Engineering and Mining Journal"

London, March 20—According to dispatches received from Berlin it is understood that Krupps intend to purchase some mines in the Urals. One of the directors is reported to have bought at Moscow the whole of the shares of the Russo-Asiatic Union of Ural Mines. [No such company is known. The Russo-Asiatic Consolidated, Ltd., with headquarters in London, has holdings in the Urals and Western Siberia totaling 2,500,000 acres.—Editor]

Broken Hill Company Shuts Down Remaining Furnace

By Cable From Reuters to "Engineering and Mining Journal"

Melbourne, March 16—The remaining blast furnace at the Broken Hill company's iron and steel works at Port Waratah, near Newcastle, N. S. W., has been shut down. Three hundred workers were paid off.

Magma Stockholders To Decide on Bond Issue for Smelter

Stockholders of the Magma Copper Co. are to hold a special meeting on March 28 to act on a resolution authorizing the board of directors to issue convertible bonds not to exceed $4,000,000 with which to finance the erection of a smelter and to increase its milling capacity as well as to widen the company's railroad to standard gage. Ore reserves are estimated at 1,505,000 tons, assaying 5.6 per cent copper, 3 oz. silver, and 50c. gold. A proposal to increase the capital stock from $1,500,000 to $1,750,000 will also be voted on.

Prospecting for Gold Illegal on East Siberian Coast

Special License Necessary—Large Area, Legally Held, Already Located or Patented—No Concessions Exist

American prospectors or others contemplating going to the east Siberian coast for the purpose of prospecting for gold, or operating gold placer claims, should bear in mind that since 1900 a law has been in existence which does not permit foreigners or even Russians, except under a special license, to prospect for gold, locate mining claims, or carry on mining operations within sixty-seven miles from the coast. The prohibited zone is an area roughly 6,000 miles in length and of the width above stated, bounded on its eastern side by the sea and on its western side by an imaginary line parallel to the contour of the coast line, and extending from the border of Korea on the south to the Bering Strait on the north.

Care should be taken therefore that this law is not infringed by those considering prospective gold mining in the coast region. The leasing or purchase of existing mines or mineral properties from owners many be arranged through the name of Russian subjects, but the closest enquiry should be made in advance as to the validity of titles. An impression which should perhaps be corrected is that the coast region is unprospected. Though this is true for many parts of it, there are over one thousand linear miles of creek and river locations for gold and other minerals, and several thousand acres of patented claims. These are legally held, taxes being regularly paid to the Vladivostok government. They are held mainly by Russian companies or individuals, exceptions being one or two foreign companies or individuals possessing exceptional mining rights.

Mining "concessions" so far as known do not exist in the region specified.

The nearest approach to special concessions are certain prospecting rights within defined area limits and for a limited time. Even these do not give exclusive prospecting rights in the regions concerned.

It is now the intention of the Vladivostok government to establish offices of the district mining engineer at Okotsk, Petropavlovsk, Anadyr, and other points where mining locations can be properly recorded by authorized license holders. Any American wishing to acquire such a prospecting and mining license is advised to apply to the Mining Department at Vladivostok. Unless he is possessed of such a license, or has previously made arrangements with existing companies holding mining claims, his presence on mineral claims in the sixty-seven-mile zone will be considered as a trespass by the Russian government authorities.

Under the heading of such trespass comes most of the individual placer mining which has been carried on by foreigners in the last few years in the Anadyr region, and in the region bordering the north shore of the Okotsk Sea.

On the other hand, in the Yakutsk government, whose eastern border is the Yablonoi and Stanovoi mountain divides, mining rights are open to all foreigners without special rights. The recording of claims made in this district however, necessitates eventual notification to the district engineer at Yakutsk or the Mining Department at Vladivostok, and the sending of an authorized government surveyor from one of those points to survey the claim for government patent. Russian placer claims may have a length of 17,500 ft. and are generally surveyed to include about 250 acres. Quartz claims are located 7,000 ft. square, and both these and placer claims may if desired be surveyed to include about 1,000 acres.

Flood Control and Moffat Road To Be Studied at Denver

Governor Shoup of Colorado has announced that a special session of the Colorado Legislature will be called to convene about April 10, for the enactment of flood-control legislation and to authorize the creation of tunnel districts empowered to issue bonds for tunnel construction. The proposed legislation has special referencee at this time to the creation of a flood protection district at and adjacent to Pueblo, and the driving of the Moffat tunnel a distance of approximately seven miles through the main range of the Rocky Mountains to facilitate the operation of the Denver & Salt Lake railroad. This road connects Denver with the northwestern part of the state, a territory rich in agricultural, stock-growing, and mineral wealth, but it is operated under great disadvantages on account of the altitude of its tracks over the mountain range. The proposed tunnel would reduce the length of the road about twenty-seven miles and would lower the roadbed over 2,000 ft. in passing over the Continental Divide.

Output of Copper Queen Branch To Remain at 4,000,000 Lb.

Changes in Staff of Phelps Dodge Corporation Announced — D. D. Irwin General Superintendent

By JAMES H. MCCLINTOCK

The Copper Queen branch of the Phelps Dodge Corporation, at Bisbee, Ariz., is to maintain production at 4,000,000 lb. of bullion a month, and no reduction of the present operating force is contemplated. There is to be no resumption of work at the Sacramento Hill or operation of the mill, now nearly completed, until the copper market is in much better condition. Water for the mill is to be secured from drifts at depth from the Calumet & Cochise shaft, where extensions have secured a material addition to the flow.

In April, Grant H. Dowell, manager of the Copper Queen, will leave Bisbee for a vacation of five or six months, for a rest. During his absence, his duties will be taken over by P. G. Beckett, general manager of the Phelps Dodge Corporation, whose headquarters are at Douglas. W. H. Webster has made public his resignation as assistant manager of the local Phelps Dodge interests, with which he has been connected for fifteen years, latterly with headquarters in Douglas. D. D. Irwin, who for two years has been general superintendent of the Moctezuma subsidiary at Nacozari and Pilares, has been appointed general superintendent for the Copper Queen at Douglas and Bisbee. At Nacozari he has been succeeded by Frank Ayer, promoted from mine superintendent, a position filled by promotion of E. Leland. These changes have been announced by the Moctezuma manager, H. T. Hamilton.

Lower Iron Ore Tariff Filed

The railway companies have formally notified the iron-ore shippers on the Lake Superior ranges that they will file new rates on ore for shipment from lower Lake ports to interior furnaces to become effective April 17, the reduction to be 20 per cent. This will bring the rate to the valleys to 71c. as against 91c., the former rate. It brings down the rate to Pittsburgh from $1.27½ to $1.02. The ore shippers believe the Interstate Commerce Commission will allow the reduction, although last December that body refused to sanction a 28 per cent reduction for the first quarter of 1922, sustaining the contention of the Buffalo furnace companies.

Recognition of Mexico Discussed

President Harding has been in communication with President Obregon on negotiations for recognition of the Mexican government. Mr. Harding is understood to have predicated recognition on the agreement of Mexico not to make the Mexican constitution of 1918 retroactive in its provisions regarding confiscation of mineral deposits on lands owned by foreigners and acquired before 1918.

A. S. & R. Co. Reports More Efficient Operation

Stockholders Informed by President of Steps Taken to Meet After-War Conditions

In a report issued on March 20 on increased operating efficiency in plants of the American Smelting & Refining Co., President Simon Guggenheim discusses the problems faced, policies pursued, and the results obtained. He says:

"During the war the company faced a tremendous increase in all costs relating to production. These difficulties it was realized must be circumvented, in part at least, by greater efficiency of plant operation. Illustrative of the policy pursued with respect to meeting the hard conditions imposed by the war's aftermath, the methods applied at one of our larger plants may serve as typical of the general efficiency policies throughout the entire organization.

"A 'job analysis' was made, covering every operation in the plant, so that the company might discover and take up any 'slack' existing. Classes were formed in executive and administrative work, in foremen's general training, and in vocational training. Out of this industrial training has grown a better and closer supervision by plant executives, so that the working force on each operation has been reduced to a minimum never before reached and a much greater production has been obtained per man employed.

"A few figures taken at random from operating records of the various plants during 1921 compared to operations during 1914 will serve to illustrate the above statement.

		Tons per Man per Eight-Hour Day	
Plants	Operation	Average 1914	Average Oct. 1921
Durango	Crushing	31.8	32.2
Murray	Unloading	9.2	25.3
Arkansas Valley	Roasting	6.4	13.6
El Paso	Bricking	2.0	4.4

"Indicating the effect of efficiency and other managerial policies on labor costs: In 1914, repair, supply, and construction labor was paid an average of $2.42 for an eight-hour day, while in November, 1920, the rate was $5.39, an increase of 123 per cent. In December, 1921, through various readjustments, the rates for repair, supply, and construction labor had been reduced to $4 for an eight-hour day. This was a decrease of 25.9 per cent, below the highest rate, $5.39, paid in November, 1920.

"The installation of mechanical equipment where it was certain that it would reduce labor-hours per ton has been a factor in the reduction of costs, and changes in fuel uses have also contributed largely in savings in material, time, and costs.

"Every plant activity, from the ore to the finished product, has undergone the closest scrutiny, and wherever an economy has been possible, or a better method feasible, the company has effected the economy and adopted the better method."

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Tariff Bill Will Be Reported Soon, It Is Expected

Senate Committee Members Refrain From Commenting on Rumors—Many Protests Made

The Senate Finance committee promises to report the Tariff bill by April 1. The committee has had the bill since July 21, when it was passed by the House. The unprecedented delay in handling the bill has been occasioned by an avalanche of protests against many of the rates provided in the House bill. The rates themselves would not have called out such a volume of objections had it not been that they were coupled with American valuation, which would have the effect, many think, of increasing these rates materially.

The Senate committee is keeping its own counsel. It does not confirm or deny the many rumors that are afloat as to the action it is said to have taken. It is the policy of the committee not to pass with absolute finality on any provision of the bill until it is placed on the Senate calendar.

It is known that the schedules on ores and metals are exceedingly difficult to adjust satisfactorily. There is great difference of opinion on many of these items, and many rumors are afloat as to what the committee has done or will do, but definite information cannot be had until the bill is reported out.

Some Good From Hard Times, Reports Show

Research Undertaken and Methods Improved — Marketing Studied — Capital and Labor More Efficient

Reports to the U. S. Geological Survey and to the Bureau of Mines indicate that the period of depression in metal mining has not been entirely without profit. Advantage has been taken of this time to revise mining methods and to concentrate on research. The results flowing from such work will make cheaper production possible and will allow of a greater output.

When the demand for metals is great, producers are too busy to spend much time with such matters as developing new uses for metals or to do active work toward discouraging substitution of inferior materials. Examples of this trend are seen in the activities of copper and zinc producers in developing new uses for those metals and the advertising campaign of lead producers which calls attention, among other things, to the ultimate economy in using lead pipe in plumbing, rather than substitutes the first cost of which is less. Another indication of the good work being done during the depression is the spirit of co-operation manifested in connection with the work of the committee on mining methods of the A. I. M. E.

There is abundant evidence that adversity is making both capital and labor more efficient and more sympathetic with the rights of their too silent partner, the general public. It is recognized generally that labor, toward the end of the boom period, was traveling on dangerous tangents. The depression has brought about a wholesome change in the psychology of labor, and operators are interesting themselves more than ever before in the basal economics of their own industry.

Mexico's Gold Output Reported

Production of gold in Mexico in January was 1914 kg. Silver production was 190,213 kg. The figures are those of the mining division of the federal Department of Industry, Commerce and labor. Gold production continued at practically the same level as in December, but silver production fell off to the extent of 21,073 kg.

Prospecting on Private Lands in East Considered

Some discussion is being held in Washington as to the advisability of legislation which will allow prospecting under certain conditions on lands held in private ownership in the East. The recent opening of the Kingdon mine, in eastern Ontario, and the fact that the Mascot mine, in Tennessee, was walked over for years prior to its discovery, are striking examples of valuable mineral deposits on private lands which were not discovered or worked, owing to the absence of any possible reward for the prospector. If a way could be found to insure such a reward following the discovery of valuable minerals, it is believed many valuable deposits would be sought out in the older sections of the country.

Wants Money for New Cable to Alaska

The mineral possibilities of Alaska were described recently to the House Committee on Appropriations by Representative Miller, of Washington, who appeared to present an argument for the appropriation of funds for the construction of a new cable to that country. "There is more mineral in Alaska commercially necessary and in war time absolutely necessary than in any other country in the world of equal area," he said. The proposed new cable is to replace the one now practically worn out, and is designed to afford communication between the United States and Alaska.

Would Appoint Conciliators To End Strikes

Secretary of Labor Advocates Assigning Representatives to Basic Industries, Including Mining

Funds sufficient to permit the appointment of special conciliators to basic industries, including mining, for the purpose of preventing industrial disturbances and settling disputes, were asked of the Senate Committee on Appropriations recently by Secretary of Labor Davis. The original plan was for thirty specialists in a like number of the basic industries of the country, appointed from among laboring or business men possessing ability and knowledge of the work of the industry to which they would be assigned. In the interest of economy Mr. Davis modified the recommendation to cover from four to seven conciliators, in order that the plan might at least be given a thorough test.

Secretary Davis intimated the probability of a coal strike in discussing this matter, as illustrating the need for such a special service to industry. "With a coal strike coming on," he said, "if we had a trained conciliator thoroughly familiar with the coal industry he would be the chairman of that particular coal commission, ready to hold sessions in any city, and the same process would follow in other lines of industry. While saying the present conciliators are jacks of all trades and masters of none, Mr. Davis said he would not dispense with their services, as they were needed in settling disputes, although he admitted they were not conducive to lasting peace in industry. He said the conciliators must be strictly neutral or they would not be retained.

Director Kerwin of the Conciliation Service said the conciliators assigned to the basic industries would be high-class men technically skilled in the basic industry to which assigned and would obtain information from the standpoint of the manager of the industry as well as the employees. This information would be made available to Government, state or municipal agencies, as well as to employers and employees, to prevent industrial disorganization and adjudicate disputes.

Mr. Kerwin also said the plan was to assign one conciliator to the mining industry. The conciliators selected would be those who understand the employees' point of view. He thought the secretary's plan was necessary to settle industrial disputes, as at present the questions at issue were difficult to adjust, as both sides vigorously maintain their interests at every stage of the proceedings. The attitude of the Committee on Appropriations to the request has not been stated.

NEWS BY MINING DISTRICTS

London Letter

Mount Elliott's Efforts To Finance Itself Held Up—Falcon Mine in Poor Position—Obbuassi Mines in High Grade

BY W. A. DOMAN

London, March 16—For some time the Mount Elliott company (in North Queensland) has been endeavoring to raise capital to pay for reserves that have been brought in sight and to expand operations. The shares are held largely in France, and in the pursuit of raising further capital, French holders have, naturally, had to be consulted. At first, the principal parties at interest desired a reconstruction, but in the judgment of the directors this was not practicable. After long negotiations, an arrangement was made by which £360,000 of fresh capital was to be guaranteed by the French and English financial groups in equal moieties. Unfortunately, and, it is reported, partly in connection with the failure of the Industrial Bank of China, the support promised by the French group has fallen through, so that the matter is again hung up. This is the more unfortunate, as Mr. Corbould, the manager, estimates the profits on the ore opened up at £2,000,000, with copper at £80 per ton, and, in addition, Mr. Corbould says there are good possibilities of developing many millions of tons of further ore reserves.

Another copper mine that is at present in a rather unsatisfactory financial position is the Falcon (in Rhodesia). The directors' report for the twelve months ended June 30 last shows total liabilities at £100,920, with, however, assets amounting to £72,600, a deficiency of £28,000. The trouble with the company has been, of course, increased working costs, heavier railway charges, the increased price of coal, and, not least, the fall in the price of the metal. The average working costs during the twelve months were just under 43s. 5d. per ton, an increase of 2s. 3d. on the previous year. Every effort was made to reduce expenses, and during the second half of the year the working costs did not average more than 39s. 9d. per ton, both this figure and the average mentioned including 2s. per ton for development redemption, although no development work had been accomplished in the second six months. The copper sold in New York realized £416,735, but working expenses reached £400,340, so that the working profit was only £15,750, and this was converted into a deficiency of £15,800.

The company's engineers recommend a further development at depth, to ascertain prospects below the twelfth level, where the orebody is disturbed. Unfortunately, with the financial position unsatisfactory, the directors are unable to sanction the expenditure at present. A point that is worth mentioning is that, in parts, the ground is slowly caving, but, so far as can be judged, the main shaft is not threatened. The ore reserves at Dec. 31 last amounted to 474,000 tons, apart from anything that might be recovered from reclamation work.

Between the fourth and fifth levels, the Obuom concession of the Obbuassi Mines (in Ashanti, West Africa) is disclosing a high grade of ore. Four winzes are being sunk from the higher to the lower horizon, and all are ahead of the fifth level, at intervals of 50 ft., from 160 ft. to 360 ft. south from the prospecting shaft. Some time ago the average value in the winzes, which were at varying depths, was 58 dwt., over an average of 24 in. of reef. No. 3a has now gone half the distance, that is, 25 ft.; the average width of reef is 51 in., and the average value 22 dwt. Three hundred feet further to the south the second winze has reached 30 ft., the average width of reef being 24 in., and the average value 20 dwt. This shows a distinct falling off from the results obtained in the winze 160 ft. south of the prospecting shaft, where the average width for the full distance of 50 ft. was 23 in., the average of assays being 150 dwt.

Hearings on Metric System Bill Ended

Hearings on the Britton-Ladd metric system bill have been definitely closed with the final appearance of representatives of the American Metric Association to rebut the testimony given in opposition to the legislation.

Forest Service Avoids Selling Timber on Claims

Director Greeley of the Forest Service has replied to criticism that his bureau sells the timber on a mining claim, at the same time denying the timber to the miner, who must send sometimes thousands of miles for timber which might have been cut from his claim. "The forest service scrupulously avoids the sale of timber on any mining claim which the Interior Department accepts as valid," he replies. As to to the charge that the Forest Service has "locked up" the resources of Alaska, Colonel Greeley says the Alaskan forests supply 86 per cent of all timber used in southern Alaska for mining and other purposes.

In testimony before the House Appropriations Committee, Director Greeley explained the work of preservative treatment of mining timber. He said there was great loss because of the rapid decay of timber used for mining purposes.

Johannesburg Letter

Gold Discovery on Crocodile River Reported—Railway From Kimberley To Vaal River Diggings To Be Built

BY JOHN WATSON

Johannesburg, Feb. 7—Report has been made of a discovery of gold on the Crocodile River to the north of Rustenburg. One prospector is said to have seen specimens of banket from the locality which were similar in appearance to the conglomerate beds of the Witwatersrand. It is stated that on the farm Hagebomen, about eighty miles north of Rustenburg, a conglomerate bed, probably of Black Reef age, is being opened up and that the indications are good. Others say that these deposits have been known for many years, are of the Lydenburg age, and comparatively unimportant.

There are deposits of ironstone in that district, and the government geologist, Dr. P. A. Wagner, recently published a memoir on these.

The Union government has decided to proceed with the construction of the railway line from Kimberley to Barkly West and Borrell's Kop. This is good news for many in Kimberley, where unemployment is great at present. Barkly West was originally the capital of Griqualand West and is today the most populous and thriving center on the Vaal River diggings, producing diamonds affording considerable revenue to the government. Borrell's Kop will be the terminus of the new railway for the present and is within easy access of asbestos mines and other mineral properties.

The Luipaard's Vlei mine, near Krugersdorp, is in a parlous position. Like other gold mines on the Rand it has been closed by the strike of workers. Rumors were afloat recently that if the strike was not settled soon work on the property would not be resumed. It is a mine without any group backing, and without money, which has recently been losing at the rate of £400 daily. About 2,000 natives and 189 whites were employed there up to the shutdown.

A statement issued by the Native Recruiting Corporation, Ltd., on Jan. 26 shows that 33,321 natives left the gold mines during January, up to Jan. 25. These are time-expired "boys" returning to their homes on account of the regretable strike on the Rand.

Government's Silver Purchases Pass 100,000,000 Oz. Mark

Purchases of silver by the Bureau of the Mint during the week ended March 20 amounted to 1,205,980 fine ounces. This brings the total purchases under the Pittman Act to 100,077,608 oz.

AUSTRALIA

Queensland

Mount Morgan Strike Settled—U. S. Got 77 Per Cent of January Gold Sold

From Our Special Correspondent

Brisbane, Feb. 14—The best news in the Queensland mining world is that the Mount Morgan mine and works are expected to resume operations. [A cable dispatch in the issue of Feb. 25 announced the settlement of the strike—Editor.] In the past few days an amended proposal, made by the state premier, has been put before the unions concerned, and these have voted in favor of it by large majorities. It is understood that, with the help of a rebate in railway freights promised by the state government, the wages to be received by the men will not represent a reduction of more than 5 per cent on those in effect when the mine closed down in March, 1921, and that any future reduction will be based on a sliding scale ruled by the price of copper. It is said that the saving to the company with a payroll of 1,766 will work out at £137 13. per day, but it must be borne in mind that the price of copper has fallen considerably.

Sales made in January by the Australian Gold Producers' Association, from whose operations all the Queensland gold fields have derived much benefit, amounted to 135,085 oz. of standard gold, of which 77 per cent went to the United States, 18 per cent to India, and 5 per cent to Java. The estimated average price realized was about £4 16s. 9d. per fine ounce. It is expected that the distributable premium for the last half year of 1921 will be approximately 17s. 5d. per fine ounce.

News has been received in Brisbane from Papua, in connection with the operations of the New Guinea Copper Mines, Ltd., that a cargo of 2,500 tons of air-dried ore has been shipped to Port Kembla, and that developments at the Laloki copper mine are regarded as satisfactory. In the crosscut from the No. 8 winze below the 137 ft. level, the lode, which had assumed a flat underlay and had risen above the crosscut, has again come down into the level. It has been cut into for a distance of 25 ft., the first 15 ft. being in low-grade pyritic ore and the last 10 ft. in high-grade copper ore averaging 7 per cent.

Little Chance for New Measure Concerning Assessment Work

Suspension of the requirements of annual assessment work on mining claims from January 1, 1920, to June 30, 1924, is authorized in a bill (referred to in the last issue) which has been introduced by Senator Stanfield, of Oregon. As there is a decided sentiment against any further remission of assessment work requirements, it is not probable that the proposition will receive favorable consideration in either house. A proviso is included in the bill that every claimant shall file a notice of his desire to hold his claim.

CANADA

Yukon Territory

Many Camping in Mayo District—New Strikes on Keno Hill Reported

Dawson—Recent arrivals from Mayo report that several new rich silver-lead strikes have been made on Keno Hill. Promising veins have been opened on the Croesus, Crystal Gulch, Gambler Gulch, Slate Creek, and Stone claims. The Slate Creek company is mining a 5-ft. vein of almost clean, steel-gray galena to a depth of 65 ft.

The Yukon Gold Co. has about 3,000 tons of high-grade ore at Mayo Landing, ready for the opening of navigation. The company has reached a depth of 300 ft. on the Rico claim, and the vein is as strong and rich as on the surface. In another shaft, a mile away, the company has reached a depth of 70 ft. on another vein, and is in good ore.

The Treadwell interests have confined themselves to development, and have only taken out ore incidental to such work. They have two shafts down more than 100 ft., and these are to be continued to 300 ft., and connected by three levels. This will block out a large tonnage of ore. The vein averages 3 ft. in both shafts, and assays run from 200 to 500 oz. in silver per ton.

It is claimed that nearly half the population of the Territory has assembled at the camps around Mayo, and that this will be greatly augmented during the coming season. The White Pass Railway Co. is making arrangements for a busy season. It is building a new steamer at Mayo to handle the increased traffic that is expected.

British Columbia

Early Opening of Yukon River Expected—Placer Mining Experiencing Boom

Victoria — Mining men are on their toes in anticipation of the early opening of navigation in the Yukon and Alaska, as well as in the active camps of northern British Columbia. The annual flow of prospectors and operators who have been wintering in Vancouver, Victoria, and Seattle has started northward. Outbound steamers are crowded already, and the bookings on Canadian as well as on American ships scheduled to leave during the next few weeks have been so brisk as to put accommodation at a premium.

Though Atlin, Dease Lake, Alice Arm and other well-known and long popular districts are attracting their quotas, most of the travelers are en route either to the Portland Canal region or to the Mayo camp. Up to the present the majority favor the latter district. The rush to that famous silver producing camp close to Dawson City has started early through a desire to get in over the snow, for when the break comes it will be some time before the roads or trails are in good condition.

The judicial committee of the Privy Council has refused the application of Anna Theresa Boyle to two placer mining claims on the Klondike River, thus sustaining the decision of a Dawson Mining Recorder. This ends litigation that has been carried from court to court for several years. Some valuable gold property, as a result of the judgment, will go to the Canadian Klondike Co., Ltd.

The Del Ecuador Mines Co., which has a large block of leases in the Cedar Creek region of the Cariboo, is reported to be arranging to put a dredge on the ground this year.

Joseph Tretheway, who recently bonded the discovery claims on Iron Creek, Taseko (Whitewater) River, in the Lillooet district, is reported to have shipped a diamond drill to Williams Lake by the Pacific Great Eastern Ry. Thence it will be taken across ice and snow by way of Hanceville into the Whitewater and set up ready for work as soon as weather permits. With this equipment it is proposed to prospect thoroughly the telluride formation reported to be rich in gold. The accounts of recoveries made from this property by a miner named Taylor last summer have created much interest in this region by prospectors.

On Cherry Creek, a placer and quartz gold mining district near Kamloops, a Seattle syndicate has staked a number of claims and already has a crew of men on the ground. Placer ground, it is said, is to be opened up by means of hydraulicking, and some lode prospects are to be explored by diamond drill.

There is activity of a similar character on Shorts Creek, on the west shore of Okanagan Lake. In this region, however, interest is being manifested exclusively in the placer possibilities.

It is reported that a Keystone drill will be put to work on the Prince of Wales Mining Co.'s leases on Horsefly Creek, this summer.

The Indian Mines, Ltd., and adjacent claims, situated in the Salmon River valley, Portland Canal, have been acquired by G. D. B. Turner and associates. This property is northwest of the Premier Mining Co. The work so far done shows a vein from 6 to 14 ft. wide, with fair gold and silver values and in places considerable galena. The latter is uniformly low in silver. The camp is well established, and development will start as soon as the season opens.

At Anyox, the Granby Consolidated Mining, Smelting & Power Co., Ltd., intends to build a short railway to the site of the dam which the company is to construct to assure an ample supply of water for purposes of operation. Recent heavy rains have improved the situation in the district of the Hidden Creek mine and the Anyox smelter.

Placer mining is experiencing a mild boom in British Columbia. Much is looked for next summer from the newly discovered fields of the Cedar Creek district, in the Cariboo. A revival in other sections of the province, notably the Omineca and East Kootenay, is anticipated. For the most part operations will take the form of hydraulicking, but a company already is reported to have started work with a dredge on the Peace River and another purposes installing a similar plant on Cedar Creek.

Nelson — The Gibson Mining Co., which had a group of claims under development on the South Fork of Kaslo Creek three or four years ago, and which became involved in financial difficulties and litigation, is being finally disposed of under the provisions of the British Columbia "Winding-up Act," with Sheriff Doyle as official liquidator. Final hearing of claims and creditors is to be held at Vancouver April 3.

Agitation for erecting an ore-testing plant, to be established by the dominion government and to be built at Nelson is being continued by local interests. Vancouver is also a contender for such a plant, and representations from both points continue to be made at Ottawa.

Kaslo—The Kaslo & Slocan branch of the Canadian Pacific Ry., and which affords communication between Kootenay Lake and the various mining camps of the Slocan, is blocked with snowslides between Three Forks and Bear Lake. It is unlikely that traffic can be resumed for several weeks.

Rossland—The Velvet mine, which is situated near the international boundary line between here and Northport, Wash., has been unable to make shipments lately because of the cutting off of all traffic on the Red Mountain Ry. by the Great Northern.

Lessees of the I. X. L. property, near here, have recently received returns on about 26½ tons of ore shipped to the Bunker Hill smelter, at Kellogg, Idaho, and which brings the total value of shipments within the last six months up to $30,000.

Trail—Ore shipments received at the Consolidated smelter from March 8 to 14 inclusive totaled 9,153 tons, coming from the following shippers: Mountain Chief, New Denver, 9 tons; Paradise, Lake Windermere, 36; Rosebery Surprise, New Denver, 143; Silversmith, 66; and company mines, 8,899.

Ontario

Sudbury—President J. L. Agnew of the International Nickel Co., of Canada, in an interview at Sudbury, Ont., outlined the new policy of the company in view of the lessening demand for nickel for armament and war material. The salient feature, he stated, would be the remodeling of the exploitation department. Specialists of high standing had been engaged with a view to broadening the field for nickel and monel metal parts, as new uses for nickel would have to be created to make the industry a success. Hereafter, all refining of nickel will be done at Port Colborne, but the resumption of operations at the smelter and mines may be a matter of months.

MEXICO

Jalisco

San Geronimo Mill Being Overhauled

Mascota—The Cia. Minera de San Geronimo S. A. (referred to in the issue of Feb. 4 in a way that is said to be misleading—Editor) and the Cia. Minera de Santa Rosa S. A. have been organized over a year. The first company owns the Mirador and San Jorge and Santa Lucia mines; the second the Lupita and several properties, in the San Sebastian district. The control and management is trusteed to the San Geronimo and Santa Rosa Securities Corporation, organized under the laws of Massachusetts. Work has been under way for four months, and there is already 10,000 tons of ore on the reserve dumps. A power plant is being erected and modern machinery installed in the mill, which is expected to be in operation by May 1. The high-grade ore is already being shipped to the smelter.

Nuevo Leon

Mill To Be Built at Minas Viejas Property

Monterrey—William A. Burr is taking over the Minas Viejas property, the terminal at Guadeloupe, and the railroad from the Cia. de Peñoles. He states that he will erect a plant for treating low-grade lead carbonate and oxide ores. Owing to the decline in the price of metals, the productivity of the mine has been retarded in recent years. The mine has important bodies of iron and zinc ores, the former running 50 to 60 per cent iron and the latter 30 to 45 per cent zinc. It has been worked for about 300 years.

Chihuahua

Erupcion Company Elects Officers

Chihuahua—A meeting of the Erupcion Mining Co. was recently held in El Paso, and the following officers were elected: President, E. F. Knotts; vice-president, John F. Bankherd; secretary and treasurer, C. A. Kinne. Other members of the board of directors are D. B. Smith, W. D. King, Jesse Yoakum and Warren and K. L. Mohler. The property of the company was discovered by E. F. Knotts.

Argument Heard in Oil Land Case

Argument was heard in the U. S. Supreme Court on March 13 in the appeal of the Government from the decision of the lower court which confirmed title to certain oil companies to oil lands in California. The Government contended that the lands were not subject to entry by the oil companies, including the North American Oil Consolidated, because they had not began development work prior to their withdrawal by the Government as Naval oil reserves. The oil interests argued that the companies were entitled to the lands under mining patents and that discovery and development work was being prosecuted before withdrawal.

ARIZONA

Old Dominion Expected To Start Furnace—Shea Stockholders Confer With C. & A. Representatives

BY JAMES H. MCCLINTOCK

Globe — The new Inspiration shaft of the Porphyry property is now down 750 ft. and is to be sunk to 1,400 ft. before a station is cut. It will be concreted throughout, will be of five 16x21-ft. compartments, modern in arrangement, and will be the largest in the state. It is reported that it is to be the main working shaft of the company when completed and connected.

Inspiration is operating about one-third of its mill, the Miami. Old Dominion and Iron Cap mills are running, sending concentrates to the International smelter. It is expected that Old Dominion will start a blast furnace about April 1.

Ajo — New Cornelia is sinking another large well seven miles from Ajo, to increase the water supply that will be needed by the proposed 5,000-ton flotation mill. It is expected that a reverberatory will be added to handle the concentrates. New Cornelia's February production was 1,459,063 pounds of copper, somewhat less than the January output.

Oatman—The condition in the Oatman district now obtaining can be called one of "watchful waiting." The first speculative enthusiasm, brought about by the reported strike in the diamond-drill holes of the Oatman United, has somewhat abated. The management of this property seem averse to giving out further information or data. The company is now driving a crosscut which will open and check up the ore indicated by the drills. This reported discovery of values in the rhyolite dikes of the eastern part of the camp has caused several other companies to initiate drilling campaigns. In all probability there will be no further increase of activity, except in drilling, until the Oatman United crosscut strikes the new ore. About two months will be required for this driving. If the strike is then confirmed, Oatman will enter into the second stage of the present boom.

Douglas—The Calumet & Arizona Mining Co. was able to produce 2,462,000 lb. of refined copper in February because it had full ore beds at its smelter. This is about 60 per cent of normal production. New Cornelia, a subsidiary of Calumet & Arizona, is on approximately a 40 per cent production basis.

At a meeting of officers and large stockholders of the Shea company with Calumet & Arizona representatives, held in Jerome, it is understood that a definite agreement was reached concerning an option on the stock to be taken by the latter company, and that this will be submitted to the Calumet & Arizona directorate at a meeting to be held April 15.

CALIFORNIA

Shasta Zinc & Copper Co. Increases Capital—Angels Deep Mine Transferred

[illegible]

San Francisco—A conference of oil men has been held here relative to a readjustment of moneys paid to the Government under the Leasing Act and to secure some amelioration of the existing charges.

A recent decision of the Federal courts confirms the ownership of F. M. Smith in certain borax claims in the Death Valley region.

The Shasta Zinc & Copper Co. has filed amended articles of incorporation increasing its capitalization from 200,000 to [illegible]00,000 shares.

The Keynote, a mining prospect six miles north of Yreka, has been bonded to N. B. Randall, of Seattle.

The Gowing mine, of Eddy's Gulch, near Cecilville (Siskiyou) will put fifteen men to work as soon as water is available for mill operation.

C. D. Jones & Co., of Hollywood, have bonded the West End, adjacent to the Mascot mine, near Whiskeytown, Shasta County. W. M. Parsons will direct development work.

The Pittsburgh Syndicate, developing a gravel mine near Iowa Hill, Placer County, has announced that 2,000 ft. of development has been driven.

R. A. Nicol and J. L. McCall, of Oakland, have bonded the Independence drift mine, near Forest Hill.

The Engels Copper Mining Co., according to local reports, milled 950 tons per day during January and February. A wage higher by 25c. per day than at Butte is being paid the men.

The California Exploration Co., of San Francisco, has taken over the Angels Deep mine, near Angels Camp. J. C. Benson will continue as manager, and a new plan of deeper development will be initiated.

NEW MEXICO

Lordsburg—Work on the Anita Copper Co.'s property, formerly known as the Octo, is being pushed under the direction of George A. Foreman, of Los Angeles. About twenty tons of siliceous carbonate and oxide copper ore carrying some gold and silver is being hoisted daily, from development work. Preparations are being made to install an experimental leaching plant. About twenty-five men are working.

Pratt—The Calumet & Arizona company has a force of men getting out fire clay. It owns 124 acres of clay ground here, and has shipped several carloads of it recently to the C. & A. and the Copper Queen smelters at Douglas.

Steins—The Volcano Mines Co. is working a small force. A hoist and compressor have been installed, and grading for other equipment and buildings is being done. Considerable development work has been done underground. The property consists of thirty-nine claims held under option and by location. The company has a capitalization of 2,000,000 shares, par $1.

COLORADO

South Park Company's Dredge To Be Started May 1

Fairplay—The dredge under construction by the South Park Dredging Co. is nearing completion and will go into operation about May 1. The dredge will cost when completed, upward of $300,000 and will handle about 5,000 cu.yd. of gravel every twenty-four hours. Two more dredges have been contracted for, both of steel and twice the capacity of the present boat. The first is to be completed in 1923 and the second in 1924.

The company, which is a subsidiary of the Hammon interests in California, owns a large acreage of placer ground between Fairplay and Alma, which it has been testing for the last two years or more. The larger dredges are being constructed for deeper work, where tests, it is said, indicate that from twelve to fifteen years will be required to exhaust the proved ground.

Lyons—The Smuggler-Ballarat Mining & Milling Co. is building a concentrator to treat the old dumps of the Smuggler mine, estimated to contain 150,000 tons of ore that may be treated at a profit. Power plant and other buildings are being repaired, and roads are being reconstructed to the property. The company was organized in January, 1922, by C. L. Sloan and associates. The capital of $300,000 is represented by 300,000 shares. C. L. Sloan is president and general manager.

Idaho Springs—The Coral Gold Mining Co. has been incorporated for $500,000, and will undertake the reopening and development of the England group of mining properties in Clear Creek County. W. L. Stevenson is president.

The Gem Mining Co. will start its Newton mill and begin treating ore from the Gem mine, where development work has been in progress for more than a year.

Telluride — During February shipments of concentrates were as follows: Smuggler-Union, 63 cars; Tomboy, 50; total, 113, compared to 143 in January, and 104 cars during February of last year.

Ophir Loop—The Valley View Leasing Co., operating the San Bernardo mine, is milling about 100 tons of ore per day. B. C. Essig is manager.

NEW YORK

Northern Ore Co. Resumes at Mine and Mill

Edwards—The Northern Ore Co., of Edwards, N. Y., has reopened the plant and mines, which have been closed since early in 1921. The plant is now employing about 100 men and running on a schedule of about forty tons daily of zinc concentrates. It is planned to double this force in the near future. Shipments from stocks accumulated during 1920 and 1921 have been continued during the time the plant was down.

NEVADA

West End Increases Tonnage—Eureka Holly and Bullwhacker Merge—Situation Better at Pioche

(From Our Special Correspondent)

Tonopah—The West End Consolidated has increased its tonnage from 225 to 300 per day. The extra tonnage will be treated at the MacNamara mill, with probably some shipments to other custom mills of the district. F. C. Ninnis, superintendent of the West End mill, is to have complete charge of the MacNamara mill also. The Halifax Co., which is controlled by the West End, is shipping 20 tons of ore per day.

It is reported that the Rescue Eula has made an important ore discovery in a vein which has been developed and stoped to the property line by the Tonopah Belmont, and that the ore will be shipped to the Belmont mill via the Belmont underground workings. The Rescue Eula is shipping about 450 tons of ore per month, from which a profit of approximately $5,000 per month is realized.

Recent bullion shipments from Tonopah, representing clean-up of operations for the last thirteen days of February, are as follows: Belmont, $101,640; Tonopah Mining, $60,000; West End, $68,000; Tonopah Extension, $59,500. These shipments are about normal.

Eureka—The Eureka Holly and Bullwhacker have been consolidated as the Holly Consolidated Mining Co. Officers of the company state that funds are now available for mill construction, and that plans are being formulated for the beginning of work in the spring, the process to be employed being flotation. The Holly is reported to have 100,000 tons of mill ore available.

Luning—A new orebody of promise has recently been cut in the tunnel workings of the Luning Consolidated Mining Co., which is operating five miles east of Luning. Face samples run as high as $50 in gold and silver. This company is shipping gold and silver ore to the Tonopah Mining Co.'s mill at Millers, and an iron ore carrying gold to Richmond, Cal.

Virginia City—The United Comstock Mines Co. plans to increase the mill construction crew by at least 150 men on April 1. Much time has been lost owing to adverse weather conditions, and it is not considered likely that the mill can be completed by July, as originally planned. The haulage tunnel is practically finished, and the mine will soon be ready for production.

Pioche—Improving weather conditions will soon be reflected in a decided increase in the ore shipments from the Pioche district. For the week ended March 10, the following mines shipped crude ore to the Salt Lake Valley smelters: Bristol Silver, 215 tons; Black Metals, 240.

Financial arrangements just completed indicate that Eastern interests, represented by C. W. Geddes, are planning to resume work on a number of properties in the Silverhorn district, including the Silver Dale, the Nevada Silverhorn, the Silver Peer, and the Silverhorn Mining & Development Co. A consolidation of these companies may be effected.

For the last two months representatives of the International Smelting Co. at Tooele, which is expected to resume soon, have been negotiating for ore in the Pioche district, and the mines with the larger tonnages blocked out, notably the Combined Metals, Bristol Silver, Black Metals and others, have been examined by engineers of the Anaconda Copper Mining Co. (which owns the International) with a view to obtaining a substantial tonnage of mixed ores from this district. The favorable long-term contract granted the Prince Consolidated by the International Smelting Co. is still in effect, and it is probable that shipments will be resumed from the property this summer, though the stockpiles of Prince ore still on hand at the smelter will be sufficient for some time. In addition to this, there is a large tonnage of siliceous Bullionville tailings available, which, with cheaper costs, can be smelted at a profit.

J. D. Thomson, president of the Virginia Louise company mine, says the mine contains the largest deposits of fluxing ore in the West, and that the present shaft and lateral workings have opened up probably 1,250,000 tons of fluxing ore of a gross value exceeding $6,000,000.

WASHINGTON

Gorrien Mine Has Deposit of High-Grade Zinc Ore—Gladstone To Reopen

Northport—The Northport district is just emerging from an unusually long winter of severe weather and deep snow. Only one property, the Gorrien zinc mine, operated through the winter. This property was recently reincorporated as the Washington Black Rock Mining Co. An engine house was built several months ago, and power machinery was installed. A crosscut has been driven 233 ft. to the vein and the shaft is now being deepened on the ore. A 125-ton log ore bin and sorting tables have been completed, and shipments of high-grade zinc ore will be started during the month. Exploration work is proving an exceptionally high-grade deposit of zinc ore. Only the ore necessarily removed in development work is being shipped.

With the promise of warmer weather the Gladstone lead mine will reopen with a small crew under the direction of Dan Dodd. This property is on a chimney of high-grade lead ore in limestone. Shipments will be made via Boundary, Wash.

It is generally believed that a slight betterment of the lead market will encourage the Electric Point mine to resume operations and shipments.

Leasers are operating on a small scale at the Lead Trust and Paragon mines. The lead smelter at Northport is still down.

MONTANA

Great Falls Smelter Now Turning Out Copper—Tuolumne Ready to Resume Production

By A. B. Keith

Butte—For the first time since the suspension of operations at the Great Falls works of the Anaconda Copper Mining Co., ten months ago, copper was turned out last week in marketable form. Since the mines resumed at Butte, on Jan. 16, copper has been coming through to Great Falls from the Washoe works at Anaconda, in the form of anodes for refining in the electrolytic department and the furnace section of this plant. With the starting of the furnace section the Boston & Montana smelter at Great Falls can be said to be in operation again, but several weeks more will be required to bring production up to the capacity planned for the immediate future. By April 1 probably 800 men will be employed in all departments at Great Falls, and during this month the growth of operations is expected to provide employment for a slightly larger crew. The volume of production anticipated for the spring months will give employment to about 1,000 men, but it is considered unlikely that more than 1,200 will be working until the year is well advanced. The zinc department now is running at about 65 per cent of capacity. This is being increased as rapidly as is possible, and it is intimated in company circles that the Anaconda will be found at capacity production by the middle of the summer so far as its zinc output is concerned.

An epidemic of influenza in a mild form has raised havoc with the forces of the company. Probably 400 men were incapacitated last week. Other mining organizations were affected correspondingly.

Operations were resumed last week at the Original and Neversweat mines, and as soon as possible production will be started also at the High Ore mine.

IDAHO

Preliminary Tests of Armstead Mill Satisfactory

Leonia—An extra steam shovel has been ordered by the Idaho Gold & Ruby Mining Co., for use in emergencies. The shovel is to be used only in the event of a break in the canal used for carrying water for sluicing.

Talache — Preliminary tests of the Armstead mill have proved entirely satisfactory. Karl A. Bernsen, the engineer in charge of construction, has returned to Salt Lake City.

Coeur d'Alene City—Tests of 400 lb. of ore from the Homebuilder property, between here and Kingston, showed platinum, palladium, and iridum to the extent of $4.75 per ton, with gold and silver values of $7.55.

Hailey—John Pope, of Butte, president of the Golden Glow Mining Co., has purchased the interest of C. L. Friedrichs in that company.

UTAH

Park-Utah Developing Into Large Silver Producer—Grand Central Making Geological Survey

[illegible]

Park City—Shipments for the week ended March 11 amounted to 2,627 tons as compared with 3,032 tons the week preceding. Shippers were Judge allied companies, 1,365 tons; Ontario, 502; and Silver King Coalition, 759.

The Park-Utah will pay its second dividend, amounting to 10c. a share, or a total of $100,000, on April 1. The first dividend, of 5c. a share, was paid Dec. 15, 1921. The mine is developing into one of the largest silver producers of the camp. Four parallel veins have been opened, and production at present is coming from one vein in which an ore shoot has been developed for 700 ft. on its strike and 200 ft. on the dip, with ore continuing in both headings. The vein dips at an angle of 50 deg. The average thickness of the ore is from 3 to 5 ft.

Present shipments are approximately 150 tons per day of siliceous ore carrying 40 to 50 oz. silver, with some gold. Some of the ore breaks 65 oz. and better per ton. The monthly silver production is between 150,000 oz. and 175,000 oz. with about $6,000 in gold. More ore is being developed than mined. Operations are being carried on through the Ontario drain tunnel, in which new track (40 lb. steel rail) is being laid from the portal to the Daly-West shaft, a distance of four miles. Electric haulage is being installed. When the new electric equipment is ready, ore will be hauled to the Daly-West shaft, hoisted 900 ft., and then trammed to the portal of the Ontario No. 1 tunnel, and there loaded into railroad cars. Waste will be hauled to the mouth of the Ontario drain tunnel. Production is at present limited by transportation facilities. The Park-Utah is on the east side of the Ontario dike, which was formerly believed to mark the limit of the productive ground and mineralization on the east.

Eureka—Ore shipments from the Tintic district for the week ended March 11 totaled 141 cars, compared with 121 cars the week preceding. Shipper's were Tintic Standard, 42 cars; Chief Consolidated, 38; Colorado, 16; Victoria, 9; Grand Central, 9; Eagle & Blue Bell, 7; Iron Blossom, 6; Swansea, 5; Centennial-Eureka, 4; Bullion-Beck, 2; Gemini, 2; and Lady Aspinwall, 1.

The Grand Central has completed the installation of a new electrically driven Sullivan angle-compound 1,400-ft. compressor. The electric transmission line to the property is completed. Surveys of the mine have been finished and geological work is progressing. A number of contracts for drifting and raising have been let, and more work will be done when the geological data are completed. Present shipments amount to amount 75 tons daily, all of which is being made by lessees. The output is about 30 per cent silver-lead ores and 70 per cent silver-gold-copper ores.

THE MARKET REPORT

Daily Prices of Metals

Mar.	Copper, N. Y., net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
16	12.125	28.25	28.75	4.70@4.75	4.40@4.45	4.70
17	12.125	28.375	29.00	4.70@4.75	4.40@4.45	4.70@4.725
18	12.125	28.375	29.00	4.70@4.75	4.40@4.45	4.725
20	12.125	28.375	29.00	4.70@4.75	4.40@4.425	4.725
21	12.125	28.50	29.00	4.70@4.75	4.40@4.425	4.675@4.70
22	12.125	28.625	29.25	4.70@4.75	4.40@4.45	4.675@4.70

*These prices correspond to the following quotations for copper delivered: March 16th to 22nd, inclusive, 12.375c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Mar.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
16	60¼	61¼	67½	143	145	22	21⅞	26	26
17	60	60¾	67½	143¾	145¼	21⅝	21⅝	25¾	25⅞
18	...	...	...	...	...	...	...	...	...
20	59¾	60¼	67¼	143½	145¼	21⅝	21⅞	25¾	25⅞
21	59¾	60	66¾	143⅜	144⅞	21¾	21½	25¾	25⅞
22	58¾	59¼	66	143⅜	144⅞	21⅝	21¼	25¼	25¼

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Mar.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	Mar.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
16	434	99⅝	64⅛	33⅛	20	437¼	99⅝	64¾	33⅛
17	435¼	99⅝	64½	33⅝	21	437	99⅝	64½	33¼
18	440	99⅝	64½	33⅝	22	439¼	99⅝	65½	33⅝

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Metal Markets

New York, March 22, 1922

The metal markets have been featureless during the last week, and prices are virtually unchanged. The copper and zinc markets are stagnant again, and tin is also quiet. Lead continues in good demand. There seems no great fear of a coal strike, but buyers are cautious.

Copper

One large producer says he cannot remember a time when the copper market was any quieter than it has been during the last week. We fear that his memory is short, but the fact remains that business has been unusually limited and largely confined to orders for a few carloads. The principal interests are generally maintaining the 13c. delivered price, but are booking only an occasional order from old customers. Some of the smaller producers are quoting 12⅞c. where the delivery charges are not excessive, and it would not have been difficult to do business at this level throughout the week. So far as we have heard, no offers which would net the producer less than 12⅝c. f.o.b. refinery were made, but if a large inquiry had come upon the market it is likely that that price would have been shaded. The present attitude of copper fabricators indicates that there is nothing to be gained by cutting prices, for they are not interested in laying in a stock of metal at any price.

Export demand has been weak, but prices have been maintained above domestic levels. The limited amount of business which was done would probably net producers here about 12.90c.

Lead

The official contract price of the American Smelting & Refining Co. continues at 4.70c. New York, and, for desilverized, 4.50c. St. Louis. Federal lead is reported quoted at 4.45c. in the St. Louis market.

The demand during the week has again been well diversified, with a satisfactory volume of small orders. Yesterday two 1,200-ton inquiries were on the market. After continuing our quotation of the New York market at 4.70c. since Nov. 25, we are this week increasing the figure to 4.70@4.75c. The charge has seemed necessary because of the continued disinclination of some producers to sell at the lower level except to favored buyers, and has been caused by a generally sold-up market in the East and by the fact that the Middle Western price has advanced so that it is more profitable to sell on the St. Louis basis than to sell in the East on a 4.70c. New York basis. Most of the lead sold at 4.75c. has been in small lots, but the total tonnage will average up well with that sold at the lower level.

On Monday, the St. Louis price weakened slightly, and it was possible to buy from several small interests at 4.40c., there being practically no business done at the 4.45c. level. Not a great deal of 4.40c. lead is available, however, and it would not be surprising if the 4.45c. price were again generally quoted in a day or two. In Chicago, lead has averaged around 4.55c. for the week. In Pittsburgh, one company has done most of the business at 4⅝c.

Premiums are generally being asked for April-May shipment, where producers are willing to sell it at all, and the undertone of the market is distinctly strong.

Zinc

Two or three orders of some importance were placed on Friday and Monday at 4.725c., East St. Louis, but the market has eased off and the general price now being asked is 4.70c. However, one producer is offering zinc at a concession of 2½ points. The market is really not much weaker, however, several operators being uninterested in selling except to regular customers. The prospect of a coal strike may be the reason for the lack of inquiry from consumers. High-grade zinc has been sold fairly actively in carload lots at unchanged prices, on the basis of 6c. with freight allowed. Zinc for forward delivery commands slight premiums.

Tin

The market has been quiet, with orders restricted to small proportions. Both the London market and sterling exchange have been steadier than usual, so that there is little variation in the New York price. The comparatively large arrivals so far this month seem to have been well absorbed. Tin for forward delivery is quoted at the same prices as for spot.

Arrivals of tin, in long tons: March 14th, Liverpool, 50; 15th, China, 75; London, 200; Straits, 75; 16th, Rotterdam, 225; 17th Liverpool, 10.

Gold

Gold in London: March 16th, 95s. 11d.; 17th, 95s. 9d.; 20th, 94s. 9d.; 21st. 94s. 9d.; 22d, 94s. 8d.

Foreign Exchange

The Government report on foreign trade for February shows a continued unsatisfactory trend. The excess of exports over imports dropped to $34,000,000, compared with $274,000,000 a year ago. This is the smallest excess since the World War began, and is even less than the figures of February, 1911, and February, 1913. With this condition, the recent rise in foreign exchanges is in part explained. On Tuesday, March 21, francs were 9.025c.; lire, 5.11c.; and marks, 0.3475c. New York funds in Montreal, 3 1/16 per cent premium.

Silver

Silver has shown a better tone this week than for some time. The Shanghai and Hongkong exchanges have improved, with the result that China has been a buyer in the London market, and on the 21st there was considerable inquiry in San Francisco for China account at prices above the New York market. This is the first time since the Chinese New Year that the San Francisco market has developed any strength. If China rates are maintained the London market should hold steady, although prices in New York will depend upon the course of sterling exchange.

Mexican Dollars—March 16th, 49; 17th, 49¾; 18th, 49⅝; 20th, 49⅝; 21st, 49⅜; 22d, 50⅛.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent: 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 4.25@4.30c.: market dull. W.C.C. brand, 5@5¼c. per lb. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese. guaranteed 99 per cent Sb_2O_3, wholesale lots, 6¾@7c.

The market has become slightly stronger owing to the withdrawal of cheaper offerings. Further improvement is anticipated.

Arsenic—7c. per lb.

The market is weaker and there is a possibility of shading the 7c. price.

Bismuth—$2@$2.10 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Iridium—Nominal, $170@$190 per oz.

Nickel—Standard market, ingot and shot, 41c.; electrolytic, 44c. Small tonnages, spot, nominal at 32c.

Palladium—Nominal, $55@$60.

Platinum—$85@$90 per oz.

Quicksilver—$50 per 75-lb. flask. San Francisco wires $49.30.

The prices of **Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of March 4.

Metallic Ores

The prices of **Bauxite, Chrome, Manganese, Tungsten, Molybdenum, Tantalum, Uranium, Vanadium,** and **Iron Ore, Zircon** and **Zirkite** are unchanged from the prices in the issue of March 4.

Zinc and Lead Ore Markets

Joplin, Mo. March 18—Zinc blende, per ton, high $30.90; basis 60 per cent zinc, premium, $28; Prime Western, $27; fines and slimes, $26@$25; average settling price, all grades of blende, $26.62.

Lead, high, $63.90; basis 80 per cent lead, $60; average settling price, all grades of lead, $62.80 per ton.

Shipments for the week: Blende, 8,515; lead, 1,480 tons. Value, all ores the week, $319,680.

Firm holding by sellers, with increased demand, advanced blende prices 50c. to $1 per ton. Shipments exceeded production, and buying for next week was above production estimates, which are placed at 7,250 to 7,500 tons per week, with shipments averaging over 8,000 tons per week.

Lead lessened slightly in demand, with one buyer seeking a small amount of ore.

Platteville, Wis., March 18—Blende, basis 60 per cent zinc, $28. Lead ore, basis 80 per cent lead, $60 per ton. Shipments for the week: Blende, 187 tons. Shipments for the year: Blende, 2,027, tons; lead, 560 tons. Shipped during the week to separating plants, 348 tons blende.

Non-Metallic Minerals

Barytes—Crude, $6@$8 per ton, f.o.b. mines. Ground, white, $17@$23; off-color grades, $13@$21 per ton, f.o.b. mills. Foreign importations of crude are being laid down at Atlantic ports for $7.80@$8.25, c.i.f.

Fluorspar—Fluxing lump, $20; fluxing gravel, $17.50; No. 1 ground, $50@$55, No. 2 ground $40 per ton, f.o.b. Illinois mines. Market dull.

There are no price changes from those indicated in the market report of the issue of March 4 covering **Asbestos, Borax, Chalk, China Clay, Emery, Feldspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur,** and **Talc.**

Mineral Products

Sodium Nitrate—$2.85 per hundred weight, ex vessel, Atlantic ports.

The prices of **Copper Sulphate, Potassium Sulphate,** and **Sodium Sulphate** are unchanged from issue of March 4.

Ferro-Alloys

Ferromanganese—Domestic, 78 to 82 per cent, $62@$64, f.o.b. furnace.

Ferrovanadium—$3.55 per lb. of V contained, according to analyses and quantity.

The prices of **Ferrotitanium, Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotungsten** and **Ferrouranium** are unchanged from issue of March 4.

Metal Products

The prices of **Copper Sheets, Lead Sheets, Nickel Silver, Yellow Metal, and Zinc Sheets** are unchanged from the issue of March 4.

Refractories

The prices of **Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick,** and **Silica Brick** are unchanged from the issue of March 4.

The Iron Trade

Pittsburgh, March 21, 1922

Demand for steel products holds up well, and in some quarters shows a slight increase. The market for nails is up to normal. Tin plate is if anything above normal, and sheets are doing as well as the average of the last few years. Standard steel pipe is above normal and oil-country goods are below normal. Demand for bars, shapes and plates is considerably below normal. Steel ingot production shows no material change, having been at about 29,000,000 tons a year for the last four weeks.

No steel product has weakened in price lately and some lines have stiffened somewhat. Nails are again quite firm at $2.40. Bars, shapes and plates are fairly steady at 1.40c., concessions below this figure having become rare, and hopes have grown that a 1.50c. minimum can soon be established. Sheets remain absolutely firm, as for three or four months.

Pig Iron—Recent sales of basic pig iron at $18, Valley, have established the market at that level, an advance of 25c. Sales of foundry seem all to have been at $19, Valley, representing a steadier market. Small-lot sales of bessemer continue to be at $19.50, Valley.

Coke

Connellsville—Furnace, $3.25@$3.50; foundry, $4.25@$4.75.

Hollinger—An Example of a Mining Investment

By Harry J. Wolf
Western Editor, Engineering and Mining Journal

THE QUESTION has been asked frequently by men whose interests lie chiefly in mining ventures of the more stable variety, "Why does the average citizen persistently refuse to consider a legitimate and well-planned mining venture as an attractive basis for a public flotation, although he is ready to place his money in the shares of some other industrial enterprise, or some railroad stock, that is often unworthy to be called a business-man's risk, to say nothing of considering it as an investment?"

The mining man who asks this question is sometimes under the impression that his favorite industry is discriminated against unjustly. If he has operated a mine successfully over a period of years, he appreciates the various factors that must be considered in order to make a commercial success of mining. He knows that a mining company is a success if the total dividends distributed to its stockholders during its lifetime are sufficient to return the original capital expenditures representing the purchase price of the mine, and its preliminary development and equipment, together with interest at a rate commensurate with the risk, all within the life of the mine. Otherwise there is no consistent profit in the venture for the stockholders who participated from the beginning to the end of the enterprise.

For those who become stockholders in the company at any time after the original distribution of its stock, by buying shares in the open market, a successful commitment presupposes that the purchaser will receive the price paid for the shares, together with whatever additional sum is necessary to constitute an interest return commensurate with the risk, before the mine is worked out and the company is liquidated.

If the desirable results above briefly outlined materialize, the venture will have been a successful investment. Because of the speculative character of most mining ventures, the term investment is limited to those that have a certain stability maintained by ore reserves sufficient to insure several years' life for the mine. However, the existence of ore reserves does not necessarily classify the project as an investment, for there are as many important speculative factors in the mining industry, such as varying wages and changing metal markets, as there are in other industries that must likewise reckon with wages and the market prices for finished or semi-fabricated products. On the other hand, mining is in no worse position in this respect than many other industries, and the chief reason why mining receives the most unfavorable consideration from the average citizen who invests or speculates in industrial shares is because most mining companies fail utterly to take their own stockholders into their confidence, to say nothing of the general public, regarding their physical and financial condition.

Whenever mining companies in general make a practice of issuing complete, detailed, and comprehensive monthly and quarterly reports relative to expenses, earnings and profits, and physical developments, mining shares will receive the same consideration from the public that is accorded other industrials. It would be unfair not to call attention to the fact that many large mining corporations, notably some of the porphyry coppers, are following this practice, and their action has done much to advance the standing of such mining shares and to merit public confidence. However, many strong companies ignore the public and their own stockholders in this regard, so that their officers and directors must remain under suspicion of desiring to influence the speculative market for their shares, to their own personal advantage and to the injury of their stockholders.

Many prominent companies could be named that say not one intelligible word about their costs or physical condition which would permit their stockholders to decide whether they are justified in holding their shares, or whether the shares should be sold to others who are more willing to assume the risks as they stand at the time, and thus permit the price of the shares to gravitate automatically to a level where they belong, so far as it is possible to accomplish this in the face of the ever-present professional speculative buying and selling. In other words, many mining shares are maintained at a higher or lower market level than is justified by the physical and economic facts, as a result of the practice of deliberately keeping the public in ignorance of information to which it is fairly entitled.

As a rule, gold mining is one of the most speculative kinds of mining, and the experience of the last few years has dissipated the fallacy that may have existed in the minds of some friends of the industry, that gold mining can claim any advantage from the fact that there is a standard price for its finished product. In opposition to the speculative character of gold mining in general, it is interesting to observe that one of the best examples of a mining *investment* is to be found in the shares of a great gold-mining company—namely, Hollinger Consolidated Gold Mines, Ltd. This company issues detailed reports regarding its physical condition and developments, its financial condition, and its operating costs and profits. Both its past record and future prospects are such as to cause the market price of its shares to gravitate to a level that indicates investment qualities. In fact, its investment yield is actually unattractive, because the shares are selling on a basis comparable with numerous substantial industrial bonds and preferred stocks, and at the same time the shares have many of the inherent elements of a mining risk. The price level of Hollinger shares is certainly complimentary to its business management.

During the six years ended with 1921, Hollinger's net income and dividend distributions were as set forth in the following table:

Year	Net Income	Earned per Share	Dividend Paid	Paid per Share
1916	$2,674,346	$0 56	$3,125,000	$0 65
1917	1,725,415	0 35	738,000	0 15
1918	2,593,414	0 52	1,230,000	0 25
1919	2,954 109	0 60	1,722,000	0 35
1920	3,346 356	0 68	2,214,000	0 45
1921	4,026,927	0 82	3,198,000	0 65
Total	$17,320 567	$3 53	$12,227,000	$2 50
Average		0 59		0 41

The average earnings and distributions are calculated on a basis of 4,920,000 shares outstanding. The average dividend is equivalent to a yield of 8.2 per cent on the par value of $5. However, the shares have sold above par during the last three years, the price range since 1918 being as follows:

Year	High	Low	Dividend	Per Cent Yield on High
1919	$7 65	$6 15	$0.35	4.6
1920	7 10	5 25	0.45	6 3
1921	8 00	5 55	0.65	8 1
1922	9 24	7 70	0.65	7 0

From this it appears that the yield on the high price for 1919, when the dividend was only a little less than the average distribution for the period of six years ended with 1921, was only 4.6 per cent; and at present the dividend represents a yield of about 7 per cent, which is not an attractive return for the usual mining risk.

As the market price of the shares represents the consensus of opinion as to their value, from a combined investment and speculative viewpoint, it is of interest to investigate the fundamental conditions with regard to the stock to see if the market price is "in line" with the facts.

The total ore reserves on Dec. 31, 1921, were reported as 3,402,609 tons, having an average value of $10.77 per ton, and a gross value of about $36,644,000. This compares with 3,294,005 tons, $11.11, and $36,596,000 respectively for the previous year. In addition to this, it was estimated that the probable ore in veins averaging under $6 per ton amounted to 787,668 tons, having an average value of $5.28 per ton and a gross value of $4,162,833. On Dec. 31, 1920, these figures were, respectively, 585 078 tons, $5.36, and $3,135,731. As current costs do not permit this ore to be mined at a profit, it is not now included in the payable ore reserves. Surface outcrops were estimated to contain 202,640 tons averaging about $9.42 per ton.

The ore removed from the mine during 1921 was 1,069,954 tons, and at this rate the known reserves would last about 3.2 years. This appears to be a safe supply of ore to have ahead of production, for it is more than likely that any larger supply would entail more expense for maintenance of underground development workings than it would be worth. There is an economic limit to the ore reserve in every mine, depending on the nature of the deposit, the heaviness of the ground, and other local peculiarities.

The company's development policy, designed to maintain a substantial ore reserve ahead of requirements, is illustrated by the fact that during the year 1921 development work comprised 176 ft. of shafts, 16,761 ft. of drifts, 12,883 ft. of crosscuts, 1,773 ft. of raises, and 37,617 ft. of diamond drilling. With much promising territory undeveloped, it is fair to assume that the company will be able to maintain a substantial ore reserve for many years.

The above-stated facts and conditions convey the impression that Hollinger shares have the elements of stability, and that they probably come as near representing a true mining investment as it would be possible to find. This very stability, with its effect of placing the shares on an investment basis so far as yield on market price is concerned, makes them unattractive to the average citizen who may be looking for a *speculative* opportunity. The fact that the price of and demand for the product is constant also makes the stock more unattractive from a speculative point of view.

Having considered the income account of the company, it is of interest to turn to the balance sheet. The largest item among the assets is the estimated value of the mining properties, placed at $21,150,244. The second largest item is over $3,000,000 in Victory Loan bonds; and the plant, less depreciation, is placed at $1,355,302. The following table shows the trend of the profit-and-loss surplus, and, what is more significant, the net working capital.

Year	Profit-and-Loss Account		Net Working Capital
1916	$269,591	Deficit	$[illegible]
1917	712,724	Surplus	793,292
1918	2,071,287		2,403,070
1919	2,670,577		3,778,873
1920	3,131,852		5,041,606
1921	3,960,780		5,662,044

It is apparent from these figures that the company was improving its financial position during a period when many industrials were forced to strain their credit to the utmost in a fight for their existence. This speaks volumes for the substantial quality of the enterprise, and the efficiency and ability of its management.

Mining Dividends for March, 1922

The following dividends were paid by mining and metallurgical companies during March:

Companies in the United States	Situation	Per Share	Total
American Smelting & Refining pfd	U.S.	$1.75 Q	$[illegible]
Calumet & Arizona, c	Ariz.	0.50 Q	321,260
Champion Copper	Mich.	6.00	600,000
Copper Range	Mich.	1.00	394,368
Federal Mining & Smelting pfd., s. l	Idaho	1.00 Q	120,000
Hecla Mining, s. l	Idaho	0.15 Q	150,000
Homestake Mining, g	S. D.	1.25 M	62,790
National Lead	U. S.	1.50 Q	309,831
National Lead pfd	U. S.	1.75 Q	426,433
St. Joseph Lead	Mo.	0.25 Q	387,342
Texas Gulf Sulphur	Texas	1.00 QX	635,000
Utah Copper	Utah	0.50 Q	812,245
Company in Canada			
Hollinger Consolidated Gold	Ont.	0.05 4 wks.	246,000

Q, quarterly. M, monthly. X, includes 50c. extra. g, gold. c, copper. s, silver. l, lead.

Two of the Michigan copper companies reappear in this month's dividend list, Copper Range, and Champion, owned jointly by Copper Range and St. Mary's Mineral Land. It is the first dividend paid by Copper Range since the 50c. disbursement of Sept. 15, 1920, and the first distribution by Champion since the $6 capital distribution of April 15, 1920. The United Verde passed its regular dividend of $1.50 which would ordinarily have been paid this month, but as this bad news affects only twenty stockholders, the disappointment will at least not be widespread.

COMPANY REPORTS

National Lead Co.

A report of operations of the National Lead Co. for 1921 shows the following statement of net earnings and their disposition:

Surplus Dec. 31, 1920		$20,344,417.94
Net earnings for 1921 [illegible]		[illegible]
		$[illegible]
[illegible]		
Dividends [illegible] 7 per cent	$[illegible]	
[illegible] 6 per cent	[illegible]	[illegible]
		$[illegible]

A comparison with the preceding year in given in the following statement:

ASSETS

	Dec. 31, 1921	Dec. 31, 1920
[illegible]	$[illegible]	$[illegible]
[illegible]	8,886,392.33	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	2,757,264.34	[illegible]
Accounts receivable	12,014,795.59	[illegible]
Notes receivable	[illegible]	[illegible]
Total assets	$[illegible]	$[illegible]
Net		

LIABILITIES

Preferred stock	$24,367,600.00	$[illegible]
Common stock	[illegible]	20,655,400.00
Bonds of subsidiary companies [illegible]	[illegible]	[illegible]
Insurance reserve	[illegible]	[illegible]
Employees' [illegible] reserve	205,920.13	
Plant reserve	[illegible]	[illegible]
Depreciation reserve	[illegible]	[illegible]
Tax reserve	[illegible]	[illegible]
Accounts payable	2,878,922.73	[illegible]
Notes payable	588,383.06	4,432,083.06
Surplus	20,880,874.85	20,344,417.94
Total liabilities	$88,705,790.12	$93,337,028.47

DETAIL OF PLANT INVESTMENT

	Dec. 31, 1921	Dec. 31, 1920
Gross property	$[illegible]	$52,523,280.95
Less depreciation and depletion reserve	10,562,252.29	9,239,587.93
Net property	$[illegible]	$[illegible]

Hecla Mining Co.

A report of operations of Hecla Mining Co. for 1921 states that a net profit of $634,965.67 was made and dividends of $500,000 were paid. Operating account follows:

INCOME

Ore sales net receipts	$1,801,768.68	
Interest	50,793.37	
Rents	6,162.24	
Miscellaneous	[illegible]	$[illegible]

EXPENDITURES

Mining and development	$[illegible]	
Ore sorting	38,736.87	
Ore hauling mine to mill	43,046.55	
Milling	94,389.44	
Miscellaneous general expense, insurance [illegible] property taxes	124,728.25	$1,099,639.64
Net income		$759,931.30
Depreciation reserves	$114,922.29	
Depletion of property investment	10,043.43	124,965.63
Net profit		$634,965.67
Miscellaneous surplus credits		6,628.41
		$641,594.08
Dividends	$500,000.00	
Taxes—Federal income and state net profit	32,960.45	532,960.45
Added to surplus		$108,633.63
Surplus Dec. 31, 1920		2,014,585.94
Surplus Dec. 31, 1921		$2,123,219.57

Current assets Dec. 31, 1921, were $1,250,437.78; current liabilities, $109,930.67. Capitalization, 1,000,000 shares; par value 25c. each, issued and fully paid.

Production in 1921 amounted to 39,137,894 lb. of lead and 1,060,139 oz. of silver, from 29,794.5 tons of concentrates, and 13,180.05 tons crude ore having a value of $45.07 per ton. There were 220,051 tons of ore milled and 267,905 tons treated.

MINING STOCKS

Week Ended March 18, 1922

Stock	Exch.	High	Low	Last	Last Div.	
			COPPER			
Ahmeek	Boston	63	62	63	Sept. '20, Q	$0.50
Alaska-Br. Col.	N. Y. Curb	2¾	2	2¾		
Allouez	Boston	28	26	28	Mar. '19	1.00
Anaconda	New York	52¼	49½	52¼	Nov. '20, Q	1.00
Arcadian Consol.	Boston	3¼	2¾	3¼		
Ariz. Com'l.	Boston	9¼	9	9¼	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*22	*19	*22		
Bingham Mines	Boston	14	14	14	Sept. '19, Q	0.25
Calumet & Arizona	Boston	61	58	60½	Dec. '21, Q	0.50
Calumet & Hecla	Boston	285	275	284	June '20, Q	5.00
Canada Copper	N. Y. Curb	*20	*16	*20		
Centennial	Boston	12	12	12	Dec. '18, SA	1.00
Cerro de Pasco	New York	36½	34	36¼	Mar. '21, Q	0.50
Chile Copper	New York	18	17½	18		
Chino	New York	29	27¾	28½	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*33	*29	*33		
Consol. Arizona	N. Y. Curb	*4	*2	*4	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	1¾	1½	1¾		
Copper Range	Boston	45	43½	45	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	*58	*52	*57		
Davis-Daly	Boston	8½	7	7½	Mar. '20, Q	0.25
East Butte	Boston	11½	10¾	11½	Dec. '19, A	0.50
First National	Boston Curb	*65	*61	*65	Feb. '19, SA	0.15
Franklin	Boston	1⅞	1¾	1⅞	...	
Gadsden Copper	Boston Curb	*75	*50	*75		
Granby Consol.	New York	29⅛	27	29	May '19, Q	1.25
Greene-Cananea	New York	28⅜	27	28	Nov. '20, Q	0.50
Hancock	Boston	3	2½	3½		
Howe Sound	N. Y. Curb	3⅜	3	3⅜	Jan. '21, Q	0.05
Inspiration Consol.	New York	42½	40	41¾	Oct. '20, Q	1.00
Iron Cap	Boston Curb	7½	7¼	7¼	Sept. '20, K	0.25
Isle Royale	Boston	25	23¾	25	Sept. '19, SA	0.50
Kennecott	New York	30¼	28¾	30⅜	Dec. '20, Q	0.50
Keweenaw	Boston	1¾	1¼	1½		
Lake Copper	Boston	3	2½	3		
La Salle	Boston	2	1½	1½		
Magma Copper	N. Y. Curb	30	28	29⅝	Jan. '19, Q	0.50
Majestic	Boston Curb	†*12	†*8	*8		
Mason Valley	Boston	2	1¾	2		
Mass Consolidated	Boston	2¼	2⅛	2¼	Nov. '17, Q	1.00
Miami Copper	New York	28⅛	27⅛	28½	Feb. '22, Q	0.50
Michigan	Boston	2	2	2		
Mohawk	Boston	60½	59	59½	Feb. '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	9	7¾	8½		
Nevada Consol.	New York	15⅜	14¾	15⅜	Sept. '20, Q	0.25
New Cornelia	Boston	18	17¾	18	Feb. '22, K	0.25
North Butte	Boston	13⅜	12	13⅜	Oct. '18, Q	0.25
North Lake	Boston			*25	..	
Ohio Copper	N. Y. Curb	*10	*10	*10		
Old Dominion	Boston	24¾	24½	25¼	Dec. '18, Q	1.00
Osceola	Boston	35¼	32¾	35½	June '20, Q	0.50
Phelps Dodge	Open Mar.	†170	†160	.	Jan. '22, Q	1.00
Quincy	Boston	47	44	47	Mar. '20, Q	1.00
Ray Consolidated	New York	15⅝	14⅞	15⅝	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*4	*3	*4		
St. Mary's Min. Ld.	Boston	48	46	47	Dec '21, K	1.00
Seneca Copper	Boston	14	13½	13¾		
Shannon	Boston	1.00	*92	1.00	Nov. '17, Q	0.25
Shattuck Arizona	New York	9	8⅞	9	Jan. '20, Q	0.25
South Lake	Boston	†1.00	†*65	*80		
Superior & Boston	Boston	1⅛	1 1/16	1⅛		
Tenn. C. & C. cfs.	New York	11¼	10⅞	11¼	May '18, I	1.00
Tuolumne	Boston	*60	*55	*60	May '13,	0.10
United Verde Ex.	Boston Curb	28½	27½	28½	Feb. '22, Q	0.25
Utah Consol.	Boston	2¼	2	2¼	Sept. '18,	0.25
Utah Copper	New York	65¼	63	64⅝	Dec. '21, Q	0.50
Utah Metal & T	Boston	1¼	1¼	1¼	Dec. '17,	0.30
Victoria	Boston	2	1¾	2		
Winona	Boston	*35	*35	*35		
Wolverine	Boston	12½	11	11		
			NICKEL-COPPER			
Internat. Nickel	New York	15½	12¾	15¼	Mar. '19,	0.50
Internat. Nickel pfd	New York	71	65	71	Feb. '22, Q	1.50
			LEAD			
National Lead	New York	91½	89	91½	Dec. '21, Q	1.50
National Lead pfd	New York	†113½	†110	112	Mar. '22, Q	1.75
St. Joseph Lead	New York	13½	12¾	13½	Dec. '21, Q	0.25
			QUICKSILVER			
New Idria	Boston	1.25	*90	1.25		
			ZINC			
Am. Z. L. & S.	New York	16½	13¼	16	[illegible] '20,	1.00
Am. Z. L. & S. pfd	New York	40½	37	39½	[illegible] '20, Q	1.50
Butte C. & Z.	New York	6½	5¾	6½	[illegible]	0.50
Butte & Superior	New York	27½	25½	27½	[illegible]	1.25
Callahan Zn-Pb.	New York	7¼	6½	6½	[illegible]	0.50
New Jersey Zn.	N. Y. Curb	147½	146	147½	[illegible] '22, Q	2.00
Yellow Pine	Los Angeles	*43	*42	*43	Sept. [illegible]	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Colorado Springs; The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.	
			GOLD			
Alaska Gold	New York	¼	⅛	⅜	..	
Alaska Juneau	New York	1¼	⅞	1	..	
Carson Hill	New York	15	13	14⅞		
Cresson Consol. G.	N. Y. Curb	2 11/16	2⅝	2⅞	Jan. '22, Q, X	$0.10
Dome Extension	Toronto			*85	....	
Dome Mines	New York	26⅞	24½	26⅞	Jan. '22, Q	0.25
Florence Goldfield	N. Y. Curb	*25	*18	*23		
Golden Cycle	Colo. Springs	*77	*75	*77	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*5	*5	*5	Dec. '19,	0.05
Hollinger Consol.	Toronto	9.24	8.90	9.20	Feb. '22,	0.05
Homestake Mining	New York	62	60⅞	62	Feb '22, M	0.25
Kirkland Lake	Toronto	*44	*39	*43		
Lake Shore	Toronto	1.97	1.80	1.96	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	19.50	13.95	19.00	Jan. '22, K	0.05
Porcupine Crown	Toronto	*30	*26½	*29	July '17,	0.03
Porcupine V. N. T.	Toronto	*30	*25½	*28	.	
Portland	Colo. Springs	*35	*35	*55	Oct. '20, Q	0.01
Schumacher	Toronto	*56½	*50	*56	.	
Silver Pick	N. Y. Curb	*9	*6	*8	....	
Teck Hughes	Toronto	*44¼	*38¾	*44		
Tom Reed	Los Angeles	*76	*70	*70	Dec '19,	0.02
United Eastern	N. Y. Curb	2	1 15/16	2	Jan. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*21	*20	*20	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb			*3		
Yukon Gold	N. Y. Curb	1⅛	1⅛	1⅛	June '18,	0.02½
			SILVER			
Batopilas Mining	New York	1⅛	⅝	1	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*35½	*33	*35	May '20, K	0.03
Coniagas	Toronto	1.35	1.00	1.00	May '21, Q	0.12½
Crown Reserve	Toronto	*21	*19½	*20	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3½	3⅛	3¾	Jan. '22, Q	0.12½
La Rose	Toronto	*57	*55	*56	Apr. '18,	0.02
McKinley-Dar.-Sav.	Toronto	*18½	*16	*17½	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.05	1.04	1.05	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅞	6⅜	6¾	Jan. '22, Q, X	0.30
Ontario Silver	New York	6½	5½	6¼	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb			*12	Jan. '12,	0.10
Temiskaming	Toronto	*33	*30	*32	Jan. '20, K	0.04
Trethewey	Toronto	*5	*3¾	*4½	Jan. '19,	0.05
			GOLD AND SILVER			
Boston & Montana	N. Y. Curb	*50	*44	*47	....	
Cash Boy	N. Y. Curb	*6	*6	*6	....	
Dolores Esperanza	N. Y. Curb	*95	*82	*90	.....	
El Salvador	N. Y. Curb	*4	*3	*3		
Jim Butler	N. Y. Curb	..		*5	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb			*3	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*14	*6	*12	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1⅝	1 9/16	1 9/16	Jan. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*63	*56	*61	.....	
Tonopah Extension	N. Y. Curb	1 9/16	1½	1½	Jan. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1 15/16	1⅞	1 15/16	Oct. '21, SA	0.05
West End Consol.	N. Y. Curb	1 1/16	*83	1	Dec. '19, SA	0.05
			SILVER-LEAD			
Caledonia	N. Y. Curb	*5	*5	*5	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	†1.02½	†*95	1.00	Dec. '20,	0.15
Chief Consol.	Boston Curb	3⅝	3⅝	3⅝	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	19	19	19	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†3.00	†1.25	.	July '20, Q	0.10
Daly-West	Boston	2¾	2¾	2¾	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†3	†2⅞	2½	Apr. '21, K	0.05
Electric Point	Spokane	*6	*5½	*6	May '20, SA	0.03
Federal M. & S.	New York	12	11⅞	11⅞	Jan. '09,	1.50
Federal M. & S. pfd.	New York	41	37½	40	Mar. '22, Q	1.00
Florence Silver	Spokane	*23½	*23	*23½	Apr. '19,	0.01½
Grand Central	Salt Lake	*48	*46	*48	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	6	5¾	6	Dec. '21, Q	0.17
Iron Blossom Con.	N. Y. Curb	*22	*21	*22	Dec. '21, Q	0.02½
Judge M. & S.	Salt Lake	2.60	2.50	2.50	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*6	*5	*6	June '21, I	0.02
Prince Consol.	Salt Lake	*8	*7¾	*8	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*6½	*6	*6	Feb '19,	0.01
Rex Consol.	N. Y. Curb	*8	*7	*7		
South Hecla	Salt Lake	*60	†*35	.	Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*15	*15	*15	Oct '17,	0.05
Stewart Mines	N. Y. Curb	*11	*5	*8	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.20	2.20	2.20	Jan. '21, K	0.04
Tintic Standard	Salt Lake	1.97½	1.82½	1.90	Dec. '21, Q	0.05
Utah Apex	Boston	3¾	3½	3½	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	....	...	*2	Nov. '17,	0.01
			VANADIUM			
Vanadium Corp	New York	39⅛	37	39⅛	Jan. '21, Q	1.00
			ASBESTOS			
Asbestos Corp	Montreal	55	55	55	Jan. '22, Q	1.50
Asbestos Corp. pfd	Montreal	74	74	74	Jan. '22, Q	1.75
			SULPHUR			
Freeport, Texas	New York	20	17¾	18	Nov. '19, Q	1.00
Texas Gulf	New York	44⅞	43⅝	44⅝	Mar. '22, QX	1.00
			MINING, SMELTING AND REFINING			
Amer. Sm. & Ref.	New York	54⅜	50⅝	53¾	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	96½	92	96½	Mar '22, Q	1.75
Am. Sm. Sec. pf. A.	New York	90	90	90	Jan. '22, Q	1.50
U. S. Sm. R. & M.	New York	38	35½	37	Jan. '21, Q	0.50
U. S. Sm. R. & M. pf.	New York	44½	44¼	44½	Jan. '22, Q	0.87½

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Volume 113 New York, April 1, 1922 *Number* 13

Need for Organization Among Miners

WE HAVE before dwelt upon the apparent need for more complete co-operation and greater organization in the mining industries; and we have cited particularly the farmers as in similar plight to the miners, but more actively striving, more evidently combining, to remedy their disadvantages by joint action.

What form of co-operation or combined effort should the mining industries take? Have we such organizations at hand, must we create new ones, or are there old ones we can patch up and build on to, so that they may be able to function more beneficially?

We have before enumerated many times the national organizations having to do with mining. Will they serve us for the purpose we have in mind? The American Institute of Mining and Metallurgical Engineers? No: it is concerned with the technique of mining; the problems we must attack are industrial. These problems are concerned mainly with marketing and allied subjects. The American Mining Congress? No: it is concerned with political problems, and therefore will be useful when it comes to legislation aimed to benefit the mining industries, or the imminence of laws adverse to their prosperity. But the problems we have in mind, we repeat, are industrial.

Industrial: and we have not a single mining industry, but many separate industries, each with its own individual needs, its own traditions and peculiar composition; each forming a group more or less apart, and demanding quite separate consideration.

The "Trade Association"

There is a form of co-operative association which confines itself to individual industries. These industrial associations are commonly called trade associations, "trades" being in this connection used substantially as synonymous with "industries." These trade associations have come into a great deal of prominence lately; some of them have misused their position for illegal and monopolistic heightening of prices, prevention of competition, and consequent extortion from the buying public, and they have therefore been made the objects of legal procedure, and of condemnation by the authorities of the Government.

This, however, only proves that there are bad as well as good trade associations, just as there are bad and good men; but if a bad man is caught at extortion, or robbery, or swindling, it does not follow that all men should be outlawed. And so the cases mentioned do not necessarily discredit the idea of trade associations. Indeed, such associations appear, on consideration, advisable, proper, and inevitable. Through them may become possible intelligent and co-operative action in an industry, which may promote efficiency, effect economies, increase the grade and quality of the product, and reduce the price to the consumers, as well as protect the industry itself. It is, morever, good business for the public to have industries well managed and prosperous. Failures and shutdowns react on the whole people.

What May a Trade Association Lawfully Do?

Mr. Hoover, in his endeavor to assist industry through the Department of Commerce, found that to benefit industries he must get into close touch with them; he could not effect this unless they were organized; he could not work with them unless they would work with him as units? Therefore, he came to the evidently correct conclusion that industrial associations were not only per se harmless but desirable. And about this time the Attorney General, influenced by the illegal activity of one trade association, rendered a decision which made it doubtful whether trade associations were not, per se, violations of the Sherman Act, considered to be combinations in restraint of trade, and hence unlawful. Therefore, Mr. Hoover, lest the Department of Commerce should come within the same category through its co-operation with the trade associations, addressed a letter to Mr. Daugherty, inquiring specifically and separately whether the main functions of trade associations were illegal. In reply, Mr. Daugherty conceded the specific activities to be lawful. These activities comprise: (1) The preparation of a uniform system of cost accounting; (2) the use of trade names; (3) co-operative standardization of product; (4) co-operative credit service; (5) group insurance; (6) co-operative advertising; (7) co-operative welfare work; (8) co-operative handling of legislative questions; (9) co-operative relation with the Government; (10) co-operative compilation of statistics, including production, productive capacity, wages by districts, consumption by districts, distribution by districts, and stocks by districts; and such statistics may be issued publicly; (11) co-operative price statistics, provided that such statistics are made public. All these things, then, an industrial association may lawfully do, provided, as Mr. Hoover remarked and Mr. Dougherty conceded, that in so doing it does not enter into an agreement whereby trade is actually restrained and the anti-trust laws are thereby violated.

A Forthcoming Trade Association Conference

In carrying out Mr. Hoover's thought that the trade associations are to be encouraged rather than discouraged, and that industry in general may, in that way, best be aided by the Government, he has called for April 12 a conference in Washington with representatives of trade associations the activities of which are national or international in their scope, in order that (1) there may be secured a list of trade associations which will furnish to the Department of Commerce statistical information concerning their respective industries, along the lines indicated above; (2) to discover the ways and means for collecting such statistics and (3) to discuss the distribution of such data to the members of the associations and to the public.

Mr. Hoover's idea is plainly to make the Department of Commerce a big brother to the several trade associations; to encourage their organization and growth, to encourage them to co-operation in all lawful ways, and warn them against unwittingly going further than the law permits and the common welfare warrants.

The Department of Commerce, and Mining

The mining industry comes within the Department of Commerce. The original act which created the department imposed upon the department the duty "to foster, promote, and develop the foreign and domestic commerce, the *mining*, manufacturing, and shipping industries, and the transportation facilities of the United States." Note that it does not include the agricultural industries; a special department is allotted to them. Similarly, a separate department should be allotted to mining; and in such department a Bureau of Markets would cover the purely commercial phase of the mining industries. But for the moment the only Government department which, by law, covers the mining *indus ries*, and has the right to foster, promote, and develop them, appears to be the Department of Commerce. That covers the marketing field, the most neglected and little understood field in the mining industries, and the study of marketing involves many questions of standardization, price, and co-operative distribution.

Trade Associations in Mining

We have some slight acquaintance with the trade association in the several mining industries, but probably not enough. The American Zinc Institute is perhaps the most conspicuous, although the American Iron and Steel Institute and the American Petroleum Institute are other examples. In copper, we have no active trade association or organized co-operation, except associations for specific purposes, like the Copper Export Association, under the Webb Act, which is another matter; and the Copper and Brass Research Association, which concerns itself only with advertising, as its name would not indicate. The lead industry has no association. The coal industry has, of course, in part been well organized. Other associations exist here and there. There is a Talc and Soapstone Producers' Association, formed at the suggestions of Mr. R. B. Ladoo, of the Bureau of Mines, and Mr. Ladoo is secretary of that body. Here we see again the principle of Government guidance. There is a Graphite Producers' Association, formed at the suggestion of J. E. Spurr, at that time executive of War Minerals investigations for the Bureau of Mines. No doubt there are others. There have been a number of regional associations like the California Dredge Operators' Association, but our chief interest at present is with those which are national in their scope.

Let Us Investigate Further

We would urge such mining industry associations to send representatives to Mr. Hoover's conference on April 12 to ascertain whether they may not receive further inspiration which might strengthen their particular industry. It might be that in this way through the medium of trade associations we shall achieve intelligent, scientific, and co-operative marketing of the products of our mines, which the fruit growers of California have perfectly achieved, and which the farmers in general have been advised to attempt by no less an authority than the President. Intelligent marketing is the chief need of the mining industries at the present time; and one industry can learn from the marketing methods of another which happens to have blazed the trail further and mapped the route.

Many of the principles and methods of the scientific and efficient marketing of one group of commodities apply as well to others.

The Mining Journal-Press will have a representative at the conference and will report.

Mathewson in Japan

VISITORS TO ANACONDA, including many thousand persons from foreign countries, will not be surprised to learn that Mr. E. P. Mathewson received numerous tokens of hospitality and good will when passing through Japan recently on his return from Burma. He attended the meeting of the Mining Institute of Japan and delivered an address, which appears to have been understood by most of those present. When visiting Nikko, he saw the electrolytic copper refinery and wire-works, where the Elmore process for depositing copper in sheet form on rotating cathodes is in successful operation. He was entertained at dinner in a tea-house in the national style and was the recipient of many presents, including a bronze statue of a workman firing cloisonné ware—this being a piece of statuary most nearly approaching a metallurgical subject. Our friend was hailed as the Buddha of Metallurgy! So when next we go to Japan we shall expect to see a comfortable statue of him guarding the entrance of some big copper smelter. At the Imperial University at Tokyo he saw the seismological museum and heard a fascinating talk on earthquakes from Professor F. Omori. Many Japanese technicians came from long distances to greet him—one came 450 miles to acknowledge the kindness received at Anaconda. We are not surprised; on the contrary, it seems entirely proper that the mental and physical hospitality extended to visitors by the Anaconda company should have been reciprocated in the person of its most distinguished manager.

Anti-Thought Legislation

BY ONE VOTE a bill was recently defeated in the Kentucky Legislature proposing to prohibit the teaching of the doctrine of evolution in the educational institutions supported by the state. In these days of intensified prohibition the individual has become more or less calloused to legislative restriction upon his habits and ordinary conduct, but attempts to control thinking processes may become the straw to break the camel's back.

Imagine the youth of Kentucky growing up without becoming aware of the great strides in scientific knowledge due to geological and paleontological research of the last fifty or seventy-five years. How can historical geology be taught without giving profound attention to former life on the globe as indicated by fossil remains? Possibly it can be taught by making the word "evolution" tabu, but surely that will not prevent some students from thinking about the subject. Perhaps fossil collections might have been ordered destroyed. Even that would be ineffectual unless the Kentucky coal miner is blindfolded to keep him from looking at fossil flora.

But the saddest thought of all is the joy future students would miss in failing to learn all about the flying cockroaches of the Paleozoic, mentioned in Wells' "Outline of History," and some of the other interesting extinct creatures. We suppose that such a volume as Wells' would be destroyed, not to mention the works of Huxley and Darwin; and hundreds of other books would have to be carefully censored.

The most pernicious legislation is perhaps that which attempts to control men's thoughts. Futile it is bound to be, as it has been in the past. Such "Dark Age" legislation would have no more effect on the doctrine of evolution than the raising of King Canute's hand upon the tide.

Remarks by the Editor

WE HAVE BEEN IN RECEIPT of many letters concerning the consolidation of the two mining weeklies into the *Journal-Press*. We are glad that the sentiment is almost entirely one of approval. Subscribers are glad that they will be able to economize in the time necessary to run over current mining literature, and also to economize in the money required. For those who need both papers, a saving of $5 a year; for those who need only *Engineering and Mining Journal*, one of a dollar a year—enough to hire a mining engineer in Washington during the war; and for readers of *Mining and Scientific Press* alone, no increase of expense. All this is a real contribution to the mining industries in the way of *lessened expenses*.

And our advertisers are glad that they have now one undisputed medium which will weekly carry the message of what they have to contribute in the way of equipment and supplies toward making mining more efficient and more economical. And we are *not advancing* our advertising rates. They remain the same, despite the combined circulation, as the previous *Engineering and Mining Journal* rates.

Still, we are going to give more expensively instead of retrenching. The *Journal-Press* is larger than either of the papers which have been combined. The entire editorial staff of *Mining and Scientific Press* has been consolidated with that of *Engineering and Mining Journal*. We have ten regular full-time, hard-working trained editors—men who know the mining industry—on our staff. They form a faculty-like group, each with his own department and responsibilities. You will meet them in the field as well as in the town. They will all be very busy in the program we have mapped out, to expound to you the mining industries. We are not going to give you *quantity so much as quality*.

Then we are going to install a new departure. In San Francisco we are going to edit, print, and distribute a monthly supplement to *Engineering and Mining Journal-Press*; and we shall call the supplement the *Pacific Mining News*. The first number will come out about May 1. Mr. George J. Young will be editor and Mr. Arthur W. Allen associate editor. These gentlemen need no introduction to you. At least you know Mr. Young's "Elements of Mining" and Mr. Allen's "Handbook of Ore Dressing." Mr. Young, as Western editor of *Engineering and Mining Journal*, and Mr. Allen, as associate editor of *Mining and Scientific Press*, have their homes in San Francisco. Mr. Young was born there. This supplement will be a regional publication; it will confine its field to the Pacific Coast belt represented by California, Nevada, Arizona, Oregon, Washington, British Columbia, and Alaska; and will be sent only to the subscribers of the *Mining Journal-Press* in those states. It will be part of the *Mining Journal-Press* —a regional supplement. Do you get the idea? It seems to us a happy one.

What some of our friends are saying to us is that we surely are doing ourselves proud, in the way of extensions and improvements, and all at a less cost all around; but how, they ask, are we going to be able to do it? How, they ask, if both mining journals found it close figuring to get along during the present period of depression in mining and in business in general, so that we had to consolidate for strength—how are we going to pay the bills now? Well, if we can do a larger business on a smaller margin of profit we shall make the riffle, as we used to say in Alaska. Certainly, it will not cost so much to run one paper as to run two papers; so these economies ought to result in a larger margin over necessary expense, which margin we have already shared in advance with our subscribers and advertisers. But if we should show a balance on the wrong side of the ledger, for a few months, we shall not worry unduly. We know that the plan is a good one, and will work out.

Mr. Rickard has remarked that this is a wedding, not a wake; and we are going to find out whether the motto of young folks who are considering matrimony, to the effect that two can live more cheaply than one, is justifiable. Of course, there may be children; but our first, which we shall call, as we observed, the *Pacific Mining News*, we hope will very soon be able to walk and even earn his own board, selling papers.

Our Contemporaries

THE RECENT MEETING of East and West arouses mixed feeling in our contemporaries. The *Salt Lake Mining Review*, a long-established publication with a good record of usefulness, is irritated and sarcastic. Evidently it does not like the move. On the other hand, the *Canadian Mining Journal* greets the announcement with frank good will. This is especially pleasant to us, as the *Canadian Mining Journal* has always maintained our respect, and we should be sorry if its editor felt otherwise. We have not yet heard from *Mining and Metallurgy*. We shall be disappointed if it does not register disapproval. We are opposed to it on principle, but not to the high-class men who edit it,

An Apologia

BY T. A. RICKARD

DURING the last five years I have interviewed a number of leading members of the mining profession, thereby eliciting the salient facts in careers rich in human interest and full of useful suggestion to the younger men. Each interview has been accompanied by an editorial appreciation written by myself, for the purpose of rounding the story told in the interview and of pointing the moral of it—also perhaps for the sake of saying something that was both true and kind concerning men whom I liked. Twenty-seven of these had been published when three of my "victims" came to me with the suggestion that I ought to submit myself to similar cross-examination. This seemed to me neither unfair nor inappropriate; besides, it would give me an opportunity for saying a few things that could not be said in any other context. The interview appears in this issue. It was to have been published in the *Mining and Scientific Press*, but it may seem not inappropriate to the first issue of the *Journal-Press*, as a greeting to a new circle of readers. In lieu of the editorial appreciation that accompanied the other interviews, I have prepared an apologia—which is not an apology—wherein I comment upon the interview and explain some of the motives that have actuated me in my work as an editor.

I am proud of my Cornish ancestry and of my descent from the mine-captains of "the delectable Duchy." Our people, like many of the Cornish, are of Breton origin, for Brittany is much closer to Cornwall than most people realize, and many family names are common to St. Malo and Penzance. This sentimental tie with France pleases me, for I love France. *Chacun a deux patries, la sienne et la France.* The interview shows that as the son of a mining engineer I began to travel early and learned two foreign languages before I became fluent in my own. All this has tended to check provincialism or a narrow prejudice against the peoples of other countries. A cynic has said, "Patriotism is your conviction that your country is superior to all others because you were born in it." The cynic was G. B. Shaw, whom I dislike intensely and with whom I am glad to disagree. I was not born in the United States, and therefore my belief in its superiority "to all others" is not based upon an accident; but it does coincide with my self-determination in the matter of citizenship. As a boy, in my visits to Cornwall, I used to look from the cliffs at Newquay across the Atlantic with the fixed intention of going to America, of which I had heard much from my father, who had been here many times on professional work. Besides, I met many Americans at our home, and I liked their cheery ways and expansive manner. As soon as I graduated I came across. Besides my father, four of my seniors—relatives—were in mining practice; fortunately I went to the youngest of my uncles, the one in Colorado, for, apart from his attractive personality, the State of Colorado in the mid-eighties was an intensely interesting mining region, especially in its geologic aspect. My first visit to Leadville in 1886 was a great event. So was my first acquaintance with S. F. Emmons, whose later friendship I treasure among my happiest memories. Another man to whom I am indebted mentally is Mr. Richard Pearce, a Cornishman of the best type, a keen mineralogist and geologist, as well as a highly successful metallurgist. He used to welcome me to his house in Denver when I was in my twenties and would talk on vein-structure and ore-deposition. He is now living in England, and I am glad to send him this expression of my gratitude.

The interview tells the story of my travels. The two years in Australia and New Zealand—1889 to 1891—were rich in experience, especially of economic geology, which, in a measure, became my special study as a mining engineer. At that time the science of ore deposits was in an early stage of development, and one did not have to know much in order to know more than most people. Since then my friends Kemp, Spurr, and Lindgren, as well as Messrs. C. K. Leith and H. V. Winchell, have applied geology to mining in a manner and with a success few of us could have anticipated thirty years ago. Of my work as a mining engineer I can say that the geologic aspect of it was intensely interesting—that is, the finding of ore; also the appraisal and management of mines. But the contact with promoters and their wily ways I did not like, and before long I became disgusted with them, partly because they involved me in a fiasco that was the direct consequence of disregarding my advice. Of that I need say no more here except that it was one of the reasons for my becoming an editor, a result for which I am grateful, for undoubtedly my life has been made happier, and possibly more useful, thereby.

A man is fortunate if he can find scope for his abilities, however moderate. The square peg in a round hole is the symbol of discomfort; the round peg snugly filling the round hole is the type of fitness. I have enjoyed the work that I have done now for twenty years. All normal men like power; some get it by means of muscle, others by the aid of wealth, others by the exercise of various arts. Of these, the art of writing makes its strongest appeal to educated men because it gives them power over their own kind; they became leaders of thought and moulders of public opinion, and that in a civilized community, especially one based on democratic ideals, is a splendid function.

As a mining engineer I wrote a great deal. My contributions to the Institute are equal in bulk to a volume of its *Transactions*. I used to write frequently for the *Engineering and Mining Journal* and occasionally for the *Mining and Scientific Press*. Raymond and Rothwell, both identified with the *Journal*, were my honored friends, and I kept in close touch with them. My first experience as an editor in New York was rendered uncomfortable by the changes of proprietorship that followed the tangle into which Johnston involved the business affairs of the *Journal*, but I found that I liked the work. I formed the idea that an editor ought to control his paper in order to be independent. As a matter of fact the successive controllers of the *Journal* while I was editor did not interfere with the editorial policy, nor have they interfered with it since in the slightest so far as I know; but I had just money enough to acquire control of the *Mining and Scientific Press*, and the lure of California was strong. If the earthquake had visited San Francisco a year earlier, I might have turned to Canada as a field for my journalistic activities; but I have no grudge against the earthquake. It was a stimulating experience, for it was great fun to carry the *Press* through the period of stress and to reorganize our business successfully. *The Mining Magazine* was an interesting adventure, for it gave me many new friends in the engineering profession and enlarged my knowledge of mining in its world-wide aspect. The *Press* suffered by my absence in London, and for three years earned no profit. It was losing money in 1915, when I returned to San Francisco and put my shoulder to the wheel in an effort to move it forward. For two years I worked so hard that I endangered my health and very nearly succumbed; but fortunately the stimulus given to the mining industry by the War came in the nick of time and carried the *Press* forward to renewed prosperity. Nevertheless, I have been compelled to recognize the fact that the personal kind of journalism for which I have stood has the serious defects of being measured by the energies of an individual. Men think all mines will peter out except their own. Even Methuselah died. These are phrases that I have used in discussing the persistence of ore; they apply to the persistence of an editor. Indeed, I fear that the days of editor-publishers are gone. The business of publishing is becoming so big and so costly that the kind of man likely to be fitted for editor is unlikely to be the kind of man fitted to direct concurrently the workings of a big industrial establishment. It seemed wise therefore to accept the opportunity to consolidate the *Press* with the *Journal*, especially when the consolidation was effected on honorable terms and under conditions that promise a wider field of activity not only for myself, but also for my two latest associates, whose skill and loyalty tempted me more than once to continue the *Press* despite urgings to the contrary. It is a pleasure now to be associated with Mr. Spurr and to be connected with a paper that perpetuates the traditions of two papers of which I have been the editor.

The urge to write is the moving spirit of journalism and the impulse to criticize is the very life of editorial writing. Of patter and comment there is more than enough; the world needs criticism—the criticism of ideas, of methods, and of men. The true editor is driven by the demon of criticism, and I use the word "demon" to mean not an evil prompter but an indwelling spirit. Sometimes his criticism hurts the feelings of the editor's friends, and he is sorry that it should, but that will not stay his hand, for if he once started to abstain from the performance of his self-imposed duty for fear of giving umbrage to one or two individuals, his usefulness would be at an end. Willingness to be unpopular and readiness to incur something much more unpleasant—the temporary estrangement from a friend—are the penalties of forceful journalism of the kind to which I am referring. An editor must learn to hold his friends "without capitulation" of his convictions. Indeed, if a man's friends are engaged in the industrial and professional activities that are the subjects of his critical faculty as an editor he is sure to annoy almost all of them sooner or later. That is the penalty of his position, and it is one that prevents many kindly spirits from becoming effective editors. One must have the courage of one's opinions to sit squarely in the editorial chair. I have tried to do so, and in doing it I have had to disagree with some of my friends, regretfully, but temporarily in most cases. I have accepted the penalty as part of the game—an honest and sportsmanlike game when played properly. And it is one that must be played. The development of a wholesome public opinion is essential to the health of our democratic institutions. My own interest is mainly in that part of the public that is engaged in mining and its allied operations. Friends have suggested that I ought to be on a daily newspaper, just because I write occasionally on current non-technical topics. The suggestion finds no response, because, by experience and by sympathy, I am an exponent of class journalism—of the journalism meant for a particular class, not the general public. In a mining paper I reach people with whom I have much in common, whom I understand, who are to me, as the Mexicans say, *muy simpático*. In short, although a journalist, I am still a mining engineer.

DISCUSSION

The Valuation of Gold

AT VARIOUS TIMES comments and letters have appeared in the technical press regarding the value of gold. The *Mining and Scientific Press* of Aug. 15, 1921, contains several. The question involves that of currency and is one of world-wide importance. Though the issue concerns America in her over-seas trade and in her gold-mining industry, it is not in America that action regarding the relationship of gold to currency is needed. She has re-established gold as the standard of exchange, and her paper is again interchangeable with gold. I do not purpose, therefore, any attempt to cover the ground generally, but I think that certain features of the question are worth diagnosis. The subject is one that appears to have received little serious consideration, to judge from many comments made thereon.

In some quarters there appears a belief that in Britain the currencies are still on a gold basis. This is not so. Immediately gold is withdrawn from circulation, and paper currency cannot freely be exchanged for gold, the gold basis disappears. The only things in common between the operating currency (notes) and the gold coins are the names. Presumably it is this fact that leads to misconception. The British pound and the French franc of today (notes) have no practical relationship to the gold pound and the gold franc.

The paper pound and the paper franc are pieces of paper indorsed by the state as legal tender. Their value (purchasing power) depends absolutely upon the number of them in circulation relatively to the circulation of commodities in the country concerned. They have no connection with the paper notes which, during a previous period, were freely redeemable in gold. Their value now is just what the authorities in each country chose to make it. Such was not the condition with their namesakes the earlier notes. Their number was decided almost entirely by economic laws and their value was the gold in the coins they represented and which they could command.

A term that seems to be responsible for common misconception as to present currencies is "rate of exchange." This at one time was used to indicate the small charges made by financial institutions for services rendered, in making money available where needed. But it was the same money—gold. The term is now used to indicate the purchasing power of currency units relatively to those of other countries. The "rate of exchange" today includes no doubt allowance for the said services, but this is a small factor compared with the relative values of the currencies. Probably the present "rates of exchange" are not precise indexes of the domestic purchasing power of the various currencies. They probably are more the indexes of the purchasing power of the respective currencies in goods that are wanted in foreign markets. This, however, does not affect the fact that "rates of exchange" today indicate something quite different from what they did when the nations were on a gold basis.

The "premium on gold" is another much misunderstood term. The real situation is that certain countries have discontinued the use of gold as their basis of currency. For a time these countries commandeered all gold produced within their territories and paid for it in notes bearing the same name as the gold currency units. These notes, not being redeemable in the gold units, and having been made more numerous, had become less valuable. Thus, while other commodities rose in nominal value (as expressed in terms of the said notes) gold was commandeered at a reduced real valuation—i.e., the old nominal value (price).

As regards the real market value of gold, two factors came into existence. One was the removal of a large part of its previous market—the mints of the various nations, except at reduced valuations. This was a real and serious decrease in the market. Many mines (working and prospective) became unpayable, and the output fell. The other factor was that, in countries still using gold, the price, expressed in terms of currency in the countries of production, rose. The value did not rise in the former countries. The value of the currency units (notes), in the countries of production fell.

When export of gold from producing countries was permitted, the gold flowed to the countries using gold, and there secured its real market value. The excess of that value, translated into terms of the currency units of the producing (exporting) countries, over the price paid by the mints of the latter, was miscalled the "premium on gold." For a time it seems that all gold produced in the paper-currency countries, except that used in the arts and industries, was exported to those using gold.

Gold thus secured its real market value. That value, however, was not the pre-war value—value being the measure of a commodity relatively to other commodities. A large part of its pre-war market had disappeared, as explained previously. But, in so far as these purchasing countries had been unable to secure gold for some time, it is probable that for a while the market value was not far from the pre-war value.

Later the demand for gold from these countries abated, but America re-established the interchangeability of her paper with gold. This she was able to do for two reasons: she had not inflated her currency to the extent that other countries had done, and the fact that other countries had discontinued the use of gold as currency made gold cheaper for her to obtain, and to retain in circulation.

The wealthiest country in the world having re-established the interchangeability of gold, its value naturally became based on her currency. There is no need for anyone to pay more than, or to accept less than, $20.67 for gold, because all desiring to do so can buy or sell gold at that price in America.

The assumption that America is paying too dearly for gold, and that she is maintaining foreign gold production by paying a premium on it, is absurd. She is buying gold at its present market value—neither more nor less. She is, however, buying it at under its pre-war value, and she is buying it at a value less than it would possess if the European nations re-established the interchangeability of their paper with gold.

In that sense the British Empire is selling its gold to America at under its real value. If the Empire were to re-establish interchangeability, it would have to buy such gold as it needed, over its present reserves, at a higher value than that at which it is now selling to America—higher pro-rata to the amount she needed relatively to the total available gold stocks. If other nations re-establish interchangeability, the value will again go higher.

It is incorrect to say that those producing gold in foreign countries, such as South Africa, have an advantage in the discount on the pound sterling. There is no such advantage. If the pound sterling appreciated so as to lose its "discount," gold would have a less nominal value in British currency but would have the same real value. The general price level would fall relatively to the appreciation of the pound and gold would have the same purchasing power as now. An ounce would still be worth 20.67 dollars, but the pound would be worth 4.86 dollars.

There is no "premium on gold." Gold has its market value. That value, measured in the existing European currencies, varies with their variations. As regards real value, it is the currencies that are varying, not gold.

Another fallacy that apparently has some acceptance is that the value of gold is ordained by the cost of producing it. This no doubt applies in the ultimate sense. It does not apply to any particular time. The "value" of gold depends on the total amount of it in use relatively to the total volume of circulating commodities. Its "price" depends on this factor and on the value of the currency units in which its price is expressed.

It cannot be too often stated that one of the causes of the world's present industrial upset is the lack of a common medium of exchange. This lack is hampering international trade. The only visible practicable world's medium is gold. It is, therefore, to the benefit of all mankind that the nations should re-establish the gold basis. America has done it. Britain should now do it. If others will do it simultaneously, so much the better. To effect it these will apparently have to put a higher nominal value (in terms of their currencies) on gold.

There is nothing insuperable in that, but space forbids discussion here.

As gold producers are concerned specially (the market value of their product being at stake) as well as generally (being world citizens), it is fitting that they should give this matter their earnest attention. Reversion to the gold basis is practicable, through government action. Recognition by the educated public of the principles involved might lead to, and should certainly help toward, that action being taken.

Perth, Western Australia. H. R. SLEEMAN.

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Kick vs. Rittinger

Arthur O. Gates deserves the thanks of many ore dressers who have neither the time nor the opportunity to specialize successfully on the theory of crushing, for his informative article on "Crushing-Surface Diagrams and Rittinger's Law," which appeared in your issue of Feb. 25. It will serve to clarify a much-debated subject.

I agree with Mr. Gates that writers of textbooks should strive to avoid what he calls a neutral attitude in matters of dispute, but I hasten to explain that the "Handbook of Ore Dressing" is, I believe, what it purports to be; it certainly is not a textbook. Had I attempted to pass definite judgment on the superiority of each machine or theory mentioned, the task would have come to early grief, for I was limited to a certain number of words in each section. When considering the two principal theories of crushing I felt that the Van Reytt tests precluded an unhesitating acceptance of the Rittinger theory; but the opponents to Kick's hypothesis had propounded their objections in so logical a manner and had done so much scientific research that I was equally unwilling to support the claims of the other group. Therefore I merely stated the two theories in a condensed form.

Mr. Gates' recent article clarifies much that was in doubt; he disposes of the Van Reytt results by the suggestion that they were based entirely on feed conditions, and he adduces new arguments to sustain the claims of Rittinger. In the face of these data it is doubtful if any future investigator will favor anything with a Kick in it. I am not sorry that I adopted a neutral attitude in the "Handbook of Ore Dressing"; but I promise Mr. Gates that the subject will be discussed more fully in the second edition, and in a manner appreciative of his more recent researches and helpful criticism.

San Francisco. A. W. ALLEN.

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Yes, It Really Is Done

As requested in your editorial of Feb. 25, relative to wireless receiving apparatus at remote mining camps, I wish to inform you that the Gold Hill & Iowa Mines Co., at Quartzburg, Idaho, maintains such a station.

We are located well back in the mountains, away from railroad and dependent upon stage transportation; we have very heavy snowfalls, at times as much as ten feet. We are in a deep canyon, where it would seem as though even the so-called ether waves could not find us, but every day we are in touch with Denver, San Francisco, Oakland, Seattle, Portland, Alberta, Canada, and practically every large city in this section of the country. Strange as it may seem, our nearest point from which we get information is practically eight hundred miles away. From these points we receive "broadcasts" at regular schedules. We generally get the most important news, the front-page stuff, even before it appears in print in the large cities. We also receive weather forecasts, stock quotations, Sunday sermons, interesting lectures on many subjects, and current prices on staple supplies.

Since installing the outfit there has not been an evening that has failed to give us some information of interest. During this time the wire phones have been down several times. We have our outfit arranged with amplifiers and loud speaking apparatus so that everyone may hear. Amplification may be made so that everything may be distinctly heard in a good-sized hall. We receive music from all of the new records and often we are privileged to hear some of the grand opera stars who have given concerts in San Francisco. We also get some clever vaudeville stunts.

The weather reports, general news, and other items of interest are gathered and put into bulletin form and posted on the bulletin board at the works and also at the post office, so that all may enjoy the privilege, but interest has now reached the point that everyone wants to get it direct from the machine, as a little of the jazz music comes along with it, which helps to cheer things up.

It is possible for $150 to get a receiving set that will give satisfactory results, and the operation and installation may be done by almost anyone. The cheap outfits selling for a few dollars of course will prove disappointments, but those made by the recognized electric companies and using vacuum tubes will give entire satisfaction. E. E. CARTER, Manager.

Quartzburg, Idaho.

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From Out of the West

"From Out of the West," down close to the "Border," comes a hearty congratulation to both the *Engineering and Mining Journal* and the *Mining and Scientific Press* on their consolidation. A great deal of "lost motion" and needless repetition is thereby eliminated, and the mining fraternity, the world over, will be greatly benefited in many ways.

"From Out of the West" a mighty effort is taking form—an effort with sufficient momentum to carry it on to a final success. This area produces copper in abundance, and large herds of cattle. Both are correctly classified as "basic industries," and both are now in a chaotic condition. With its two basic industries seriously crippled, would you expect a country to be "up and going"? "They have lost their nerve," you say.—Now don't you ever believe a word of that. Their smiles are as broad; their handclasp is just as strong. "It's hard, men, it's tough, and some few are hungry, but that must not matter: team work, men, team work, and we will all pull out of this together." That is their motto, and that is the "spirit" which has given this "effort" such a momentum.

The West was called upon to produce copper—to produce millions of pounds of it annually. And it answered the call. It had big men and lots of them, and the most efficient methods and organizations were developed to produce that copper. It was a stupendous undertaking: it was remarkably carried out: it was all done in typical Western fashion. And now what—the copper cannot be sold. "Somebody has gone to sleep at the switch." Must the West produce that copper and market it too? Must the West go out to the Atlantic seaboard and develop selling agencies? Must the West work both ends of the line? The West was given a "man's job," and it certainly qualified in no uncertain manner.

No, the West is not going to pack up its little going-away bag and move to centers of population in an effort to develop markets for its mineral products. That is not its "mighty effort"; that is not "the kernel in the nut." The West is going to stay "in its own back yard": it is going to crack that nut right in "home territory." The "kernel" is the millions of dollars of power that is going to waste in the rivers of the West. The nut that is to be cracked is to harness and control that power and put it to work manufacturing needed and salable articles from the West's raw products.

The three essentials for the success of such an enterprise are raw products, cheap power, and efficient organization and management. The first and last requirements are already developed; the power is here—it is idle. It only remains to control and harness this power for the solution of the problem. The West does not ponder over "Can it be done?" Its only query is "How soon can we do it?" and why not?

It will cost millions, you say—certainly it will, and the benefits and returns to posterity will amount to billions. But where will we get the money, comes the inquiry? Why not declare the "Soldiers' Bonus," a "Peace Bonus," and with those funds which would go to the Soldiers' Bonus build these power projects? Give every ex-service man who wanted help work. Pay good wages. Give the ex-service men an interest in the project—either power or irrigation. Let them build one, if not the greatest, monument to peace and civilization that has ever been built—that has ever been erected to mankind. Call it the "World War Soldiers' Monument." Let it aid them materially now, but let the good that it will do mean even more than a material help—let it be a moral uplift to those great men as well as to our nation.

Patagonia, Ariz. C. A. PIERCE.

Who Are Fit for Self-Government?

Discussing the question "When are a people or group fit for self-government?" brought up in the editorial pages of your March 11 issue, it seems to me that the verdict of history has been that a people are ready for self-government whenever they have "guts" enough (excuse the English) and strength enough to no longer permit someone else to govern them; and that they are no longer fit for self-government the moment they will permit someone else to govern them.

The American people won their independence by stating to the world the broad principles of right and justice under which they demanded it, and then going into a "Liberty or Death" fight for it, and by all hanging together won it, and saved themselves from being hanged separately. The clear statement of principle involved, however, was half the battle. It won the sympathy and moral support of the world, and the active assistance of France, and destroyed the morale of the enemy by creating sympathy in England itself. This is an early example of intelligent propaganda. However, these same men that enunciated these broad principles of liberty held slaves, simply because the negro was not yet advanced to the point where he could demand liberty and "get away with it."

Entering the World War, America stated to the world the broad principle under which she fought for the defense of her violated rights, and joined her allies undividedly and unselfishly until the war was won and her rights defended, and then went back home and started minding her own business again, disappointing a lot of people who thought we were to go on and defend everyone else's rights under the principles enunciated as well as our own, and hand them out on a silver platter. The statement of principles involved was another example of successful propaganda. It won allies and friends, and brought about the destruction of the morale of the enemy.

History decided that the Roman people were no longer fit for self-government when luxurious living made them reluctant to *fight their own battles*. After being successful in their first encounter with the Goths, the Romans said, "Why, these are a fine husky lot of men; let's organize an army of them and let them do our fighting for us"; and the Roman Empire was wrecked by this Gothic army joining the enemy at a critical stage.

Theodore Roosevelt said "Fear God and take your own part"; in other words, "be sure you are right and then go ahead," and fight for your rights. Fear God, state the broad principles of right under which your demands are made, and then fight. A people have a right to self-government, as an individual has a right to success, but has to fight for it.

"The ten thousand" members of the Institute are unfit for self-government just so long as they will permit "The Few" to govern them by "divine right." A government of "The Few" is probably the most efficient form of government, as long as you have a "good" few, as the Institute has had; but proves fatal with a "bad" few that may show up at any moment. Mr. Spurr says he wants "self-government, even if it is poorer government"; these are also the exact words used by the great Filipino patriot.

We may hasten the day when a people will be fit for, and will have, self-government, by giving them education, and letting them "paddle their own canoe" just as fast as they learn how. Or a people's capacity for self-government may be destroyed by someone else exercising a function they should undertake to exercise themselves. PAUL R. COOK.

New York City.

Economic Mineralogy

Certain comment seems warranted by the editorial entitled "Economic Mineralogy," in the Feb. 11 issue of *Engineering and Mining Journal*. If your attack in this editorial on the teaching of mineralogy is based upon the paper presented in the recent meeting of the geologists and mineralogists at Amherst, Mass., as is suggested, the writer of this article should be better informed than your citation would indicate. The point is that Dana's "System of Mineralogy" is neither a standard textbook nor a textbook which is not standard. It is not a textbook, has never been a textbook, and has never claimed to be a textbook. I doubt if there is an institution of learning in the country where it is used as a textbook.

On the contrary, Dana himself prepared a textbook years ago which is a standard work and does not furnish examples of the types you cite. In Dana's textbook of mineralogy one full page is devoted to chalcocite and less than a quarter of a page is given to the discussion of sternbergite. A. N. WINCHELL.

Madison, Wis.

Moving drill apparatus across creek

Drill Hole No. 20 in Red Ledge area

Diamond Drilling in the Seven Devils Mountains

Problems in Exploration That Were Encountered in a Rugged District Where Transportation Is Difficult—A High Percentage of the Core Was Obtained In Drilling, and Careful Records Were Kept of the Formations Passed Through

By Frank A. Kennedy

THOSE accustomed to the standard diamond drilling outfit used on the Michigan and Minnesota iron ranges and in the Michigan copper district will be interested in methods of diamond drilling in a district where the topography is so rugged that the ordinary practice and drilling machines cannot be conveniently used.

The Idaho Copper Co. has been carrying on an extensive drilling campaign in what is known as the Red Ledge area in the Seven Devils mining district of Idaho. This region lies on the slopes of Snake River Canyon, a valley that outrivals the Grand Canyon of the the Colorado in depth and ruggedness. Mountains rise to a height of 9,000 ft. on the brink, with a drop of 7,000 ft. to the river four miles away.

Deep Creek cuts a narrow deep gorge in the side of the canyon on its way to Snake River and crosses the Red Ledge formation at an elevation of 1,400 ft. above the river. The Red Ledge extends upward to an elevation of 7,000 ft. and the slopes are too steep to allow set-ups or moving of a drill machine to advantageous and promising drill locations. Because of these conditions, it was found necessary to restrict all drilling to the creek bottom.

The proper locations along the creek were plotted on paper from a careful geological study of the area, but when these points were located on the ground more often than not they were found to present conditions impossible for drilling. To get set-ups it was sometimes necessary to place the drill on a bridge over Deep Creek and drill in the outcropping faces.

The Red Ledge formation is an intrusive quartz porphyry and is partly covered with the remains of limy tuffs. The rocks vary in hardness from a soft tuffaceous material and altered porphyry to an extremely hard fragmental rock. The ore formation is 2,500 ft. wide and the ore zones are from a few feet to 200 ft. in width. The ore varies in texture from an extremely soft silver-copper sulphide to hard disseminated chalcopyrite. Discounting the topographic features, it was considered favorable ground in which to operate a diamond drill.

The drilling was done by the Diamond Drill Contracting Co., of Spokane, Wash., which company manufactured its own machines. It was necessary to use a somewhat different type of drill underground in the tunnel than on surface. The tunnel machine was mounted on skids and had a drive shaft from the side as well as from the end. This drill was driven by a Ford gasoline engine stationed outside the tunnel 400 ft. away. The drive shaft consisted of forty 10-ft. lengths of drill rods connected and suspended from posts in the tunnel. By using a universal joint at the drill, the operators were able to drill in any direction and at any angle.

The surface drills were mounted in a light, well-braced steel frame made of angle iron. A Ford engine equipped with self-starters furnished all the power. The gears were so arranged that it was possible to obtain any desired speed, and the adjustments and all connections so designed as to secure the greatest speed in pulling rods, changing bits, and moving the drill

Red Ledge formation in the Seven Devils Mountains, Idaho

from place to place. These machines could be moved by their own power, and I have seen them pull themselves up a 40-deg. slope with all equipment. They were equipped with two high-pressure pumps, and had a drilling capacity of 600 ft. of $2\frac{3}{8}$-in. hole and 1,000 ft. of $1\frac{1}{2}$-in. hole.

The drills were trucked from Homestead, Ore., an elevation of 1,700 ft., through to Cuprum, Idaho, to the Peacock mine (elevation 7,200 ft.). A 36-in. trail was completed down Deep Creek Canyon to Red Ledge, a distance of five miles. This trail has an average drop of 815 ft. per mile, and the last two miles drop 2,400 ft.

The machines were moved down the trail, a distance of three miles, by their own power, and considerable care was necessary to keep them right-side up. They rolled over several times, but, owing to their compactness, came through without breakage. The last two miles was not only steep but overhung the creek in many places, and here it was thought advisable to dismount the drills and use horses to pack the remaining distance.

Over four thousand feet of rods and pipe, some air machinery and two years' supplies were packed in over this trail. Gasoline was brought down in 10-gal. cans, and it required approximately one barrel per day to keep the drills running.

The work was divided into three shifts, with two men per drill on each shift. One setter was required for each drill, and he acted as a foreman for that drill.

All holes were drilled the first 10 ft. with a bit that cut a $2\frac{3}{8}$-in. core. This distance was cased to act as a guide and prevented shattered surface material from falling in the hole. The rest of the hole was drilled with a bit that cut a core of $1\frac{1}{8}$ in., approximately an N bit, unless it became necessary to case. Then, instead of reaming the hole for the casing for the same sized bit, a casing was put down and the bit reduced to cut a core $1\frac{3}{16}$ in. If further trouble was experienced, the bit was reduced to an E size.

The $1\frac{1}{8}$-in. bits were set with fourteen stones, six on the inside and eight on the outside, two of which were small stones set down in the outside of the bit to act as reamers, and called "jokers."

Considerable trouble was experienced in holes that crosscut underground watercourses and crevasses. In hole No. 18 at a depth of 460 ft. the rods suddenly dropped into a crevasse over twenty feet before they were caught, though we were able to complete all holes.

Specially made core boxes were constructed with a cover that fastened on with screws to fit the size of core drilled, and which kept the core in place when it was moved. The core was separated off with markers, giving the exact depth at every pull and was later classified and marked off according to structure.

All sampling was done, wherever possible, by using a Longyear core-splitter, one-half being left for classification and future reference. Otherwise, the core was broken with a hammer and a part left as before. The part taken for the sample was reduced by a crusher.

A careful record was kept of the drilling operation, and the data on the following page give part of the record of an average drill hole. From this data one is able to tell the number of pulls made with core per day, the distance drilled, character of material passed through, amount of core or sludge recovered, the length of sample taken and the analyses. No analyses was made on sludge where the hole was represented by a good percentage of core.

The speed of diamond drilling depends largely on the number of pulls made necessary by the character of rock being drilled. The best record made on the Red Ledge was 41 ft. in one shift in hard porphyry, and the lowest were made in either broken formation or in heavy soft sulphides. Ninety-five per cent of core was recovered in last season's drilling.

Core from a diamond-drill hole in the Red Ledge area, Idaho

RECORD OF DRILL HOLE No. 20, RED LEDGE REGION, IDAHO
Fifty Degrees With Dip, Ninety Degrees With Strike. Elevation, 2,960 ft

Date	Depth, in Ft From – To	Classification	Amount in ft. Core	 Sludge	Sample Number	Ounces Per Ton Au	 Ag	Per Cent Cu
Oct. 13	0 – 10	Porphyry	4	No	146	02	19.82	.25
	10 – 13		3	2				
	13 – 19		6	3	150	.04	1.28	.35
	19 – 24		4	6				
	24 – 27		2	3				
	27 – 29		2	2	147	02	5.86	.78
	29 – 35		5	6	151	04	.96	.53
Oct. 14	35 – 41	Porphyry	6	6	148	03	3.97	.53
	41 – 45		4	4	152	04	.40	.40
	45 – 48		3	3	149	04	1.84	.35
	48 – 52		4	4	153	.02	1.38	.55
	52 – 59		7	7	154	04	.76	.60
	59 – 66		7	7	160	04	52	.68
	66 – 71		5	5	155	02	2.90	.38
Oct. 15	71 – 82	Porphyry and tuffs	11	11	161	02	.58	53
	82 – 92		10	10	156	.02	2.70	.75
	92 – 98½	Porphyry	7½	7½	162	04	1.04	.40
	98½–104		5	5	157	.04	2.64	.70
	104 –111		7	7	163	04	80	.58
	111 –114		3	3	158	06	1.18	.40
Oct. 16	114 –122		8	8	164	.04	.40	.98
	122 –126		4	4	159	04	2.04	.60
	126 –134		8	8	165	.08	.60	48
	134 –143		9	9	170	.20	1.56	7.91
	143 –153		10	10	166	10	08	7.22
	153 –161		8	8	338	10	.70	4.46
Oct. 17	161 –168		7	7	339	06	77	4.56
	168 –177		9	9	172	08	.52	5.80
Oct. 18	177 –182	Schist and porphyry	5	5	168	.18	54	10.83
	182 –186	Schist and tuffs	4	4				
	186 –196	Porphyry	10	10	173	.02	.38	13
	196 –206		10	10	169	04	.24	.10
	206 –217		11	11	174	.04	.28	.05
Oct. 19	217 –227		1	10				
	227 –237½		3	11½				
	237½–241	Porphyry and schist	3	3½				
Oct. 20	241 –251		8	10				
	251 –261		5	10	175	02	.04	.08
	261 –271		10	10	180	02	18	.17
	271 –277½		6½	6½				
Oct. 21	277½–287½	Porphyry	4	4½	176	02	66	1.78
	287½–291½		3	4				
	291½–296½		5	5	181	.02	38	.53
	296½–306		6	8	177	.04	.12	.27
	306 –317	Porphyry and granite tuff	11	11				
	317 –327		10	10				
Oct. 22	327 –335		2	8				

It would have required four times the expenditure to have secured the same knowledge of the ore and orebodies by tunneling and would have taken four times as long. It seems best, therefore, no matter how rugged the country is, but, of course, depending on the nature of the rock and orebodies, to do all preliminary exploration by diamond drilling. It is possible with the information thus gained to lay out all tunnel work, and the development may be so planned that the drifts will be driven where they will do the most good, not only in developing tonnage but later on as a part of the system or method to be used in mining.

Rhodesian Mineral Production

The British South Africa Co. announces the following mineral production from the mines of Southern Rhodesia during January: Gold, 53,541 oz.; silver, 13,696 oz; coal, 49,830 tons, and small amounts of other minerals. The number of producers was 150, as compared with 158 in December.

Comparative tables of the production during 1920 and 1921 are as follows:

	1920	1921
Gold, fine oz.....	552,498	585,525
Silver, fine oz....	158,982	152,989
Copper, tons....	3,108	3,080
Chrome ore, tons..........	60,269	50,188
Coal from Wankie Colliery, tons	578,492	574,753
Asbestos, tons............	18,823	19,529

From northern Rhodesia mineral valued at £30,965 were produced, lead being the principal mineral won, and representing a value of £27,384. The total value of all minerals raised since the beginning of mining in the Northern Province is £2,279,825, to which lead ores contributed 67 per cent.

According to the report of the executive committee of the Rhodesia Chamber of Mines, Bulawayo, the gold production in December last was 55,967.64 oz., valued at £267,005; the silver production 13,369.77 oz., valued at £1,433, and the production of base minerals and precious stones was valued at £53,756, making a total of £322,194. The grand total value of mineral production to date was put in the report dated Jan. 22 last at £60,884,694, which included gold to the value of £51,501,615, silver, £410,668, and base minerals and precious stones to the value of £8,972,411.

Problems in Fan-Pipe Installations*

The following summary indicates some of the problems in connection with fan-pipe installations in metal mines on which further information is necessary:

1. Best type of joints and range of leakage losses for the more commonly used galvanized-iron pipe joints of the following two classes: (a) joints made on surface in assembling 10- to 20-ft. lengths for transportation underground; (b) joints made underground in uniting sections assembled on surface.

2. Best type of joints and range of leakage losses for canvas tubing.

3. Methods of preventing decay of canvas tubing without excessively increasing its cost or its fire risk.

4. Quick, inexpensive methods of repairing both galvanized-iron pipe and canvas tubing with minimum loss of fan operation.

5. Amount of heat produced in small fans of various standard types under various conditions of speed and pressure, together with best methods of control.

6. Amount of heat produced by friction due to velocity in pipe lines made of various materials, especially the difference between galvanized-iron and canvas pipe; also methods of control.

7. Amount of heat transfer through material of pipe line due to difference of temperature within and without the pipe, and methods of control.

8. Practicability of using water as spray or otherwise to reduce air temperatures in ventilation pipe and in other underground air currents.

9. Determination, by Kata thermometer, of numerical values for comfort at various distances from end of pipe in confined openings similar to drift ends (such data are needed to convince mine operators of advantage derived from keeping end of pipe close to face by use of removable sections).

10. Check existing published values of friction in galvanized-iron pipe, and determine same for canvas tubing.

11. Can exhaust methods be used to advantage on long pipe lines (over 1,000 ft.) assembled as for mine use, (a) in connection with pressure methods (arrangement for reversing air direction), under high-temperature conditions, for removal of explosives fumes only; (b) as only method of ventilating under low-temperature conditions, for removal of explosives fumes only.

12. Determine, for typical mine installations, what results can be obtained by use of booster fans on lines over 1,000 ft. long.

13. Determine what advantage (if any) in comfort conditions at various distances from end of pipe can be obtained by contracting the end section to produce higher velocity.

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*Abstract from *Reports of Investigations*, U. S. Bureau of Mines, serial No. 2,320, "Performance of Fan-Pipe Installations in Metal Mines," by D. Harrington and G. E. McElroy.

A New Asbestos Discovery Near Barberton, Transvaal

Deposits of Pure White Chrysotile Occurring in Regular Arrangement—Location Is Close to Tidewater

SOUTH AFRICA is affording sensational developments in the manifold forms and varieties of its asbestos deposits. Asbestos workers had scarcely recovered from their surprise after blue asbestos was thrown on the market, when the long-fibered amosite gave them another shock. The latest discovery represents nothing new in variety, as it is a cross-fiber chrysotile of the well-known type, but in the manner of its occurrence it presents features of unusual interest.

The deposit is twenty-eight miles northwest of Barberton, the nearest railroad station being Godwan River, fourteen miles distant, from which there is a short rail haul to Lourenco Marquez, Portuguese East Africa.

The asbestos occurs in a sheet of soft green serpentine which lies in the form of a low hollow or syncline rising to form a somewhat abrupt anticline toward the south. This sheet is overlaid with a sheet of harder blue serpentine. The asbestos occurs in the upper 15 ft. of the green serpentine close to its contact with the blue rock. The outcropping edges of this syncline are 800 to 1,200 yd. apart, and the fiber occurrence has been proved for at least 800 yd. east and west on the strike in the region where the most work has been done. No fiber appears in the blue serpentine, but it occurs so constantly at the contact of the two sheets as to suggest that its origin is due to the association of the two varieties of basic rocks. A secondary fiber zone occurs at the contact of green serpentine with quartzite.

The fiber is a pure silky white chrysotile of superior quality. Unlike the Canadian asbestos veins, which occur in an irregular network, the Barberton veins are in regular parallel arrangement, conforming in direction with the plane of contact of the two belts of serpentine. Another remarkable feature is the closely packed nature of the veins. Through a vertical thickness of 7 ft. the upper part contains as many as fifteen veins to the foot, while lower down the number increases to thirty per linear foot. The alternate seams of serpentine and asbestos are as regular as lines on a sheet of ruled paper. As may be inferred, the fiber in these veins is short, the maximum length being about one-half inch. The proportion of fiber is, however, high; in the 7 ft. zone referred to it runs about 40 per cent fiber and 60 per cent massive rock. This is in favorable contrast to the Canadian deposits, in which the highest proportion of fiber is about 12 per cent of the mass.

Below the 7 ft. zone noted the seams are farther apart and much wider, reaching a maximum of three inches or more. Crude fiber is obtainable from the latter veins. At one point a vein 8⅝ in. thick has been found, but the fiber is not continuous across its entire thickness. At one of the drifts on the "New Strike" property the 7 x 7 ft. face is entirely made up of such ribboned rock, the total number of fiber veins being about 150. Approximately three tons of rock gave one ton of fiber, which graded as follows:

10 per cent grade E (½ to ¾ in.)
40 per cent grade F (¼ to ½ in.)
50 per cent grade G (⅛ to ¼ in.)

The following table indicates the proportion of the different grades of fiber obtained for a four-month period of operation.

TABLE OF GRADES AND PERCENTAGES OF BARBERTON ASBESTOS

Grade	Lengths, Inches	Preparation	Percentage of Total Output
A	Over 2½	Hand cobbed	3.87
B	1½ to 2½	Hand cobbed	9.25
C	1⅛ to 1½	Hand cobbed	14.09
D	Over ¾	Screened	39.89
E	¼ to ¾	Screened	32.98
			100.00

According to this table 27.21 per cent of the total production was hand-cobbed fiber over one inch long. This is promising, in view of the fact that fiber over one inch long constitutes only about 1.4 per cent of the total Canadian output.

As shown in the following table, the chemical composition of the fiber closely approximates that of the Canadian asbestos:

ANALYSIS OF BARBERTON AND CANADIAN FIBRE

	No. 1	No. 2		No. 1	No. 2
SiO_2...	40.05	40.49	MgO	38.35	41.41
Al_2O_3	1.90	1.27	K_2O	.15	
Fe_2O_3.	1.60	2.53	Na_2O....	.25	.
FeO...	.40		Ignition.	16.60	14.06
NiO...	.25	.. .			
CoO....	Trace	.		99.70	99.76
CaO....	.15	.			

No. 1 is the best quality long chrysotile from the "New Strike" Joubertsdal, the analysis being by Dr. McCrea, Government Laboratories, Johannesburg. No. 2 is the mean of eleven analyses of Canadian asbestos as given in Cirkel's memoir.

The most important developments at Joubertsdal and "New Strike" consist of several adits driven into the hillside in the direction of the dips, to a depth of 90 ft. or more. Drifts have been projected to right and left, covering a length of several hundred feet. The Myburgh and Munnik workings are smaller, but their location two miles east of the larger workings, in essentially the same grade of fiber, gives fair promise of continuity and volume of ore reserve. No figures are available as to tonnage so far obtained.

The ready availability of this deposit to tidewater as compared with many of the African deposits, together with the high percentage of fiber available, encourages the belief that this new territory may yet constitute an important supplementary source of asbestos supplies. The deposits have recently been described by A. L. Hall, of the Geological Survey of the Union of South Africa, in a paper presented before the Geological Society of South Africa.

United States Coins Meet Tests

The annual assay commission, in its report to the President, states that all United States coins of 1921 have passed official examination. The examination was made at the Philadelphia mint, the commission testing a number of pieces of each quantity of metal melted for coinage. All coins were found to be fully within the law's requirements. The commission passed resolutions commending the operation of the mint and the new silver peace dollar, noting with approval the coinage of a silver dollar commemorative of the peace following the Great War, thus completing the redesigning of the entire silver coinage of the Government. The commission reports that the designs of the new coinage have been brought to a state of artistic excellence compared with the best coinage of nations.

Mexican Mining Law Under the New Constitution of 1917

Extralateral Rights Not Recognized—Exploration Confined to the Areas Specified in Federal Permits—Strict Requirements as to Surveys for Title—Foreigners May Acquire Mineral Land Except in a Prohibited Zone

BY D. A. RICHARDSON

NOT ONLY the mining laws of the Republic of Mexico, but also those of the United States, are largely the outgrowth of civil rather than common law, notwithstanding the fact that the law of the United States has, in most instances, been an offspring of the common law of England.

The civil law concerning mines, in force in Spain at the time of the settlement of Mexico by the Spaniards, was based upon the assumption that mines should not become property in the same sense as the soil, but should be held and worked for the public good. This law always regarded gold, silver, precious stones, and precious metals as belonging to the state absolutely, though some of the lower or baser metals belonged to the owner of the soil, subject to control by certain of the departments of the state. The resemblance to the common law of England exists in the so-called "royal mines," which, when proved to exist within private ground, are still considered the property of the government.

EXISTING LAW DATES FROM 1910

The present mining law of Mexico became effective on July 10, 1910, and still governs except where it conflicts with the new constitution of 1917. The old Spanish mining laws in force at the time of the Mexican independence were retained for many years, with such changes only as were necessitated by the change in the form of government; and until the adoption of the mining law of June 4, 1892, the Spanish ordinance of May 23, 1783, was largely determinative of all rights in mining properties. Among the provisions of the old ordinance will be found the following, which are at least of historical interest:

Mines could be granted to certain persons who could, in turn, dispose of them to persons qualified to hold mines. This grant was of a right to work the mines rather than a right to the mine itself. The conditions of the grant were: First, the payment of a royalty into the royal treasury, this generally being a fixed proportion of the metal extracted, without reference to the expense of production; and, second, that mining operations should be carried on as provided by the various ordinances, in default of which the rights of the holder were forfeited.

Under the present law the title to all mines is in the Republic of Mexico, and as to the first condition is quite different, as mining property, when once acquired, may now be held as long as the federal tax is paid. This tax has really been substituted for the old royalty, which was a part of the metal extracted. As to the second condition, no work is now required of the possessor of mining rights, his title depending upon the payment of the tax imposed.

The term "claim" as used in the mining laws of the United States has no exact equivalent in the Mexican law; the word pertenencia (meaning portion) is the unit of measurement of the surface of mining rights, and in the old Spanish law consisted of a piece of ground two hundred yards along the course of the vein, one hundred yards in width for a perpendicular vein, and not to exceed two hundred yards in width for a vein having a dip or pitch.

THE PERTENENCIA IS THE CLAIM UNIT

A pertenencia, under the present law, consists of a piece of ground the surface of which is one hundred meters square, which size can be departed from only if former locations have segregated the ground in such shape that the form and size must, of necessity, be varied. The fact that the vein has or has not a dip or pitch does not effect the size of the pertenencia.

Under the old ordinance a discoverer of a new mineral district could acquire rights in not to exceed three pertenencias on the principal vein discovered, and a discoverer of mineral in a known mineral district could acquire rights from the crown in not to exceed two pertenencias on the discovered vein, regardless of whether the pertenencias were contiguous or separated.

Under the present law there is no distinction between discoveries in new districts or elsewhere, and any proper person may locate a piece of mineral ground containing as many pertenencias as he desires, although he may not locate less than one pertenencia, except where the size and shape of the free ground to be located is such that a full pertenencia cannot be located.

SPANISH MINING LAW INFLUENCED AMERICAN LEGISLATION

Originally, the manner of initiating a right to mineral ground bore considerable resemblance to the procedure of miners under the local rules and customs in many of the new districts of the United States during the great mining activity following the discovery of gold in California.

Mr. Yale, the author of the pioneer work on American mining law, thus comments on the similarity:

> "Most of the rules and customs constituting the [mining] code are easily recognized by those familiar with the Mexican ordinances, the Continental mining codes [and] especially the Spanish. . . . In the earlier days of placer diggings in California, the large influx of miners from the Western coast of Mexico and South America necessarily dictated the system of work to Americans who were almost entirely inexperienced in this branch of industry. . . . The Spanish-American system which has grown up under the workings of the mining ordinance of New Spain was the culmination of the rules and customs adopted."

The old Spanish law exerted an evident influence on the mining law of the United States, for as late as Feb. 12, 1848, Colonel Mason, as Military Governor of California, considered it necessary to issue a proclamatter declaring that "from and after this date, the Mexican laws and customs now prevailing in California, relative to the denouncement of mines, are hereby abolished."

A reference to the present Mexican laws relative to denouncement or location shows that the old Spanish ordinances resemble the present laws of the United States relative to location fully as closely as does the present Mexican law. It will be seen that the miners of California found, as being well suited to their peculiar wants, the main principles of the mining laws of Spain still in force at the time of the discovery of gold in California; and, among these, discovery, being the source of title, and development, which was necessary to the continuation thereof, were the two main principles out of which the present United States mining laws have grown, although the present Mexican law has almost entirely ignored both of these principles.

The location of abandoned mines, according to the Mexican law, was made in practically the same manner as an original location, but, in addition thereto, the locator was compelled to set forth the names of the former holder and the adjoining neighbors, they being then summoned to give evidence as to the facts of abandonment. Under the present laws, generally, no reference need be made to the former locator for the purpose of establishing the fact of the abandonment.

After the boundaries of the claims had been ascertained, the locator was obliged to mark them by either permanent stakes or land marks, easily distinguishable, and to further engage to keep and observe them forever without the right to change them except where no other rights had intervened. The present law relative to the change of boundaries is practically the same, but the provision as to the character of the markings now requires solid monuments, so closely set that one may stand at one monument and see the preceding as well as the following one. It is further provided that the color and shape shall differ from those of adjacent claims.

Although a vein discovered was in ground belonging to private owners, the discoverer could denounce it, but the surface rights had to be acquired from the owner. At present, private ground can be explored only by other than the owner after permission is obtained through either the owner or the administrative authorities.

SUPERIORITY OF MEXICAN LAW RECOGNIZED

Under the early ordinances, as well as under the present law, there was an absolute right to work all veins or portions of veins within the located claim, regardless of the apex and without regard to the dip or pitch. There was and is absolutely no right to follow a vein either on the strike or dip outside of the lines of the claim, unless the vein passes into vacant ground, in which the locator must acquire rights prior to other locators, to protect himself in the possession of the extended vein. The contrast between this feature and the extralateral right accorded the locator under the laws of the United States is probably the most important of the entire mining system, and the superiority of the Mexican law, particularly where there are many adjacent locations, in districts containing numerous cross lodes, broken veins and covered apexes, is recognized in the United States in many such districts by the execution of agreements between the principal mine owners restricting the rights of locators and mine workers to the ore found within the space formed by extending their surface lines vertically downward.

Originally, foreigners were not allowed to work mines in Mexico, but later their right to furnish capital to those entitled to hold them, and to retain an interest in the property worked, was recognized. Still later, resident foreigners were allowed to work mines in their own names. All religious orders, whether foreign or not, were prohibited from acquiring any mining rights. At present, foreigners, whether resident or non-resident, may acquire title to mines and work them when not within the prohibited zone.

PROHIBITED ZONE FOR FOREIGNERS

Foreigners may not under any conditions acquire direct ownership of lands and waters which are not distant at least one hundred kilometers (sixty-two and one-half miles) from a national boundary line, or fifty kilometers (thirty-one and one-fourth miles) from the coast line. Only Mexicans by birth or by naturalization, or Mexican corporations, have a right to acquire dominion over lands, waters, and their dependents, or to obtain concessions for the exploitation of mines, water power, or combustible mineral in the prohibited zone.

The state may concede the same right to foreigners providing they agree, by arrangement with the Department of Foreign Affairs, to consider themselves as Mexicans in all that has to do with said properties, and that they will not invoke the protection of their respective governments in matters relating to these properties, with the understanding that if they fail to comply strictly with this agreement, they will loose their rights over the properties they may have acquired by virtue of said agreement, the same passing again to the dominion of the nation.

Mexican corporations organized by foreigners with a statement in their articles of incorporation that the stockholders of the corporation consider themselves as Mexicans in all that has to do with properties owned by the corporation, and that they will not invoke the protection of their respective governments in matters relating to the property owned by the corporation, with the understanding that if they fail to comply strictly with conditions the corporation will loose its rights over the properties owned by it or that it may have acquired, the same passing again to the dominion of the nation, may own mining properties within the limits of the prohibited zone.

In Mexico, the disposition of the national lands, including mines, whether situate on national lands or in respect to precious metals and minerals, even when situate on private land, are within the control of the federal government, and are not subject to the control, except in minor matters, of the individual states or territories. The federal mining law is operative in all of the states and territories in the same manner as the national mining law of the United States, but it is not supplemented by state laws, regulations, and customs, as is frequently the condition in the United States.

Under the present law and regulations, the various steps to be followed in obtaining a mining title are clearly explained, but the order in which they are presented is not that in which they are performed in actual practice. It has seemed advisable to present a general outline of the acts to be performed in the order in which the locator encounters them.

Exploring permits to explore national ground may be obtained from the proper mining agent on application.

The permit covers a piece of ground surrounding a fixed point, and the diameter cannot exceed one thousand meters. The permit cannot cover ground theretofore worked as mineral, nor can it be allowed within 200 meters of a mining property. The permit is valid for sixty days, during which time only the one holding the permit can denounce ground within the zone. If a prospector desires to explore private ground and the owner will not give his consent, the mining agent, after hearing both parties, will exact from the explorer a bond to cover any loss or damage that may accrue to the land owner, and the permission to explore the ground will be granted. The petition for the exploration permit is presented to the mining agent in duplicate with a certificate from a licensed expert (mining surveyor) to the effect that the ground has no mines upon it and is distant at least 200 meters from the nearest mining property.

Denouncement certificates, with the proper fees, must be filed in the mining agency within the jurisdiction in which the property denounced[1] is located.

The denouncement certificate represents both the location notice and application for patent as they are understood in the United States. It must be formulated in writing and in duplicate, and in it shall be stated the name, age, occupation, nationality, legal residence and temporary address of the party denouncing, the substances which are particularly intended to be exploited, the number of pertenencias, their location on the ground, together with such data as may serve to identify them, the designation of the adjoining mineral properties when there are any, and the district in which the pertenencias are situated.

Denouncements Executed According to Regulations

In addition, the location with reference to some permanent object must be given, so that the claim may be easily identified, and the names of the denouncers must be specified and individually set forth. The denouncement must be made and signed in person by the party denouncing or by his lawful representative or by an attorney in fact, who must show his authority by a public document (power of attorney).

The mining agent must receive the denouncement and indorse upon his register, and also upon the document, the day and hour of its receipt. The publication of the extract of the denouncement is in actual practice attended to by the agent, but is paid for by the denouncer. If the denouncement is made in the name of a foreigner (American), application for permission to hold title in his name should be made and filed with the denouncement certificate.

The locator shall name the surveyor or expert in the certificate, although it is not absolutely necessary, as the mineral agent will appoint a surveyor within three days if the locator does not name one. In practice, the locator generally procures the surveyor to survey the claim before the certificate is presented, and the field notes are used in describing the claim. After the certificate is filed and the surveyor appointed, he makes return of the survey without again going upon the ground. The surveyor must notify the agent of his acceptance or refusal within eight days, and if he accepts the work he must complete the survey and file his return within seventy-eight days after the denouncement is filed and within sixty days after his appointment.

The survey and return, including the map or plan, is made in strict accordance with the regulations and instructions and is not a matter in which the denouncer can render any great assistance. In addition to the survey and return, the surveyor or the owner shall cause to be erected the monuments needed, which shall be solid foundations of rubble stone masonry, not less than fifty centimeters in height, level on top and square in shape, each side being not less than fifty centimeters.

The following rules shall be observed in the placing of monuments:

1. The position of monuments shall not be changed so long as the mining properties for which they serve as monuments are not changed. They shall be solidly constructed and shall always be kept in good condition.
2. They shall be placed in convenient locations in whatever numbers may be necessary, in order that from each of said monuments the monument on each side thereof may be seen, and they shall be distinguished from the monuments erected on adjoining mining properties by their dimensions, form, color, or some other characteristic.

Procuring Title Requires Patience

When the final report of the expert or surveyor has been filed with the agent, notice of this fact is posted on the bulletin board of the agency for fifteen days. At the expiration of one hundred and twenty days from the date of the acceptance of the expert, the agent shall, if the whole matter is not delayed pending adverse or opposition proceedings, make a copy of the record and transmit it to the Department of Commerce, Industry, and Labor.

The department shall disapprove of the proceedings if there has been an infraction of the laws or regulations by the denouncer, or it may order an amendment in accordance with the justice of the case as it appears from the record.

Upon the approval of the proceedings, the mining title, corresponding to the patent in the United States, is executed by the secretary. It is then either delivered to the owner or his duly authorized attorney in fact, or transmitted to the local mining agent. Notice is also given the Department of Hacienda that its agent may be prepared to collect the taxes.

The local agent notifies the owner of the receipt of the title by posting a notice on the agency bulletin board for thirty days, and the title is retained, if not called for, until the owner receives notice of the announcement of the forfeiture of the property.

Upon the delivery of the title, the owner should immediately have it recorded in the register of the municipality where the property is situated. The record date of the title is counted from the date of issue, if it is thus recorded within thirty days from the date of issue, but otherwise it dates only from the day of actual record.

The title should then be presented to the stamp agent, and the taxes, if any are due, must be paid to the end of the tercio in which the title issued. The owner is then not only entitled to absolute possession of the mine, but has the right to ship ore as though he were the absolute owner, as under a patent from the government in the United States, and his rights continue as long as the mining tax is paid.

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[1] This term is peculiar to the mining law of Mexico and means to offer for record a legal notice of a claim for a mining concession covering a described area of land the mining rights to which reside in the federal government.—Editor.

T. A. Rickard, Engineer-Editor

An Interview, by Charles Butters and W. J. Loring

B. You are of English origin?

Cornish on my father's side, Scottish-Irish on my mother's.

B. You were born in Cornwall?

No, I was born at Pertusola, in Italy, in 1864. My father was in charge of a smelter operated by a British company at that place. Only last week we received a subscription to the *M. & S. P.* from the Societa di Pertusola; in the accompanying letter the writer stated that he recalled my father's connection with the management and that since then the plant had grown so much that it was now the largest lead-smelting establishment in Italy.

B. So it seems that you happened, at your birth, to be connected with a successful enterprise.

Yes, I shall be glad to accept the coincidence as a mascot. I might add that thirty years ago, when in charge of mines in France, I had the pleasure of selling ore to the smelter at Pertusola.

L. Has that smelter been in operation continuously since that date?

Yes, it has. The control of it was acquired by Sir Thomas Brassey, later Lord Brassey, and it remained in the family until recently.

L. Your own family was connected with mining, then?

Yes, my father, Thomas Rickard, was the eldest of five brothers, all of whom were mining engineers and metallurgists. My grandfather was James Rickard, known as "Captain" because he was a Cornish mine captain. He was one of the first accredited mining engineers to come to California, in the summer of 1850, in behalf of John Taylor & Sons, a firm still honorably active in London, for whom he examined the Mariposa grant, then under option from General John C. Fremont, "the Pathfinder" and the rival of Lincoln for the Presidency in 1856. My grandfather brought a sectional stamp-mill to California, to test the ore of the Mother Lode, and this was the first stamp-mill erected in California—at Coulterville, in Mariposa County. Hennen Jennings and Edward Benjamin told me that they had seen records to this effect, but unfortunately they were destroyed in the San Francisco fire.

B. The firm of John Taylor & Sons is the oldest mining engineering firm in existence?

Yes, I believe it is; and I am glad to say that, as the grandson of James Rickard, I am on friendly terms with the grandsons of the founders, John and Richard Taylor. I may add that my great-grandfather was Richard Rickard, also a Cornish mine captain, who was a man of distinction in his own little world in the "old county," as the Cornish call it.

L. Were you educated in Italy?

No. Two years after my birth, my father went to Andeer, in Switzerland, for John Taylor & Sons, and after two years more he went to Russia as manager for the Russia Copper Co., operating two smelters and several groups of mines close to the Russo-Asiatic border. Some of the mines were across the border in western Siberia. My first recollection of mining operations is of an aërial rope-tramway in Switzerland, but my first memory of a mine is that of the copper mines at Kargalinsky, in the Ural region. In these, the copper occurred native and as carbonate—that is, in a form attractive to the eye, so that I remembered it. Moreover, the copper appeared as a replacement of plant remains in the Permian sandstone, and the peculiar character of these deposits naturally arrested my boyish observation.

L. What was your early education?

The first language that I learned to speak was German, because our nurse came with us from the German-speaking part of Switzerland, near Zürich. In Russia, my first teaching was received from a Russian tutor, and the first history I learned was the history of Russia. Until I was fourteen, I thought in German, and spoke Russian better than English. While in the Ural, I used to accompany my father on some of his inspections, and I recall the fact more particularly that I acted as interpreter for him and for George W. Maynard, of New York. Maynard came there, I believe, to introduce some American concentrating machinery. Twenty-two years later, W. H. Emanuel, who represented Fraser & Chalmers in Denver, brought Maynard to my office, whereupon the following colloquy ensued. I asked him: "Are you Professor Maynard?" He admitted it. Then I said, "George W. Maynard?" He said "Yes." Whereupon I said, "I knew you *long* ago"; and he replied, "Are you that boy?" "I am." Our renewed acquaintance started a friendship that lasted as long as he lived.

B. To what school did you go?

While in Russia, my brother Forbes and I had a Russian tutor. Later, when I was eleven, the three oldest children, including my eldest sister, now Mrs. F. W. Baker, of London, traveled from the Siberian border to England, to go to boarding schools. I remember that we went up the Volga, from Ufa to Nijni Novgorod, and then by train to St. Petersburg. The journey to England from the Ural took three weeks and three days. My brother and I went to school at Taunton, in Somersetshire. In England it would be described—pathetically—as a lower middle-class school, but it was a good school. It is known now as Queen's College. We had a field club and a debating society. In the debating society we learned to speak while on our feet; in our field-club rambles we obtained glimpses of natural history. I remained there for six years and then matriculated at London University.

B. Was the teaching at this school helpful to you in your profession?

It was useful for mining engineering in so far as we received a smattering of science, but my taste at that time was all for English and the classics.

L. Had you already decided to follow in the footsteps of your father?

No; on the contrary, I had won a scholarship at Cambridge and was about to go there, with a view to adopting one of the so-called liberal professions, possibly the law, when I was diverted by the advice of my uncle, Reuben Rickard, who arrived in England on a visit from Berkeley, California. He was, as those that knew him will recall, a kindly and eminently sensible man. He urged me to follow the family calling, and I had so much respect for his sagacity that I did as he had suggested to me.

B. Don't you think you were particularly fortunate to have had the good sense at that age to be willing to accept the advice of an older man?

I cannot analyze my reasons for accepting the advice, but I feel sure that one of them was the fact that I liked the adviser; so I went to the Royal School of Mines, in which at that time Huxley was dean of the faculty.

B. You emphasize the fact that Huxley was the dean.

Yes, indeed, because, although I was only a boy, I learned quickly to appreciate the fact that I was in touch with one of the great men of the world. He was an extremely attractive character in many ways. He would preside at some of our student meetings and always spoke so as to hold the attention and deep respect of the students. While at South Kensington, I had the honor of serving on a committee with him.

B. How old were you then?

I was eighteen or nineteen. The reason why I was chosen as a representative of the students on this committee was that, although I entered as a private student, I won a free studentship, so that I received monetary assistance from the Government, and that ranged me with the men who were being trained to be science teachers. Among them was H. G. Wells. After graduating, I bought a set of nine volumes of Huxley's essays for $10, and I have them still. What is more, I have lent them to several young men at different times during the last forty years.

L. When did you graduate?

I graduated with the class of 1885, in June of that year, and sailed by the "Aurania" for the United States at once, before I had received my diploma, arriving at Denver on July 25.

B. To what extent has your college training helped you?

Greatly, of course. The teaching at the School of Mines was not as good, in some respects, as can be obtained now in many mining colleges in this country. It dealt more with principles and less with the application of those principles; it was more a college of science than a school of mines. Indeed, being the son of a mining engineer and having heard mining discussed at home so much, I skipped the mining course and took the one in metallurgy, because I had already made up my mind, from hearing my seniors talk, that practical mining was not a thing that could be taught in lectures. Having a scholarship and having a certain measure of choice in my curriculum, instead of going to the lectures that Sir Warington Smyth gave on mining in the afternoon, I went to Westminster and listened to the debates in the House of Commons, followed by afternoon tea where there was attractive company. The great benefit that I received at the Royal School of Mines was the stimulus imparted by mental contact with Huxley. He did not lecture to those of us who were graduating in mining or metallurgy, his subjects being paleontology and biology, but as I took a special course in dissection and biology in preparation for my B.Sc. degree in London University, I came under his spell. His lectures were windows to the infinite.

B. You said just now that the teaching was not so good in your time as in some of our modern schools, but is it not true that the purpose of the teaching in a college should be to impart a thorough knowledge of principles?

You are perfectly right, and I think some of our schools overlook this fact, giving too much time to details that are soon forgotten and soon obsolete, whereas the principles endure.

B. You also had more of your teachers' time than the average student obtains today in our crowded colleges.

That is true. There were twenty-four of us in our class, and only five or six graduated.

L. Who were your fellow students?

I have mentioned Wells. Sir Thomas Rose, the author of "The Metallurgy of Gold," was in the class that followed mine; also Henry F. Collins, who was a brilliant student and won distinction. My own particular pals were Ernest R. Woakes, who is now with John Taylor & Sons, and Percy E. O. Carr, who was manager for the Mazapil Copper Co. and was killed at Saltillo during the Mexican revolution in 1918. My brother Forbes was in the class after me. He is now living at Denver. My cousin James was my contemporary part of the time. Both of them graduated. Besides these kinsmen, my wife's brother, Harold Rickard, was also a student there, but several years later.

L. Were your college associations of any use to you in after life?

No, they were not useful, although many of them were, and are still, delightful. The reason that they were not useful was that I left England and plunged into a new environment in the United States.

L. What did you first do after arriving at Denver?

I joined my uncle, Alfred Rickard, the youngest of my father's brothers, at Idaho Springs, in Colorado, as assayer to the Kohinoor & Donaldson Co. My uncle was manager for several British companies operating near Idaho Springs and Central City. I received my first pay, $100, on my twenty-first birthday. I had not taken the surveying course at the School of Mines, so late in the fall of '86 I went to Leadville as the guest of William Hanson, then the manager for the La Plata company, to which the firm of Rickard Bros. was consulting engineer. I stayed at the company's house and took advantage of the opportunity to learn surveying by working gratuitously with Charles Dunham, the company's surveyor. On going back to Central City, where my uncle was then living, I was appointed surveyor as well as assayer to a group of mines, and my pay was doubled, to $200 per month. I was glad to do the surveying, because, among other things, it enabled me to begin the study of structural geology.

B. Did you like surveying?

Not much. Our mine workings were small, extremely dirty, and cold. The surveying had to be done under conditions of great physical discomfort; and although, of course, I was willing to face anything, I cannot say that I liked it.

B. Your pay was pretty good for that time.

Yes, but then you must remember that the manager was my uncle. What is the use of an uncle anyhow unless you can get good pay through him? Here I may add that Alfred Rickard was more like an elder brother than an uncle to me; he was a kind and considerate man, and a first-rate manager of mines, with a keen eye for exploratory work underground.

L. What did you do next?

After I had been with my uncle a couple of years, his wife died and he had to go to England with the children, leaving me in charge of several small mines. One of them was the California, which was the deepest gold mine in Colorado; the shaft was 2,260 ft. on the dip of the vein, or 2,040 ft. vertically. The hoisting was done with a hemp rope, and many is the time that I remember being startled when it would slip on the drum, giving the bucket a drop that made me fear it was going to the bottom.

During my uncle's absence, I received a visit from Philip Argall, who had succeeded Hanson as manager for the La Plata company, at Leadville. He had just returned from California, where he had been examining a gold mine. He seemed to like my work as temporary manager, and asked me whether I would like to be the manager of the mine in California. As I had been to California on a visit to my Uncle Reuben, at Berkeley, during the previous winter and had returned with a delightful impression of California, I told him promptly that I would be glad to go thither. The result was that I was appointed manager of a mine called the Union, previously owned by the Rathgeb brothers, four miles south of San Andreas, close to the road from San Andreas to Angels Camp, in Calaveras County.

L. You were rather a young mine manager, were you not?

Yes, I took charge soon after my twenty-third birthday. I had a house, hot and cold water, a Chinaman, a horse and buggy, and $300 per month.

B. I have noticed in your various writings a friendly feeling for Philip Argall, and now I can understand it.

Yes, sir; you are right. A fellow that cannot remember with gratitude the friend to whom he owed his first management of a mine would be a poor thing indeed. I had met Philip Argall when I was a boy of fourteen, when he was manager of the Duchy Peru mine, not far from Newquay, in Cornwall, as is recorded in my interview with him.

L. What was the result of your operations in Calaveras County?

The mine was a pocket mine. It was about 250 ft. deep when I took charge, but the quartz below the water-level, at 120 ft., looked hungry. At the time I became manager, about $275,000 had been spent on the purchase and equipment of the property, and only $7,000 worth of gold had been won. In other words, it was a fizzle, for it had been sold on the report of the promoter himself, a man named Hamilton, who used to paint cuspidors and coal-scuttles for the Southern Pacific railway, and who got into mining in consequence of photographing mines and mining plants. The English company did the silly old thing of giving the management of the mine to the promoter, who thereby was able to cover up his chicanery, in the meantime receiving a handsome salary from his victims. Mr. Argall exposed the whole affair and advised a change of management, so I succeeded Hamilton. I did not know enough to hurt me, but I did see at once that the past production of the mine had come entirely from pockets above the water-level, so I put one or two trustworthy men to work in search of more pockets. This was successful. I took out $3,000 in two hours with an iron candlestick myself, and a working miner took out $25,000 at a cost of $200, which was his pay, in one month. I paid him extra wages, because the work required a man of special integrity. I advised the company to do a little prospecting before they abandoned the enterprise. I remember that at that time I made the acquaintance of Charles D. Lane, who was running the Utica, and he told me that the show was no good because we were not in the "black slate," or Mariposa schist. We were in the gray schist, and our quartz was not of the ribbony kind characterizing the real Mother Lode mines. We were on the western edge of it.

L. Did you find much specimen ore?

No, only in spots. When I made a profit, thanks to these pockets, the directors wrote most complimentary letters, but when the returns dwindled, I received a letter upbraiding me for my failure; whereupon I wrote to them that, whereas I recognized that it was my duty to search diligently for ore and to extract it at the minimum cost, I declined to be held responsible for the distribution of the gold in the crust of the earth, because I had not been consulted by the Almighty when these interesting ore deposits were being created. The chairman of the company showed this letter to my father, a most punctilious gentleman, from whom I received a letter suggesting that I ought to be more respectful.

B. So at your first mine you received a fairly handsome salary and the poor shareholders received nothing? Were you ever in the happy position of being able to benefit both yourself and the shareholders?

Yes, I am glad to say that I have returned in dividends many hundred times more than I have received, for I have been manager or consulting engineer of mines that have yielded over $50,000,000 in gold and silver.

B. Do you think that you have received your fair proportion of the profits?

Yes, I think I have, for I did not risk my capital; as an engineer I did not receive much as compared with the promoters, but that is another story.

L. How long did you remain in Calaveras County?

Two years, from 1887 to 1889. Early in 1889 the directors sent a mining engineer to investigate conditions generally, and incidentally to criticize my management. They took pains to select a man unacquainted with my family, an Australian named Charles Cowland. He proved to be a most agreeable man, for, among other things, he expressed a favorable opinion of my youthful attempts as a manager and asked me to go with him to Australia. So, in October, 1889, I went with him to London and from there to Australia.

B. What did you do?

I examined several mines that he was promoting, and I regret to say that I had to report unfavorably on most of them, but we continued to be friends. I had saved enough money from my salary in California to be able to travel, and this I did energetically. In the course of two years I examined eighty-five mines in Australia, all the way from Broken Hill to Mount Morgan.

B. Did you get fees for the examination of these properties?

No, sir. I received mighty few fees, and even those I found hard to collect, for in those days the people who paid for reports expected to see them first. However, I obtained a good working knowledge of the principal ore deposits of Australia and of the prevailing mining and metallurgical practices.

B. So you bought your experience?

Yes, in a measure. Here I may say that I began to write. I wrote several articles for the Melbourne *Evening Standard*. My first contribution to the *Transactions* of the American Institute of Mining Engineers was my paper on Mount Morgan, which I wrote at this time and which was published in Volume 20 (1891).

L. Was this your first writing?

No, the first technical article that I wrote was on the

Globe mill, a kind of ball-mill. This was when I was eighteen years old, and I remember being paid £6 for the job. My next article to appear in print was a description of the ore deposits at Redcliff, near Leadville; this I contributed to the London *Mining Journal* in May, 1886.

L. *What led you to write?*

The love of writing. While at school, I was editor of a manuscript magazine and contributed frequently to the printed magazine that was published quarterly. I may add that, as a schoolboy, I looked upon poetry as rather "sissy" stuff, but one of our masters read us Tennyson's "Lady Clara Vere de Vere" and the "Ode to the Duke of Wellington," and I was so much impressed by both of them that I started to read Tennyson, and after that read four or five other poets right through. Shortly afterward I entered for the prize poem and was second, and the next term I wrote the prize poem, the subject of which was the discovery of America by Columbus.

B. *So in your life's work you have followed your early bent?*

Yes, that is true.

B. *And thus obtained a double profit?*

To that I agree also, for if a man can do what he likes, if a man's hobby becomes his occupation, he is most fortunate.

B. *Turning back to your Australian experience, I remember your paper on the Bendigo saddle-reefs.*

Yes, that was one of my earliest contributions to economic geology. No doubt, for many years, if I was known at all, I was known as the author of that paper; and I would say for the benefit of the younger men that this was pleasant, because when I called on a mine manager or visited the office of a mining company and gave my name they would at once ask me if I was the man that had written about the Bendigo saddle-reefs. In other words, I made many mental acquaintances in consequence of that piece of writing.

B. *Which shows, Mr. Rickard, that the young man who early commences to write carefully about his work gets a benefit more far-reaching than he supposes.*

You are right. Apart from the enlargement of one's mental acquaintance, there is the benefit that comes to a man from having a reason for making notes and preserving his impressions of the things he sees. Any one of us who visited a mining district ten years ago and is asked now to describe it will find extreme difficulty in giving anything but the vaguest description, whereas if we made notes at the time, and particularly if we took pains to prepare them for publication, we could now refresh our memories so as to give an intelligent account. The writing of a paper compels a man to crystallize his information on a subject; before that it is amorphous.

B. *It seems to me that our profession was fortunate in finding one among its number who was willing to retire from active work and write about what his fellow-engineers are doing, and I sincerely hope you may continue to fill that useful position. A friend of mine, Adolph Goertz, the head of the firm of Adolph Goertz & Co., who represented the Deutsche Bank in South Africa, said to me, "Butters, while it is important first to do a thing, it is equally as important, after doing it, to write about it, so that the world may know what you have done, because then the useful thing that you have done becomes common property." I think the average engineer is loath to write on what he is doing, and it is a pity. My first South African engagement was brought about by an article I wrote in 1889 to the "Mining and Scientific Press" about a process for the treatment of low-grade tailings that I had developed at Kennett, in Shasta County.*

L. *What did you do after leaving Australia?*

I was examining a mine in Otago, New Zealand, when I received a cablegram from my father, asking me to come to France to take charge of a mine of which he was managing director. This was in 1891. In November of that year I went to Grenoble, in the Department of the Isère, and went from there to Allemont, where the French Mines, Ltd., was operating two groups of mines a silver-lead group and a nickel-cobalt-silver group. The latter deposits, named Les Challanches, were a prototype of those at Cobalt, as was recognized and stated by Dr. Willet Miller in his official report as Provincial Geologist of Ontario in 1904, in which he quoted my description of the Challanches veins as given in *Trans.* A. I. M. E. of 1894. This old mining district in France is in a beautiful region, the Dauphiné; I lived in a house that belonged to the Dauphin, or son of the King, more than two centuries ago.

L. *Were the mines any good?*

No, of course not. The Lord rarely puts mines amid such lovely surroundings. My father was doing a lot of interesting engineering work, equipping the mines with single-bucket rope-ways that ran up the cliffs, and erecting a concentrator at Grand Clos. When the mill was about ready to start, we were checked by a severe frost. I did not regard this as a calamity, because I could see no future for the mines. The workings consisted of a series of galleries or adit-levels driven into a steep hillside. There was ore in the face of the top level and in the face of the bottom level, about 500 ft. apart vertically, and ore had been found in a vertical range exceeding this, but I could see no warrant for assuming that the ore in the lowest workings had persisted from an upper horizon on a level with the uppermost workings. On the contrary, I believed in measuring the persistence of the ore, not from the imaginary horizontal surface of a former geologic day but from a surface more nearly parallel to the inclined surface of the existing hillside. In the sequel this proved true, for the drifts ran out of ore at approximately the same distance from the surface.

L. *So you did not stay there long?*

No, I had lost confidence in the enterprise and was anxious to leave before the funeral.

B. *In the words of Henry C. Perkins to Cecil Rhodes, in reference to Rhodesia, you did not want "to stay up with the corpse"?*

Just about that time my Australian friend Cowland appeared on the scene again and made an appointment with me in Paris, where he asked me to join him as his assistant, he having been appointed consulting engineer to H. H. Warner, of Safe Cure fame. Warner was engaged in mining operations in the Western States, and Cowland recognized that he himself knew more about placer mining than he did about vein mining, so he wanted me to join him, and I was glad to do it, because the appointment took me back to Colorado and to my old haunts in the West.

B. *What age were you then?*

I was twenty-eight. I went to Denver and examined the old Caribou mine, in Boulder County, as well as other mines in other parts of the state. Later, on my advice, Warner bought the Hillside mine, near Prescott, Arizona, and then, to my horror, he started a share campaign characterized by practices of a questionable kind. The mine itself was a good one, but he capitalized it at several times its value and then proceeded to gut it. I resigned, and opened an office on my own account at Denver. This was in 1893.

L. You were successful as a consulting engineer?

Yes, in a measure. In those days the opportunities for an independent engineer were better than they are now. In '94 I became manager of the Enterprise mine, at Rico, and in '96 I was appointed State Geologist by Governor McIntyre. I was reappointed by the two succeeding governors, Alva Adams and Charles S. Thomas, so that I was State Geologist for three terms, or six years, until 1902.

L. When did you go to Australia the second time?

In 1897, while State Geologist of Colorado, I was engaged by the Venture Corporation to examine mines in Western Australia, which was then enjoying a boom.

L. Do you consider that the boom was justified?

Yes, it was, because some extraordinarily rich ore deposits had been found at Kalgoorlie, not to mention those previously found near Coolgardie, but a great many wildcats had been foisted upon the public, particularly in London, on the strength of the real mines, and the people for whom I acted had acquired a good deal of property that was no good.

L. Whom did you meet in Australia?

Among others, Herbert Hoover. He had just come out for the firm of Bewick, Moreing & Co. As there were a number of pseudo-experts on the goldfields at that time, and mining engineering was rather in disrepute, it was a pleasure to meet a young man so keen and capable. He was then twenty-three years old and I was thirty-three. As he came from California and I from Colorado, we naturally became pleasantly acquainted, and we agreed to exchange reports on wildcats; that is to say, we let each other know of prospects that we turned down, so as to avoid useless examinations.

L. How long did you remain in Australia that time?

I was there a year. Before returning, I examined some mines at Bendigo for my clients and then returned by way of London, reaching Denver in April, 1898, just when the United States declared war against Spain.

B. Is there anything else that fixed that date in your memory?

You have made a good guess. It happens to be the date also when I declared peace with the lady who is now my wife—my cousin Marguerite, the daughter of Alfred Rickard, with whom I was first associated. I knew her as a child. My marriage is the cleverest thing I ever did.

B. I can corroborate that.

L. Did you resume practice at Denver?

Yes, and I established myself in nearly the same offices as before, in the McPhee building. I was still under a retainer from the Venture Corporation, and examined one or two mines before I was able to recommend the Independence. This property was floated in London for a large amount of money and under circumstances that led to a fiasco, although the mine fully justified the report that I made on it in March, 1899. In the same year I examined the Camp Bird mine and reported favorably upon it in terms that the history of the mine has confirmed.

L. Referring to the Independence fiasco, as you call it. I am aware of most of the facts and that the mine was placed in London at a price more than twice as great as your estimate of its value. You found yourself in a difficult position?

Yes. The dilemma was one that may present itself to a mining engineer at any time. It suggests the old question as to whether loyalty has any limitations. In other words, when is an engineer justified in turning on his clients? As to that, I will say that a man must play the game even after the other fellow has quit.

B. It was at about this time, I believe, that you became an editor. What were the circumstances leading to this?

My work as consulting engineer compelled me to travel a great deal. For twelve years I averaged 35,000 miles per annum. During the first year after I was married, I was at home only once for a whole week, although I was at home several times for a few days. I found the call to travel unpleasant because, naturally, I wanted to be more at home; and at that time I had begun to discover that, as I was called upon to examine big mines and continually bigger mines, I was compelled to take part in various ways in the negotiations incidental to the purchase of mines and to be associated with the promoters of mines, much of which work was entirely distasteful. It is a common experience in our profession that when an engineer achieves a certain position he is consulted by his clients not only as to the mines but also as to the negotiations, and he may have to take part in these negotiations and become cognizant of doings with which he is not in sympathy. These two considerations influenced me at the time when I received an opportunity to become an editor. After R. P. Rothwell died, the *Engineering and Mining Journal* passed for a short time into the hands of W. J. Johnston, who had been running a paper called *Mining and Metallurgy*. He had asked me to become editor of that paper and I had declined, telling him that he had better obtain control of the *E. & M. J.*, and if he did I would consider an offer of the editorship. He did get hold of the *E. & M. J.* in 1902 and promptly telegraphed to me, offering me the editorship. This part of the story has been told by me in the reminiscences that I published in the anniversary number of the *M. & S. P.* on May 22, 1920. Toward the end of 1902, I went to New York to be ready to assume the editorship of the *E. & M. J.* on Jan. 1, 1903.

L. How long did you remain editor of the "Journal"?

Until the first of July, 1905.

L. Why did you leave?

The paper changed hands over my head three times in the two and a half years. I had been able to work with the previous controlling owners, but found it uncongenial to work with John A. Hill, who was honest and capable, but rough and domineering.

L. Did you have a large interest in the "E. & M. J."?

The property was capitalized for $500,000; of this, $200,000 was in preferred stock held by eighty mining engineers. I myself held $50,000. During the Johnston regime I could have obtained control of the paper without difficulty, but I made up my mind that I did not want to have anything to do with the publishing end of the business. All I wanted to be was an independent editor, and therefore I did not second the idea of obtaining control of the paper for the profession, as would have been entirely feasible at the end of 1903.

L. Why were you adverse to this idea?

At the time of our troubles with Johnston, who was an erratic person, we had a finance committee consisting of three or four mining engineers of the first rank, including John Stanton and Ben B. Lawrence. I found out very soon that if the paper was to be controlled by a directorate of mining engineers it would be by a coterie in New York—a coterie that, either individually or collectively, would expect to direct the policy of the paper, not for any wrong purpose, but still in a measure for their own interest or for that of their friends, entirely in what you might call a polite way. It seemed to me that this would endanger the status of the paper, and I felt sure that I would be uncomfortable under such an arrangement; so I used my command of the position with the idea of arranging that an experienced publisher should hold the common stock and exercise the business control, while I, as editor, would be left free to run the reading-pages.

L. What do you think of the Institute magazine?

B. Look out!

The Institute magazine is a feeble effort to do the very thing that I opposed—namely, the running of a periodical by a small group in New York without the discipline that comes from explicit responsibility. As both of you know, I feel very strongly on this matter. The Institute magazine seems to me to be merely a subsidized form of journalism, and of "kept" papers we have too many already.

B. I noticed on my last subscription card to the Institute that $5 was set aside for the magazine, and I wondered if this $5 was spent on the magazine. If so, I felt that possibly a large number of the members of the Institute would like to spend their $5 elsewhere. I object to being obliged to pay $5 for something that I never read.

As I understand it, the $5 is allocated as a matter of form to comply with the postal regulations and is not supposed to measure the cost of the magazine. On the other hand, it does seem to me that a subscription price ought to be set on the magazine and that those who do not want it should not receive it. If a subscription price of $2 were put on the magazine it would be fair to those who do not want it; they would be relieved of paying for it. Meanwhile, the Institute would save a good deal of money in paper and postage—money that it needs very much at this time. Referring to the matter in a broader way, I venture to say that the profession owes just as much to the technical press as it does to the Institute; the time may come when it will be called upon to choose between a periodical published by the Institute performing a function for which it was not intended, and a technical press that is established for the purpose of performing that function. It seems to me that the Institute is no more justified in engaging in these publishing activities than in running an ore-testing works or an assay-office at headquarters—in other words, the publication of a magazine is foreign to the purposes of the Institute, and it happens to be something that can be done better by those outside who have devoted themselves to that particular kind of work.

L. And who are independent?

Yes. If you want to see to what depth of depravity journalism can fall when it is subventioned and subsidized, you have only to go to London and see how such practices there have degraded the financial and mining journalism of that great center.

B. How about "The Mining Magazine"?

The Mining Magazine was started by me as an independent paper, and, I believe, did good work in its time, but today it is going the way of London financial and mining journalism in that it is becoming dependent more upon the so-called company-meeting advertisements than upon straight advertising from manufacturers of mining machinery. In other words, it is being supported largely by the mining companies—the promoters and directors—so that it is departing from the policy of frank and free criticism that made it worthwhile seven or eight years ago.

P. You might explain why the companies are willing to pay for the publishing of the reports of their meetings.

The primary purpose is publicity; the printing of the proceedings helps to keep the company in the public eye and so assists the market for its shares; the secondary purpose is as a sop to Cerberus, to disarm the financial press. The purchase of space by the company for the report of its meeting, as for its prospectus when it is incubated, has the effect of silencing criticism and of eliciting compliment. The practice gives the promoter and company-monger a control of the papers that are venal, or even complaisant.

B. What about "The Mining Congress Journal"?

There is some excuse for *The Mining Congress Journal* because the Mining Congress is, in essence, a political lobby at Washington in behalf of the mining industry, and it performs that duty admirably. Incidentally, it collects a good deal of information concerning the progress of legislation and it sends that information to many of its members, but not to all. If this information were sent in the same inexpensive form to all the members, the Congress would have done all the publishing that it is called upon to do, outside the annual volume containing the papers and addresses read and discussed at its conventions; but by publishing an elaborate monthly periodical on costly paper and by including a good deal of editorial comment, it also is competing unfairly with the technical press. It is wrong to regard the members who have no choice in the matter of receiving the *Congress Journal* as subscribers. Here again, if the Congress were to place a subscription price on its periodical it would find that the larger portion of its membership would not subscribe to the *Journal*. The technical press is willing to compete with any paper that is issued on a legitimate basis, but it protests against having to compete with papers that are subventioned by organizations specifically created for other purposes.

L. Could the technical press give the publicity that the Congress requires?

Yes, I think it could, and I believe that the two leading mining papers would be glad to co-operate for that purpose.

B. You came to my laboratory in 1915 when I was conducting some preliminary experiments in flotation. At that time flotation was entirely a new subject to you. Since then I note that you have published three books on the subject. How did you happen to take such a keen interest in flotation?

In the first place, because I knew nothing about it and was curious to learn. My conversations with you showed me how interesting the process was and suggested to me that it was bound to prove of great importance to the mining industry. As at that time very few people knew anything about the process and as the few who knew something about it preserved a sphinx-like attitude, I decided that it would be useful and profitable to collect information and possibly even to make experiments with a view to giving the profession, through the *Mining and Scientific Press*, the information that was then of growing importance.

B. I remarked to you jokingly at the time that you would be writing a book on the subject.

Yes, I remember that you did, and I demurred smilingly, hardly believing at that time that I would have the temerity to write a book on the subject.

L. When did you acquire control of the "Mining and Scientific Press"?

In 1905, but I did not assume the editorship until Jan. 1, 1906. I bought two-thirds of the stock of the Dewey Publishing Co., which is the holding company for the *M. & S. P.*, from J. F. Halloran and the remaining third from W. B. Ewer. My only reason for becoming a publisher was to be an independent editor.

L. Did the "M. & S. P." prove a profitable venture?

It has given an average return equivalent to that of the preferred stock of the average railroad or public utility corporation. During my absence in London the business dwindled sadly, and for three years we had no dividends.

L. You went to London to start "The Mining Magazine"?

Yes, and I did this in response to the invitation of a number of British and American engineers in London. They felt the need of a good technical paper, so Edgar Rickard, who was business manager of the *Press*, and I went to London in June, 1909, and started the *Magazine* in the following September.

B. The "Magazine" was a success, was it not?

Yes, it was a *succès d'éstime* and an interesting journalistic adventure, but the business it did was relatively small, because British manufacturers do not appreciate the value of advertising as much as ours do. However, the *Magazine* became the most influential mining periodical under the British flag.

B. You have no financial interest in it now?

I sold my stock four years ago. Early in 1915, when the *Press* was in a bad way, and actually losing money, I wanted my cousin, Edgar Rickard, to come here and look after it, while I continued to run the *Magazine*, but he had become associated with Hoover on the Belgian Relief Commission, so I left him with the *Magazine* and came to San Francisco, in March, 1915. I worked very hard to save the *Press* and nearly lost my health in the effort, but within two years I had the satisfaction of seeing our subscription list more than doubled and our business on a profitable basis once more.

[*]*A. You have done some non-technical writing?*

My book, "Through the Yukon and Alaska" is non-technical and the larger part of my "Journeys of Observation" is also non-technical, but some of the chapters in the latter are severely technical and rather spoil the symmetry of the book. I have written many magazine articles that have not been technical, but most of them have dealt with some phase of mining. My field is distinctly that of class journalism; that is to say, I appeal to a distinct class—those engaged in the mining industry. As an editor, I write editorials dealing with non-technical subjects—the chief topics of the day—because I believe that they are interesting to my readers. The first purpose of journalism is to be interesting, the next is to be profitable. Journalism is neither interesting nor profitable unless it be truthful, Hearst and Brisbane notwithstanding.

A. Did you make notes at the time with the idea of writing a book later, or was it compiled from memory?

My books are based on detailed notes carefully collected. Usually I take pains to set down the exact words of some of those from whom I obtain my information, so as to preserve the local coloring. Before publication I submit each chapter to the person or persons from whom I have obtained my information, so as to benefit from their criticism. I read the proofs in galley or page form at least ten times before the text is finally released. Too much care cannot be taken in the revision of manuscript and of proofs, and it is always well to obtain the assistance of friends that are willing to read them.

A. Do you consider that the acquisition of skill in writing on technical matters is a help or a hindrance to expressing oneself on everyday matters?

Certainly, skill in writing on technical matters connotes skill in writing on any matter. The ability to write lucidly indicates, among other things, the ability to foresee what one is going to say or write, and therefore helps one when writing on subjects other than the technical. Effective writing is the reflex of clear thinking.

A. What is your opinion on the differences between the technical literature of England and the British possessions and the technical literature of the United States?

The technical press of the United States is the more highly developed, partly because it is supported by the larger public and also because it receives the larger measure of support from advertisers. I believe that the technical press in the United States is more nearly independent than that of any country. The style of writing is not as good as in other English-speaking countries, mainly because our people care less about being careful in this matter; but I can see signs of improvement.

A. In what way do you think that the maintenance of a high standard in technical journalism is helpful to the profession as a whole?

The technical press reflects the ideas and ideals of the profession. It has done a good deal to stimulate the development of character in the profession and to render the profession articulate in public. As literature is the criticism of life, so technical journalism is a criticism of the life of the technician. Obviously, I cannot speak in terms of the present because I have been connected with the three leading mining papers of the world, but I can point to the good influence exerted by Rossiter W. Raymond and Richard P. Rothwell in their time. We who have succeeded them aim to carry on the work that they started.

A. You receive manuscripts from all parts of the English-speaking world. Do you notice the local influence of well-written technical journals?

Yes, only last week I received manuscripts from Yokohama, London, and Sydney. Your question is a sequel to the one that preceded it. The influence of a technical paper is a good deal more than local. Among other things, it brings together in thought men living at distances far apart, because they can use its pages for the discussion of interests common to all of them. It promotes peace and international good will among technical men by establishing a mutual understanding of their work and purpose.

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[*] The questions marked "A" and "P" were interpolated by A. W. Allen and Arthur B. Parsons, the Associate Editors of the *M. & S. P.*

A. *What is your opinion as to present-day activities in technical book publishing?*

I marvel at the extent of the activities, and I wonder who buys some of the books that are published. As I review a good many technical books during the course of a year, I venture to note the urgent need for the services of a capable editor on the staff of each publisher. In most technical books will be found errors that should not escape the detection of a conscientious editor or even a capable proofreader. The publishing of books is conducted too much on a manufacturing basis, and too little as an art.

A. *Do you think that some agreement might be made in regard to a uniform system of spelling in the English-speaking countries, as exemplified by the style adopted in the better-class publications?*

Yes, I do. Indeed, there is a growing tendency toward uniformity. After all, the English language is the common heritage of all the English-speaking peoples, and a Britishism or an Americanism is equally objectionable, whether in spelling or locution. Moreover, as a book printed in English may be read in all the English-speaking countries, it becomes desirable from the publisher's point of view, in order to be pleasing, to adopt a spelling as nearly uniform as possible. For instance, in the *M. & S. P.* we adopt the American way of spelling "color," "honor," "labor," "endeavor," and similar words; we also write "traveling" with one "l," and use the "z" in words signifying agency, such as "standardize" and "organize," but we use "centre" instead of "center," and we prefer to retain the French spelling of the metric units, believing that there is no gain in Anglicizing them, particularly as we use the word "meter" in a sense different from "metre." For the so-called spelling reform, or simplifyde spellin, I have no use whatever.

A. *You have interviewed a number of well-known men. What would you give as a definition of success, as applied to a mining engineer?*

Success, of course, is measured at first in terms of dollars. The mining engineer that is paid a big salary and accumulates a large fortune is rated as a successful man. On the other hand, if in acquiring this fortune he has lost his health and, worse, has lost his friends, we come to recognize him as a failure. On the whole, I would say the mining engineer is successful that has done work of which he can be proud as a professional man, that has done work he knows to be useful, and that is able to retire not only with a handsome bank account, but in good health and in the possession of many friends.

A. *Do you think that foreign travel and observation are essential to a proper appreciation of the technical and professional outlook of a mining engineer?*

The mining engineer makes the whole world his field. Undoubtedly foreign travel and observation broaden a man's vision and widen his experience. Without travel a man is likely to be provincial. On the other hand, some people are parochial when they start on a journey around the world, and they end the journey without any enlargement of their mental horizon. Most of our leading mining engineers have been men that have traveled widely.

A. *What pointers would you give to a would-be writer who wished to gain the sympathetic consideration of the editor of a technical publication?*

In the first place, he should have his article typewritten, because one of the first rules of writing is economy of attention on the part of the reader—that is, to save him as much trouble as possible. The typewritten text should be double-spaced, with an ample margin, so as to leave room for the editor's corrections. In the next place, he should take care to spell correctly the name of the person to whom his article is addressed, because an error in this particular is irritating to the recipient; when a man spells my name "Richard" or "Rickards" I resent it, because the blunder is a discourtesy, whether due to stupidity or carelessness. Next, he should accompany his article with a personal letter stating the circumstances that have prompted him to write it and describing the opportunities that he has had to obtain the information used in the article. If he is tactful, he will apologize for the possible errors in his writing and ask the editor's kind assistance in improving the text. I take pleasure in revising the manuscript sent to me by young fellows, although this work of revision is the most tiresome that I do. In many cases I send a clean copy of the edited text to the author, together with the original on which the corrections appear, and ask him to note the corrections, so that he may inform me if any of them have failed to convey his meaning. Usually I tell my correspondent that his manuscript has given me less trouble than most of those that come to me, and thereby save him from embarrassment. After one or two of his articles have been revised and amended in this way, sympathetically and helpfully, it is surprising how quickly an intelligent young man will improve in his writing. He learns to be careful instead of careless; he begins to appreciate the effect of using words properly.

P. *What are your hobbies?*

The technique of writing—on which I have published two books, as you know. If I am remembered when I am gone, it will be, I hope, as one who helped to improve the writing of those in the engineering profession. Another serious purpose in my life is to promote good will between the English-speaking peoples, for I believe that in their friendly co-operation lies the one hope for the peace of the world.

P. *You are an enthusiastic golfer?*

Yes, I must accept the soft impeachment. My friends know that I play regularly. A few days ago a lady asked me if I played golf on Sunday, and I replied: "Yes, madam, I take my golf religiously." I may add that I divide my week into two parts by playing on Wednesday also, sometimes morning and afternoon, usually afternoon only, working at home in the morning. After a round, or even two, of golf I am in the right trim to do my writing. I believe in outdoor exercise as a means of clearing the brain and stimulating healthy thought. Before I became old enough for golf I played tennis with similar regularity.

P. *What principal benefit do you think accrues to one who contributes an article to the technical press?*

Apart from the gain in knowledge to the writer, caused by the need for compiling, correcting, and correlating his information on the subject of his article, the publication of it serves to give him publicity in an honorable way—in one of the few ways open to him honorably. The making of mental acquaintances by means of the printed word—an article in the technical press—is beneficial to all concerned. Most people are more ready to claim than to disclaim acquaintance with a member of their own profession; they feel that they have had contact with a man if they read something he has written, particularly if it be marked by sincerity; so they are prepared to claim favorable knowledge of him whenever his name is mentioned. That is how reputations are made.

P. Many young engineers would like to write for publication but are timid. Could you offer a word of advice to such men?

I advise them not to write for publication too soon; they had better make notes on the technical operations in which they are engaged and put these notes together in the form of a lucid description, for their own use; thus they will acquire facility in writing; meanwhile they had better read Huxley and Stevenson, or Agnes Repplier and W. H. Hudson, and acquire a taste for good English; thus they will prepare themselves. Before long they will see something or do something on which they can write their first article, which they had better send to a sympathetic editor, willing to help as well as to criticize.

P. What do you find to be the most prevalent fault in the manuscripts of inexperienced writers; in other words, what would you advise them to avoid?

Carelessness and insincerity; the first is shown by blunders in grammar and composition, the other in attempts at so-called fine writing—purple patches—that are foreign to their style of expression. The two chief requisites in writing are to be careful in the use of words and sincere in the expression of thought.

P. Do you find that many engineers take offence at criticism appearing in your editorial pages?

No. Perhaps more are irritated than I suppose, for they are inarticulate. An editor worth his salt does not strive for popularity; he takes the risk of unpopularity. In any event, I am as willing to be judged by the enemies I have made as by the friends I have won. I have very few enemies—they may be inimical to me, but not I to them—I forget them. I regret if any of my criticisms give offense; the purpose of them is not to be offensive but to be useful, to be constructive, to create a healthy public opinion. That is the function of journalism.

Sillimanite, an Aluminum Silicate, Is a Promising New Refractory

A considerable amount of research work has been done during the last seventeen years in an effort to produce a refractory that would have a fusion point considerably above that of those made of the best grade of flint fireclay. The result of this work has been the recent development of at least one new refractory of this type—sillimanite, a stable silicate of alumina having the formula Al_2O_3,SiO_2, according to A. F. Graves-Walker in a paper published in a recent issue of the *Journal of the Society of Chemical Industry.*

About twenty years ago a serious need began to be felt for a refractory that would not only withstand extremely high temperatures, but would carry heavy loads practically up to its fusion point, would resist the deteriorating effect of the blast from oil burners, and would withstand rapid and extreme fluctuations in temperature. It was about this time that work was begun on the problem.

The raw materials or minerals which would withstand high temperatures were well known and limited in number, and knowing the various conditions to be met, it did not take long to decide that the ores of aluminum offered the only promise. The three best known are bauxite, $Al_2O_3,2H_2O$; diaspore, Al_2O_3,H_2O, and gibbsite $Al_2O_3,3H_2O$. The deposits of these ores are large and widely distributed over the earth's surface, but are now practically all in the hands of the large aluminum and chemical companies.

Pure sillimanite has the composition SiO_2 37 per cent, and Al_2O_3 63 per cent, and its fusion point is 1,816 deg C. The test bricks were much higher in alumina and lower in silica than sillimanite, but on the other hand they contained a total of 7.57 per cent of fluxing impurities. Of these the ferric oxide is the least active. However, it is the intention to bring the composition as near to that of sillimanite as possible, except that the alumina content will be increased to overcome the fluxes present. For special purposes the alumina may be increased to 90 per cent; in fact, by following the melting point diagram a product can be made which will fuse at any point between 1,816 deg. (the fusion point of sillimanite) and a higher temperature of 2,025 deg. C.

So far as we know, bricks of the nature described have not yet been offered commercially in the United States for experimentation and use by the metallurgical industry.

The Proposed Flow Sheet of the Empire Consolidated

The new 100-ton concentrator of the Empire Consolidated Mines, Inc., at Empire, Col., will employ a rod mill for grinding table and flotation feed. Excavation work for the new plant has already been started. The pyritic gold ore from the mine will first be discharged into a bin, from which it will be fed over a 3 x 2-ft. Ross drop-bar grizzly, the oversize (1½ in.) passing to a 3M Universal crusher (20 hp.), and thence to a 225-ton crushed-ore bin. From that bin it will be taken by an 18-in. x 18-ft. Stephens-Adamson apron feeder to a 4 x 9-ft. Denver Engineering Works Co. rod mill, crushing being done in open circuit without classifier to reduce to 40 mesh.

The mill discharge will pass direct to Plat-O roughing tables. The middlings and tailings will go direct to an eight-cell Ruth flotation machine, the concentrate froth going to another Plat-O table for cleaning. The middling and tailing from this cleaning table will go back to the head of the flotation machine, forming a closed circuit to retain the finest material until the mineral is recovered. The tailing from the flotation machine will be split between three Plat-O tables, the tailings from which will go to waste. The middlings will go to a 2-in. Wilfley sand pump for return to the rod mill after dewatering has been accomplished by means of a No. 40 Allen cone.

The concentrates, together with the concentrates from the roughing tables and the flotation cleaner table, will be dewatered in another No. 40 Allen cone, the dewatered concentrate then passing by gravity to a concentrate bin.

Joseph McAuliffe is the mill superintendent, and we are indebted to him for the preceding information. The property is in Clear Creek County about forty miles west of Denver.

USEFUL OPERATING IDEAS

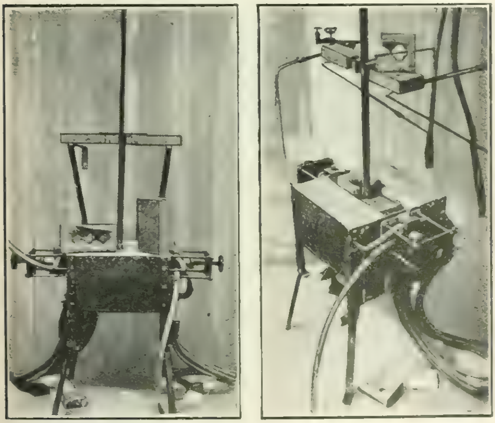
Electric Furnace for Drill Steel

Refrax Carborundum Brick Used as Heating Unit on Either Alternating or Direct Current Circuit—Rotating Hearth for Larger Capacity

By Thomas M. Bains, Jr.

The problem of heat-treating drill steel is again before mining men and metallurgists. The Bureau of Mines has assigned investigations of the subject to one of its stations, to be worked out in co-operation with the Missouri School of Mines and Metallurgy. Prof. C. Y. Clayton is conducting a series of tests at Rolla, Mo., in which the heat-treatment is done in an electric furnace which I have designed. A description of this furnace is as follows:

The basic principle employed in the construction of this furnace is the use of Refrax carborundum brick, heated by either alternating or direct-current circuit. This material is not affected by oxidation, and a temperature of 800 deg. or 900 deg. C. can be maintained without replacement of the heating element. In the furnace now in use at Rolla, a standard Refrax brick, 9 x 4½ x 2½ in., is heated by passing alternating current through it. The voltage required at first when the brick is cold is about 120. At 800 deg. C., 20 volts will give 5 kw. input. Two electrodes of Acheson graphite are pressed against the end plates of iron, which are cemented to the Refrax brick by carborundum cement. This is shown in the left-hand cut. The electrodes are water-jacketed and surrounded by a little crushed carbon to prevent oxidation taking place.



LEFT—ELECTRIC FURNACE FOR DRILL STEEL. INSULATOR BRICK ON TOP (WITH HOLES); ALSO EXTRA HEATING UNIT. RIGHT—HALF OF INSULATOR BRICK IN PLACE

Three steels of 1¾-in. gage and of any length can be stood upright on the brick and the bit ends heated to the desired temperature. A brick of non-pareil or Sil-o-cel insulating material, with holes properly shaped for the bits to pass through, covers the Refrax brick, as shown in the right-hand cut. This insulating brick gives the proper depth of heating to the bits. The shank ends of the drill steel are also similarly treated, but are quenched in oil instead of water. Full description of the steel thus treated was furnished by Professor Clayton at the February meeting of the American Institute of Mining and Metallurgical Engineers at New York.

By heating the bits, so that the temperature only slightly exceeds the critical temperature of the steel, a fine porcelainic structure is secured on quenching in water. A shell of martensite is formed, backed by a mixture of martensite and troostite. Under these conditions, carbon steel will give the best results in drilling.

The advantages of such a furnace for a mine blacksmith or sharpener shop are: There is no chance for overheating the bit or shank and thus causing coarse structure. No oil or molten bath is used for hardening the bits. The work can be done by any ordinary blacksmith or drill sharpener. Low voltage only is used on the furnace. Temperature control, either by hand or automatic, is simple.

I have worked out, also, another design, with a rotating hearth. This furnace will be large enough to handle the steel sharpened by a single drill sharpener. The heating element is composed of a series of Refrax brick. The "feather edge" 9 x 4½ x 2½ x ⅛-in. standard brick will be used in this design. Eight of these brick placed end to end in octagonal form will give a heating surface of 72 x 2½ in. This area will allow thirty-two bits, of 1¾-in. gage, to be heated at once. A description of the two methods for heating the Refrax bricks is, in brief, as follows:

The first method is a multiple-series combination of the bricks, so that when starting the furnace cold, on a constant potential circuit, either alternating or direct current, the bricks are connected in multiple across the circuit. As the resistance decreases on heating, and the current thereby increases, a point will soon be reached when the maximum amperage allowable will be attained. At this point, by the contactor system, the bricks will automatically be thrown into a multiple-series connection, two bricks in series and four such sets in multiple. On further heating, a series-multiple connection of four bricks in series and two sets in multiple will be made; and finally a connection of eight bricks in series will allow 220 v. to be impressed. If only 110 v. is the standard line voltage, the last step is omitted.

The electrical connections are made by using Calite connectors between the Refrax bricks, cemented with carborundum cement. Pressure must be applied until the cement vitrifies. Calite, which is a special steel, will stand 900 deg. C. without oxidation. The two terminals used for operation at the desired temperature will be water-jacketed.

The second method of electrical control is by means of a current transformer. This apparatus will automatically decrease the voltage on the terminals of the furnace, as the current tries to increase, thereby keeping a constant current flowing through the bricks, no matter what their resistance. The secondary coil of the current transformer will be in series with the eight Refrax bricks. The primary coil of the transformer is connected across the supply circuit. This type of transformer can be used on alternating-current circuits. On direct-current circuits the method first described must be used.

The use of the wedge-shaped bricks causes most of the heat energy to be generated at the upper surface of the bricks, where it can most readily be conveyed to the steel. Also, the resistance of the bricks will be greater than that of the standard rectangular bricks. This is advantageous at the operating temperature around 800 deg. C.

By placing the straight leg of the wedge on the outer periphery of the octagon, a 4½-in. vertical wall of heating surface can be utilized for the heating of the shank ends of the steel. An annular space of about 1½-in. between the outer vertical surfaces of the Refrax brick and the wall of Sil-o-cel or non-pareil brick will allow ample room for heating of the shanks. Thus the heat-treatment of both the bits and shanks may be conducted in the same furnace.

The diameter of such a rotating furnace will be less than 4 ft. and the furnace will have a capacity of sixty-four steels per hour, if a heat-treatment of thirty minutes is given each steel. By decreasing this time to fifteen minutes, twice the number of steels may be treated. The furnace could also be used for heating the steel preparatory to sharpening it, but the temperature would have to be higher than for heat-treatment and the annular space outside the Refrax brick would have to be increased to the diameter of the bits heated.

The cycle of operation for bits would be as follows: (1) Heating of bits for sharpening; (2) sharpening; (3) cooling just below the critical point of the steel; (4) placing steel on furnace; (5) removing steel after a complete rotation of the hearth; (6) quenching same in water; and (7) placing of another sharpened steel in place of the steel removed from furnace.

In the treatment of shanks, the shanks should be quenched in oil, instead of water.

A tougher steel would be secured, if, during the rotation of the hearth, the steel was cooled below its critical point several times and brought back slightly above each time. This could be accomplished by having jets of compressed air at several points, cooling the steel at these points to about 700 deg. C. If an especially accurate control of the steel temperature were necessary, just before quenching an extra unit of one Refrax brick, similar to the furnace at Rolla, could be used for the final temperature. In this furnace, a thermocouple is brought up through the brick and extends about 1-in. up into the steel, when hollow steel is being treated.

The power required for a rotating furnace of this type would be about 30 kw. The one unit type at Rolla takes about 4 kw. at 18 v., when at its working temperature. The new electrothermic installation at Rolla has a voltage control from zero to about 600 v., at 60 cycles, alternating current, and therefore there is no trouble about securing the voltages desired on the terminals of the furnace. For a commercial furnace, however, such an electrical equipment would be too expensive, and the second design with rotating hearth would be used. In this design, any standard mine circuit, either alternating or direct current, could be used for the furnace.

Strength, Wear, and Life of Wire Hoisting Ropes

Practically all manufacturers list the tensile strength of the different sizes and types of wire hoisting ropes which they manufacture, and the figures are generally accepted as accurate. The strength of the rope usually ranges from 80 to 90 per cent of the aggregate strength of the wires. Rope strength is generally given in tons of weight constituting the breaking load.

The modulus of elasticity for a wire rope is a somewhat uncertain figure and depends largely upon the method of construction. For new rope of ordinary construction one authority gives 11,180,000 lb. per sq.in. of rope section; another 12,540,000 lb. As the rope is used the modulus gradually increases, and an old rope may show a modulus of 19,000,000 lb. per sq.in.

Wire ropes stretch from 1.3 to 2.3 per cent of their original length, and decrease in strength with use. The decrease is due to the reduction of the cross-section of the rope by wear and also to internal strain. The only practicable method for determining the reduction in strength is by actual test of a portion of the used cable and by testing the individual wires of this part.

Ropes wear not only on the surface but also internally. The internal wear is difficult to determine, but the surface wear can be measured. The wires on the crown of the strands show the most wear. Wear is caused by contact with the drum and sheaves and by the individual coils which are wound upon the drum under tension, slipping one against the other as they adjust themselves. Where two or more layers are coiled on the drum there is greater wear than with one layer. Both internal and external wear as well as corrosion can be reduced by the use of a proper rope dressing. The rope dressing should be a lubricant as well as a protection against the introduction of moisture.

Service rather than time determines the life of a hoisting rope. Williams has pointed out the influence of the initial factor of safety, the material, the care taken in placing the rope on the drum, the way in which the hoisting engine is handled, chemical deterioration, shocks, stability of the rope in the shaft, wear, and the hoisting arrangements. (*Journal of the South African Institute of Engineers.* "Notes on Use of Winding Ropes," by A. Williams, February, 1911). Williams gives examples of hoisting ropes which have been in operation from 1,552 hours to 5,472 hours, and which have hoisted 315,663 and 701,727 loads, from depths of 2,520 ft. and 1,840 ft., respectively. Both ropes were of crucible steel and one had a factor of safety of 7 and the other 5.2 with loads of 10,000 lb.

Vertical and Inclined Hoisting

Incline differs from vertical hoisting in the increased friction and the decreased proportion of the weight to be hoisted. In inclined hoisting the hoisting ropes are subjected to greater wear, and larger ropes are required to compensate for this wear than are necessary for the direct forces to be overcome. In addition to guides, rollers are required at intervals of 50 ft. to support the rope and reduce the wear. Hoisting speeds are less and may be estimated to be one-half the speed used in vertical shafts.

Slope hoisting differs from incline in the fact that, in place of cages or skips, trains of mine cars are handled. Slope angles of inclination range from 10 to 20 deg. from the horizontal.

THE PETROLEUM INDUSTRY

Oil Resources of Northern Fergus County, Montana

THE GEOLOGY and oil resources of the northern part of Fergus County, in north-central Montana, were studied in a reconnaissance examination made in 1921 by the U. S. Geological Survey, and a full report on the work is in preparation. The following is an abstract of the preliminary report. The area covered by the geologic field party, consisting of Frank Reeves in charge, J. B. Eby, L. C. Fenstermacher, M. N. Bramlette, and James Gilluly, is about eighty miles long and from fifteen to thirty-five miles wide. It lies south of Missouri River, between Musselshell and Judith rivers. Its southern limit is the boundary between the Bearpaw shale and the Judith River formation, which boundary begins at a point on Musselshell River one mile north of the Cat Creek oil field and extends northwestward to Winifred and thence westward to Judith River.

The entire area examined lies in a broad, shallow, eastward-pitching syncline, which is one of the major structural features of the plains region of the eastern half of Montana. According to W. T. Thom, Jr., this syncline extends eastward across Garfield and McCone counties to the Little Sheep Mountain syncline, near Glendive. In the area examined this syncline is narrowed and slightly accentuated by the pronounced folding of the strata in the Little Rocky Mountain uplift, about forty miles north of its axis, and by the Judith Mountains and Black Butte-Cat Creek anticlinal uplifts, about twelve miles south of its axis. The movements that produced these anticlinal folds tilted the rocks at steep angles in a narrow belt on their flanks, but in the syncline they caused only slight tilting, at few places exceeding 1 deg. However, in the northwestern part of the syncline other forces have brought about pronounced faulting and folding of these otherwise flat-lying strata.

RESULTS OF DRILLING FOR OIL

Three wells have been drilled for oil in the area mapped—the E. G. Lewis Development Co.'s well, in Sec. 15—16—28; the Home Oil Co.'s well, in Sec. 22—21—20; and the Kansas Montana Oil Co.'s well in Sec. 18—21—19. The first well was drilled on the flank of a syncline and stopped in the Bearpaw shale at a depth of 1,280 ft.; the second well was on the downthrown side of a fault and probably stopped in the Eagle sandstone, where a showing of gas was encountered at 840 to 860 ft.; so neither can be considered a thorough test. The third well, which is on an anticlinal fold near Winifred, has started near the top of the Judith River formation and has penetrated nearly to the base of the Colorado shale. Showings of oil and gas were encountered in the top of the Claggett shale, in the Eagle sandstone, and near the base of the Colorado shale in a sandstone that extends from a depth of 2,855 ft. to the bottom of the hole. Other sands, from 5 to 20 ft. thick, were encountered in the last 600 ft. of strata penetrated by the drill. The last sandstone penetrated may be basal sandstone of the Colorado shale, in which most of the oil of the Cat Creek field is found. This well should be drilled through the Cat Creek sand and, if no oil is encountered, carried down 300 to 400 ft. deeper, to the Kootenai sands. As, however, the well is within about 600 ft. of what is probably a thrust fault, the possibility of the drill hole cutting across the fault plane at a depth of 2,500 to 3,500 ft. must be considered. At any rate, the axis of the fold at these depths probably lies a few hundred feet south of its position at the surface, and consequently the well should have been drilled south rather than north of the axis of the anticline.

CONDITIONS GOVERNING FINDING OF OIL

As no adequate test has been made for oil in the area, the possibility of its occurrence here depends on the presence of geologic conditions favorable to its accumulation. Most of the conditions are certainly favorable. In the black shales of the Claggett and Colorado formations and in the Madison limestone there is an abundance of the proper kind of organic material that might form oil, and in the Eagle sandstone, Colorado shale, Kootenai, Ellis, Quadrant, and Madison formations there are porous sandstones and limestones interbedded with impervious beds in relations that may afford good oil sands. There has also been sufficient and not too much regional alteration of the sediments to convert the organic material into oil, as shown by the alteration of the Judith River and Eagle coals, which contain 55 to 58 per cent of fixed carbon. Apparently, all that is needed is the proper structural condition to insure the accumulation of oil in commercial pools. Many regions in the world, however, lack only this condition. Domes and anticlines are the most favorable type of structure, but regionally inclined strata modified by structural terraces or cut by faults and dikes may also be effective in forming oil pools.

Only in the Winifred faulted area do the conditions appear to approach those that are generally regarded as favorable to the accumulation of oil. In the Blood Creek syncline there are no anticlinal folds and apparently no barriers, such as terraces, dikes, or faults, which might form commercial oil pools. So that part of the area may be considered as unlikely to contain oil. In the Winifred faulted area the structural conditions are peculiar and are unlike those of any known productive oil field, except possibly the fields of northern Peru. In the Winifred area flat-lying beds have been highly faulted, and the strata are folded and tilted only along narrow belts, generally on the upthrown side of the faults. In most regions such faulting is associated with highly folded strata. The questions are whether the belts of tilted or folded strata are broad enough to furnish a sufficient gathering ground for oil and whether the faulting has permitted the escape of such oil and gas as may have accumulated. The gathering ground is probably large enough, for in this area there is apparently so much organic material that a large gathering ground would not be necessary to fill the reservoir rocks.

In considering the possibility that the oil has escaped along the great faults in the region it may be pointed out that the strata in many oil fields are highly faulted and that large gas wells have been obtained from the Eagle sandstone in similar faulted areas near Havre, on the north flank of the Bearpaw Mountains. The presence of gas under normal rock pressures indicates that the hydrocarbons have not escaped to any extent along the fault planes, and it is reasonable to believe that a proper test of the Colorado and Kootenai sandstones near Havre will yield oil. The absence of gas or oil seeps along the fault planes may be due to the fact that the soft Cretaceous shales have completely sealed the faults. The structure of the region, which is that of a syncline, is particularly favorable to the accumulation of oil, for water has perhaps not been active enough to flush the oil out of the sands, as it apparently has in the anticlinal area adjoining the Big Snowy Mountains, where the proximity of the outcrop and greater regional folding have resulted in a more rapid circulation. This probability is strengthened by the discovery of salt water in the Eagle sandstone and the lower sandstone of the Colorado shale in the Kansas Montana well.

TEST WELLS ESSENTIAL TO PROVE AREA

It should be emphasized, however, that as the folding of the strata is of an unusual type, the presence of oil in the area can be definitely determined only by the drill. It is fairly certain that all the areas of flat-lying rocks between areas of tilted strata in faults and anticlines will be unproductive. Drilling should be confined at first to the crest of the anticlinal folds, the wells being drilled on the unfaulted flanks or on those with the lower dip. If oil is obtained the fault blocks should be tested by wells sunk on their upthrown side but far enough away from the outcrop of the fault to avoid drilling through the plane of the thrust faults. The area is so complex in structure that a number of test wells may be required to prove whether or not it contains commercial pools of oil.

February Daily Petroleum Production Exceeds Daily Consumption

During February domestic production of petroleum, according to the U. S. Geological Survey, attained a new high record, the daily average of 1,470,107 bbl. being an increase of 78,462 bbl. over the previous high record of January, and only once before in the last two years has the daily rate of production exceeded the daily rate of consumption. Although the daily rate of consumption and of imports increased slightly, stocks of crude oil (not including consumers' stocks) increased almost twelve million barrels. On the last day of February total net pipe-line and tank-farm stocks of petroleum east of California, gross pipe-line and tank-farm and producers' stocks in California, and stocks of Mexican petroleum held in the United States by importers amounted to 208 million barrels, equivalent to 143 days' supply at the present rate of consumption. Although this is the largest amount of petroleum ever held in storage in the United States, it is of interest that the 163 million barrels of petroleum held in storage in 1915, at the time of the Cushing overproduction, was sufficient to meet the requirements of consumption for 218 days.

The accompanying figures for the states east of California, compiled from company reports made to the Survey, show the quantity of petroleum (pipe-line oil) transported from producing properties. Oil consumed on the leases is not included. This item and net changes in producers' stocks at the beginning and end of the year are obtained by annual canvass and are included in the final statistics of production. Figures for California are the average of those reported by the Standard Oil Co. and the Independent Oil Producers' Agency and show gross production, in part estimated.

PETROLEUM PRODUCED IN THE UNITED STATES IN JANUARY, 1922, FEBRUARY, 1922, AND FEBRUARY, 1921

Barrels of 42 U. S. Gallons

State	January, 1922(a)		February, 1922		February, 1921	
	Total	Daily Average	Total	Daily Average	Total	Daily Average
Central and Northern Texas	8,528,000	275,097	8,102,000	289,357	5,774,000	206,214
Coastal Texas	2,998,000	96,709	2,672,000	95,428	2,566,000	91,043
Oklahoma	9,991,000	322,290	10,072,000	359,714	7,937,000	283,464
California	9,753,000	314,613	9,077,000	324,179	9,184,000	328,000
Northern Louisiana	2,778,000	89,613	2,848,000	101,714	2,172,000	77,572
Coastal Louisiana	128,000	4,129	117,000	4,179	156,000	5,571
Kansas	2,683,000	86,548	2,423,000	86,536	2,478,000	88,500
Wyoming:						
Salt Creek	1,187,000	38,290	1,061,000	37,893	868,000	31,000
Other districts	452,500	14,597	419,400	14,978	629,000	22,464
Total Wyoming	1,639,500	52,887	1,480,400	52,871	1,497,000	53,464
Arkansas	1,100,000	35,484	1,030,000	36,786		
Illinois	924,000	29,807	715,000	25,536	785,000	28,036
Kentucky	700,000	22,586	700,500	25,018	695,000	24,821
West Virginia	549,000	17,704	565,000	20,178	634,000	22,643
Pennsylvania	541,000	17,452	559,000	19,964	603,000	21,536
Central and Eastern Ohio	365,000	11,774	365,000	13,036	427,000	15,250
Northwestern Ohio	146,000	4,710	154,000	5,500	175,000	6,250
Montana	144,000	4,645	121,000	4,321	115,000	4,107
Southwestern Indiana	70,000	2,258	63,000	2,250	70,000	2,500
Northeastern Indiana	18,000	581	18,000	643	22,000	786
New York	77,000	2,484	73,000	2,607	66,000	2,357
Colorado	7,500	242	7,600	272	9,000	321
Tennessee	1,000	32	500	18	1,000	36
Totals	43,141,000	1,391,645	41,163,000	1,470,107	35,366,000	1,263,071

(a) Revised.

CONSULTATION

Cyanide Leaching of Copper Ores Impracticable

"We are copper-ore miners, and we are developing a process for leaching these ores with cyanide. Our ores are a mixture of chalcocite, native copper, and oxidized minerals (carbonates, oxides, silicates). We have seen that these ores can be leached with cyanide, in which all the copper minerals are readily dissolved. The difficulty is that cyanide is excessively costly for this purpose, and the only thing that would make the process profitable would be the regeneration of the cyanide, and a lower cost of this chemical. Would it be possible to sell the cyanide at a lower price than it is now sold for, 26c. per lb., if used in large quantities? Can you tell me if cyanamid would also dissolve the copper ores the same as cyanide? Do you know if it is possible to regenerate the cyanide or cyanamid from copper solutions, by electrolysis or other methods?"

We are indebted to W. S. Landis, of the American Cyanamid Co., 511 Fifth Ave., New York, for a most complete and satisfactory answer to our correspondent's query. Based upon many years' study of the use of cyanide in chemical and metallurgical processes, some of which, in 1913, was directed particularly to the copper industry, he is inclined to believe that it is not possible to use cyanide on copper ores at any prices for this reagent which are likely to prevail in the near future. The cost of production of the 96@98 per cent sodium cyanide, he believes, has never been less than 15 or 16c. per lb. and today is considerably higher. Even Aero Brand cyanide, though sold somewhat cheaper than 96@98 per cent sodium cyanide, per lb. of contained cyanide, still does not reach the point where it would be profitable to use it at the present price of copper.

The use of cyanide for extracting copper from ores requires large quantities of the reagent because of the peculiar chemical behavior of the copper cyanides. The cupric compounds are reduced at the expense of cyanide to cuprous compounds, and a considerable quantity of the reagent is lost. Native copper is not dissolved to any extent, and the sulphides only slowly and also with loss of cyanide. There are other cyanicides present in most ores, which also consume much copper. It theoretically requires something over 1⅓ lb. of sodium cyanide to put into solution 1 lb. of copper if the latter is in the cuprous state, and considerably more if the copper is in the cupric state. Clennell has published an equation showing a consumption of three and a half parts of cyanide to one of copper, with copper in the form of carbonate.

One can readily understand from these figures that cyanide would have to sell at only a few cents per pound to make it possible to use this reagent in copper metallurgy. It is plainly evident, therefore, that the problem is hopeless in consideration of the principles above set forth.

It is probable that copper might be precipitated from a cyanide solution as a sulphide by the use of sodium sulphide and the cyanide thereby regenerated. This precipitation would be incomplete, would involve certain losses in cyanide, and would be further handicapped by the fact that the precipitated copper sulphide would be less valuable than metallic copper and the sodium sulphide is a reagent really too expensive for consideration.

Electrolysis is impossible, because of decomposition of the cyanide solution by the electric current, with loss in cyanide. It will not solve the problem.

Cyanamid does not dissolve copper compounds, but, on the other hand, soluble salts of copper are precipitated as copper cyanamids in alkaline solution.

Commercial Ore as Applied to Mining Leases

"Would it be imposing upon your good nature to ask you to tell me what in your opinion would be "commercial ore" as applied to the following sentence:

> " 'Lessee agrees and guarantees, during the life of this lease, to mine and remove from the leased premises all of the commercial manganese and manganiferous ore that is in, on, or under said leased premises; that is, all the manganese or manganiferous ore that will analyze as much as 10 per cent metallic manganese.'

"It is my opinion that commercial ore will depend upon tonnage and availability, and I would appreciate some expression from you as to your opinion of this term with these qualifications."

Unquestionably the latter part of the sentence in the above contract implies the limitation so far as the analysis of the ore is concerned. As to the actual meaning of the term "commercial ore" in the sentence, we would assume it to be that which can be commercially mined. Unless this is understood, the lessee certainly places himself in a position where he is totally at the mercy of the lessor, a situation which would not be tolerated willingly by any operator. Commercially available ore or commercial ore available would perhaps be the better expressions and would provide a more reasonable basis for both parties for common agreement.

Assuming that the parties are in agreement as to tonnage and availability, it is also necessary to consider the salability of the ore. By this is meant the amenability of the ore to treatment, for it is well known that for certain refractory ores a high and ordinarily marketable per cent of one particular element, such as copper or zinc, does not necessarily determine the utility or commercial possibilities of that ore. A commercial ore can be regarded as one which can be supplied in sufficient quantity and produced and marketed at a figure that will allow a margin of profit to the producer.

It should be noted that some authorities consider the term "commercial ore" incorrect diction, the word commercial being superfluous, inasmuch as the definition of ore itself implies mineral matter which can be mined and treated *at a profit*. However, the term is commonly used in the profession, and it is well that all interested be familiar with a correct understanding of its limitations and significance.

Book Reviews

Modern Tunneling. By David W. Brunton and John A. Davis, with new chapters on Railroad Tunneling by J. Vipond Davies. Second edition. Cloth; 6¼ x 9¼; pp. 612; illustrated. John Wiley & Sons., Inc., New York. Price, $6.50.

The first edition of this book, which dealt with mine and water-supply tunnels, has been enlarged, and the scope of the work widened to include the study of enlarged tunnel construction, such as would be required in carrying water for power, irrigation, or domestic use. A mass of well-selected and well-arranged data is given on costs and bibliography, in addition to complete chapters covering the history of tunneling and materials, apparatus, and methods used.

Petroleum Resources of California. By Lawrence Vander Leck. Cloth; 6 x 9; pp. 188; illustrated. Bulletin 89, California State Mining Bureau, July, 1921. Price, $1.25.

California's petroleum resources and the possibility of obtaining crude oil in portions of the state now unproductive are discussed in detail in a new report just issued by the California State Mining Bureau. Information relative to northern and central California on the subject of petroleum and gas possibilities is available nowhere else, either in Government or private documents.

In California, wildcat wells are being drilled from the Oregon line to the Mexican boundary, some of them in places where even a cursory inspection of the geology would indicate the futility of looking for oil. Therefore, the report aims to point out the unfavorable as well as the favorable areas for the development of additional petroleum resources in California. The bulletin should prove of particular interest to those who are thinking of prospecting for oil in the state.

A Textbook on Mineralogy. With an Extended Treatise on Crystallography and Physical Mineralogy. By Edward Salisbury Dana. Third edition, revised and enlarged by William E. Ford. Cloth; 6 x 9; pp. 720; illustrated. John Wiley & Sons, New York; 1922. Price, $5.

This book is not to be confused with the author's more complete "System of Mineralogy," of which the descriptive part of this volume is essentially an abridgment. The longer work has not been revised since 1909, however, so that the present book is more up to date in several respects. The last edition of the "Textbook" appeared in 1898. Since then several other books covering the subject in a more or less efficient manner have appeared, but none are so complete. This volume covers the subjects of crystallography and physical mineralogy with particular emphasis; additional matter appearing in the new edition describes the methods employed in the use of the stereographic and gnomonic projections, and much of the section on the optical characters of minerals has been rewritten in the interest of greater clearness to the student.

The scope of the work may be indicated by the following divisions: Part 1, Crystallography, 177 pages; Part 2, Physical Mineralogy, 126 pages; Part 3, Chemical Mineralogy, 32 pages; and Part 4, Descriptive Mineralogy, 306 pages. Much of this is in fine print so a comparatively large amount of information is contained in the space allotted.

Lexique Technique Anglais-Français. Par G. Malgorn. Board Cover; 5 x 7½; pp. 216. Gauthier-Villars & Cie., 55 Quai des Grands-Augustins, Paris (6e). Price, 10 francs.

This is a valuable little book for those who have to do English-French translation of a technical nature. Most language dictionaries are weak in technical words, and it is often difficult to translate accurately without a close familiarity with the industry concerned. This book contains words relating to machine tools, internal-combustion motors, electricity, naval construction, metallurgy, and similar subjects. It is of no use for translating from French into English, for only the English terms are defined.

The Design of Steel Mill Buildings and the Calculation of Stresses in Framed Structures. By Milo S. Ketchum. Fourth edition. Flexible; 6 x 9; pp. 632; illustrated. McGraw-Hill Book Co., New York; 1921. Price, $6.

Professor Ketchum's book now appears in its fourth edition, and it is almost completely rewritten, with several new chapters added. The latest revision is a totally different book from the first edition, which appeared in 1903, and also is a much more valuable book to present-day engineers than the revisions of 1906 and 1912. We would therefore advise those who have the older editions and find them useful to inspect the present volume. Part 1, covering the calculation of the stresses in simple beams, trusses, portals, the transverse bent, and the three-hinged arch, and Part 2, covering the calculation of the deflections of structures and of the stresses in statically indeterminate girders, trusses and frames, and secondary stresses in trusses, are essentially for the student. Part 3 covers the design and construction of steel frame buildings for mines, mills, smelters, and other industrial plants. The information given is largely practical and includes much data on accessories such as windows, floors, roofs, and paint. All who direct and supervise construction work will find Professor Ketchum's book a necessary acquisition to their library, but they in general know this already, and it only remains to suggest that the latest edition contains much new material.

Technical Papers

Carbon-Monoxide Poisoning—The U. S. Bureau of Labor Statistics, Washington, D. C., has issued a forty-seven page bulletin, No. 291, on carbon-monoxide poisoning. The first part of the bulletin is devoted to a description of acute and chronic poisoning from this cause, and the last part to sources of the gas. The paper may be obtained from the Superintendent of Documents, Washington, D. C., for 10c.

Indian Bauxite — "The Bauxite Resources of India" are described in a fifteen page paper in *The Mining Magazine* for February (Salisbury House, London Wall, London, E. C. 2; price, 1s. 6d.). The article compares the Indian deposits with those in other parts of the world; discusses the possibility of producing alumina and aluminum at a low cost; and briefly mentions possible outlets of the product.

Painting With the Air Brush—Painting by hand with a brush is, for many purposes, uneconomical, according to a short article in the February issue of *Compressed Air Magazine* (11 Broadway, New York; price 35c.), which describes some of the latest developments and uses of the air brush. Compressed air at from fifteen to twenty-five pounds pressure is required.

Mine Fans—In *The Mining Magazine* for February (Salisbury House, London Wall, London, E. C. 2; price, 1s. 6d., is the first part of a paper on "Modern Mine Fans," nine pages. The second part will appear in a following issue. Theoretical principles are first mentioned and then practical types of fans are described.

Ontario Silver—The *Bulletin* of the Institution of Mining and Metallurgy for February, 1922, contains a seventeen-page paper describing the geology of the silver ores in South Lorrain, Ontario. Separates of the paper may be obtained for 1s. from the offices of the Institution, Cleveland House, 225, City Road, London, E. C. 1, England.

Removal of Clay From Rock—In the Feb. 11 issue of *Rock Products* (Chicago; price, 25c.) is the first of a series of articles by Edmund Shaw describing the various ways of removing clay from sand and rock.

Clay—The U. S. Bureau of Mines, Washington, D. C., has recently issued Technical Paper 281, entitled "The Use of Electrolytes in the Purification and Preparation of Clays" (47 pages; obtainable from the Bureau on request). The bulletin will be of considerable interest to those who own commercial clay deposits.

Metallurgical Accidents — Technical Paper 297 of the U. S. Bureau of Mines, twenty-eight pages, contains statistical data on accidents at metallurgical works in the United States during 1920. Obtainable on request from the Bureau at Washington, D. C.

SOCIETIES, ADDRESSES, AND REPORTS

Standardization of Sampling, Assaying, and Settlements Reached by Committee

The report of a joint committee of buyers and sellers on standardization of sampling, assaying, and settling of lead and zinc ores in the Missouri, Kansas, and Oklahoma district has just been completed. Committees were appointed by the American Zinc Institute, the ore buyers, and the American Mining Congress.

The following recommendations were made with regard to sampling:

That both buyer and seller take more interest in the sampling of ores, and see to it that proper samples are taken.

That sheet zinc cans having a capacity of not less than 1,000 gm. of zinc ore be used, and that no zinc sample be put into a can that contained lead, and vice versa.

That after taking samples with sample horn in the usual manner, extreme care be used in rubbing out all sludge balls, and thoroughly mixing sample before placing in sample cans.

That three, and only three, samples be taken; one for buyer, one for seller, and one for umpire or control, the buyer to be custodian of the umpire or control sample, which is to be sealed by the seller at his option.

That all samples sent to chemists shall be marked by lot or code numbers. The buyer and seller shall each keep, for mutual inspection, a record of all lot or code numbers and corresponding car numbers.

That the samples must be delivered to chemists promptly.

The following recommendations were made regarding assaying:

That twelve working hours be allowed the chemists for making their assays and determinations.

That entire contents of the can be used and indirect heat applied in determining the amount of moisture.

That the entire sample be ground and all passed through a 20-mesh screen, then thoroughly mixed and quartered down to not less than 250 gm., which amount is to be used for final pulp sample. This final sample is to be ground and all passed through an 80-mesh screen, though a 100-mesh screen is preferred.

That pulp sample must be thoroughly rolled and mixed before sample is taken for assaying.

That c. p. sheet zinc be used in standardizing the zinc solution, and that litharge be used in standardizing the lead solution. These solutions are to be standardized daily by three determinations.

That chemists reporting assays are to make one, and only one, original signed certificate, and copies made must be of different colored paper and marked "duplicate" or "copy."

That if the chemist finds sludge balls in the sample he must so state on his original certificate.

Recommendations regarding settlements are as follows:

That all settlements be made by the exchange of certificates, or where settlement is made over phone or otherwise this settlement must be promptly confirmed by the exchange of certificates to be identified by having the proper car number placed thereon by buyer or seller.

That the settlement on zinc ore shall be made on a split if the difference in assay of zinc and iron combined is not greater than six-tenths of 1 per cent. This difference is to be computed by deducting from zinc assays all iron in each over 1 per cent and then taking the difference of these results.

That the settlement on lead ore shall be made on a split if the difference is greater than six-tenths of 1 per cent.

That the settlements on moistures shall be made on a split if the difference in determination is not greater than six-tenths of 1 per cent.

That if the difference should be greater than six-tenths of 1 per cent in either of the three above-noted cases, then an umpire assay or determination must be made, and settlement made on the middle of the three assays or determinations. The loser shall pay the cost of the umpire assay or determination, but if neither side loses the umpire expense is to be borne equally by the buyer and seller.

Unless otherwise specified at time of sale it shall be understood that approximately 10 per cent over-weight is inferred.

That all weight certificates shall be signed by the weigher.

The suggestions of a committee representing the chemists of the district have also been included in the report.

With reference to the prices the chemists ask for complying with these requirements the committee finds the matter is outside of its province beyond that the prices are to be consistent with the kind of work expected.

Charges for assaying as recommended by the chemists are: Zinc, $1 per determination; zinc and iron, $1.25; zinc, iron and moisture, $1.50; lead, $1.25; lead and moisture, $1.50; moisture, 50c.

The committee recommends that no discounts be allowed unless bill amounts to $100; that 15 per cent be allowed on bill from $100 to $150, and that 20 per cent be allowed on bill from $150 up.

The joint committee is as follows: Ore buyers, George F. Braun, T. O. Vest, H. E. Kingsbury, Edward P. Dwyer. Operators, W. T. Landrum, F. N. Bendelari, M. F. Owen, and D. R. Muir.

Northwest Mining Association Discusses "Blue-Sky" Law

DR. H. M. PAYNE GUEST

At the regular weekly meeting of the Northwest Mining Association at Spokane, on March 16, Dr. Henry M. Payne, of New York, was the guest of honor. He discussed the metal and general business situation in the East, and expressed the opinion that Mexico offered an excellent opportunity for substantial mining investments. He concluded with a strong plea for more Americanism on the part of the mine operators and the general public, pointing to the fact that the present situation in the coal-mining industry held grave possibilities.

At the same meeting the Denison Federal "blue-sky" bill was discussed. The chairman pointed out that enactment of the measure would kill mining promotion and lead to utter stagnation in an industry that is only now beginning to recover.

In preparation for a national promotion, no matter how honest the project might be, it would be necessary to pass the "blue-sky" commissions of forty-two states, at a cash outlay of at least $42,000 and loss of possibly a year's time.

Furthermore, it was pointed out that the exemption of securities listed on stock exchanges in cities of population of 500,000 and over would drive all investment and speculative capital to a few large communities and bring disaster to such mining centers as Denver, Salt Lake, Spokane, and Butte.

It was decided to begin an energetic campaign of education, and with that in view a public meeting of mining men will be called soon to take action. Meanwhile, communications are being sent to every mining organization in the West, calling attention to the bill.

Practical Mining Men Meet at Picher

The first of what it is hoped will be a series of get-together meetings for practical mining men in the Miami-Joplin field was held at Picher, Okla., on March 16. Will H. Coghill, of the U. S. Bureau of Mines, was the principal speaker, explaining the results of experiments he and others from the Bureau have been making in the district for several months. He freely criticized the present milling practice in the field, and suggested the possibilities of a new jig, designed for the handling of material between minus $\frac{3}{4}$ in. and plus $\frac{3}{8}$ in., that might be taken out of the mill feed. A sample jig has been constructed and a large-

[illegible] model has been installed in the new West Side mill of the Commerce Mining & Royalty Co., where it will be tried out.

A number of the practical jig men of the district expressed doubt as to the successful introduction of innovations, saying that they believed the old time Cooley jig the best concentrating machinery for the ores found in this field.

Another meeting of jig men will be held in four weeks, and in the interim a meeting for drill men, blacksmiths, and ground foremen will be held on March 30. The meetings are held in the hall of the Tri-State branch of the American Zinc Institute.

Coal Situation Reviewed by M. and M. Society

The New York Section of the Mining and Metallurgical Society of America held its monthly meeting at the Harvard Club on Wednesday, March 22. H. W. Wiley, president of the Boone County Coal Corporation and also vice-president of the Kanawah Coal Operators' Association, told of labor conditions in the West Virginia bituminous union field, and C. E. Bockus, president of the Clinchfield Coal Corporation, summed up the same problem in his section, the southwestern Virginia non-union field. C. E. Lesher, editor of *Coal Age*, also spoke, contributing some valuable data and comments.

Mine Valuation Exclusively Engineers' Work

According to L. P. Barrett, mine appraiser for the State of Michigan, the Michigan system of mine valuation is simply the application for purposes of taxation of approved scientific methods of valuation in use by the best geologists and engineers in actual commercial practice. Prior to 1911, mining property in Michigan was appraised by local assessing officials. In that year the Legislature authorized the board of state tax commissioners to make a special investigation and valuation of all property in the state. As a result of the investigation, made by J. R. Finlay, the assessed valuation of iron mining property was increased from $26,978,477 to $85,697,110.

The appraisal proved conclusively that local assessing officials are not ordinarily competent to value mine property equitably, and that such work can be executed satisfactorily only by engineers or geologists, especially fitted by training and experience. It furthermore demonstrated, in the opinion of Mr. Barrett, the necessity of an annual valuation of the iron mines, as mining property fluctuates in value to a greater degree than any other class of property, especially individual mines.

The object is to assess the mine for 100 per cent, cash sale value. The increase in taxes of recent years has been due not to increase in valuation, but to increase in the amount of money that has been raised on the same valuations. The 1921 valuation of the Michigan iron mines was $117,691,208. The system of valuation worked out in Michigan has been pronounced the best that could be devised and has been adopted by several other states. It has been indorsed by economists and is considered fair and equitable in principle and application.

MEN YOU SHOULD KNOW ABOUT

Frank M. Manson, of Reno, Nev., is visting San Francisco.

Eugene Dawson has just returned from Panama to New York.

Willet G. Miller sailed from New York for England on March 23.

Basil Prescott is examining mining properties in Chihuahua, Mexico.

C. D. Kaeding, consulting engineer, was in Reno on March 15, en route to Candelaria.

N. G. Evered has been appointed manager of the Vipond property in Porcupine, Ontario.

Harold Stotesbury, of the Tonopah Mining Co., is making examinations in Butte County, Cal.

John G. Kirchen, general manager of the Tonopah Extension Mining Co., is ill in San Francisco.

Henry C. Carlisle will make his headquarters for six weeks at Gadsden Hotel, Douglas, Ariz.

Alford Roos has returned to Bayard, N. M., from an examination of fluorspar properties near Hatch, N. M.

Sidney J. Kidder, manager of the Mogollon Mines Co., is in Los Angeles, Cal., recuperating from a recent illness.

Joseph McAuliffe has accepted the position of mill superintendent for the Empire Consolidated Mines, Inc., Empire, Col.

J. R. Finlay, having completed his work in New Mexico for the State Tax Commission, is at his home in Redlands, Cal.

A. W. Koch, of Boston, who has been making examinations in Arizona, is in Los Angeles, Cal., en route to the Northwest.

D. C. Jackling recently visited the new plant of the Shasta Zinc & Copper Co., at Winthrop, Cal., on his way from San Francisco to New York.

C. K. Leith has returned from South America and has left New York for Madison, Wis., to resume his duties at the University of Wisconsin.

H. I. Smith, chief supervisor of mineral leases for the Bureau of Mines at Denver, is in Washington conferring with Interior Department officials.

A. H. Jones, formerly superintendent of mills for the Tonopah Belmont Development Co., at present with headquarters in Salt Lake City, is in Tonopah.

E. A. Krisher has been appointed superintendent of the Lucky Twenty Mining Co., Ouray, Col., to fill the vacancy caused by the death of **J. A. Lannon**.

Clyde Heller and **Frederick Bradshaw**, president and general manager respectively of the Tonopah Belmont Development Co., were in Tonopah during the second week of March.

George Huntington Clark has returned to Birmingham, Ala., from a trip to Georgia and Florida, where he had been studying the fuller's earth mining operations of the Standard Oil and other companies.

R. L. Chase, of Denver, has been retained as consulting engineer by the Golconda Consolidated Mines Co., which has a large gold-silver property in development in the San Juan Mountains of Colorado.

Bert W. Dyer, who has been serving as Federal mine inspector in Alaska, has been recalled to fill the vacancy created by the death of **George Salmon**, the late assistant supervisor of coal mine leases in the West.

Frederick Marston, former mill superintendent for the Arizona Copper Co., at Morenci, Ariz., and for the Caucasus Copper Co., Batoum, Russia, is now mill superintendent and chief metallurgist for the Alvarado Mining & Milling Co., at Parral, Chihuahua, Mexico.

A. A. Beville has been promoted to the position of chief engineer on the Mesabi Range for the Cleveland Cliffs Iron Co. to fill the vacancy created by the resignation of **W. A. Sterling**, who has accepted the position of assistant superintendent with the **E. W. Coons** Contracting Co.

M. Van Siclen, assistant chief mining engineer of the Bureau of Mines, has been detached from the Washington office to act as technical adviser to the Indian service in making new leases for lead and zinc deposits on Indian lands. **E. H. Denny** has been called to Washington to take up the duties of assistant chief mining engineer.

Mining and metallurgical engineers visting New York City last week included: **H. W. Edmondson**, Hyde Park, Vt.; **Allan G. Waite**, Buffalo, N. Y.; **D. A. Lyon**, Washington, D. C.; and **F. T. Agthe**, York, Pa.

OBITUARY

Harai R. Layng, metallurgist, died at Gilroy, Cal., on March 4, of influenza.

Kent Archibald, a pioneer of the Nova Scotia gold mining industry, died at Truro, N. S., on March 20 at the age of seventy-nine.

B. T. Link, president and manager of the Grant County Copper Co., died recently at his residence in Santa Rita, N. M. Mr. Link had been a mine operator in the Silver City district for forty years.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded

Leading Events

CALUMET & HECLA and its subsidiaries, Ahmeek and Isle Royale, in northern Michigan, resumed operations on April 1. Isle Royale will start milling soon.

The lease on the Hoskins Mound sulphur deposit near Freeport, Tex., now held by the Texas Company, will be sold to the Freeport Sulphur Co., if the stockholders of the Freeport Texas Co. ratify a contract to this effect between its subsidiary and the Texas Company. The matter will be voted on at a meeting to be held on April 10.

Charles S. Herzig has made an unfavorable report on the property of the Boston & Montana Development Co. at Elkhorn, Mont.

The Minnesota tonnage tax hearing will take place at St. Paul on April 10.

Stockholders of the Magma Copper Co. voted on March 28 to ratify the directors' proposal to issue $4,000,000 in bonds to finance the construction of a smelter and other improvements at the company's property in Arizona.

E. P. Mathewson has made an interesting report on the Burma Corporation, the gist of which is given in this week's London news.

A bill to remove the "discovery clause" from the Ontario Mining Act is being sponsored by the present Provincial Minister of Mines in the face of adverse criticism.

The "blue-sky" legislation, recently under discussion, has been eliminated from further consideration at Toronto.

Hoskins Mound Sulphur Deposit Sought by Freeport Company

Proposed to Transfer Lease Now Held by Texas Co.—Thomas Nevins Claims Agreement Subject to Cancellation

The Freeport Sulphur Co. has entered into a contract with the Texas Company providing for the transfer of the latter's mineral lease on the Hoskins Mound sulphur deposit, fifteen miles northeast of Freeport, Tex., and near the coast. The Freeport Sulphur Co. is a subsidiary of the Freeport Texas Co. Stockholders of the latter will meet at Wilmington, Del., on April 10 to ratify the action of the company in guaranteeing and entering the contract between its subsidiary and the Texas Company, which is dated March 14, 1922. A proposal to issue $4,000,000 in 7 per cent convertible bonds will be considered at this meeting; also one to issue additional stock, not to exceed 250,000 shares, to meet the conversion privilege to be contained in the bonds. It will be necessary for the Freeport Texas Co. to advance money to the Freeport Sulphur Co. for development and working capital.

Three thousand acres of sulphur lands on Hoskins Mound, which the Freeport company is to add to its holdings, are owned by the Mound Company, a Texas corporation, which leased the acreage to the Texas Company. It is this lease which the Texas Company is to transfer to the Freeport Sulphur Co.

A rumor of possible complications is heard, to the effect that Thomas Nevins, who controls the Mound Company, claims that the lease given by his company to the Texas Company is subject to cancellation because of numerous breaches of obligation.

Utah Apex Resumes

The Utah Apex Mining Co., of Bingham Canyon, Utah, resumed operations on March 27. A contract has been entered into with the American Smelting & Refining Co. for the treatment of its ore and concentrates at Midvale.

Butte & Superior Hearing Again Postponed

The hearing in the accounting proceedings between the Butte & Superior Mining Co. and the Minerals Separation, Ltd., has again been postponed, this time until April 11. It was to have been held on March 28 in New York.

Coal Miners Strike in Colorado To Have Little Effect

Those in charge of smelters, power plants, mills, and mines in Colorado are unanimously of the opinion that the threatened strike of coal miners will not appreciably affect operations in that state. Large quantities of coal are in storage, and with the non-union mines in operation there is not likely to be any shortage for several months at least. The production of coal for the first two months of the year as shown by the State Coal Inspector's report shows a falling off of 215,709 tons as compared with last year.

Calumet & Hecla Resumes Mining Operations

Ahmeek Expected To Mill 1,500 Tons Daily—Isle Royale To Start Stamps April 10

By M. W. Youngs

The Calumet & Hecla Mining Co., in the Michigan copper country, starts operations April 1 by sending about 2,000 tons of rock daily to the mill from the conglomerate department. Several of the conglomerate shafts will be put in operation. A force of 500 men is employed in restoring shafts, removing fallen rock, and repairing the skipways and timbering. The several shafts are already opened to the deeper levels, making possible the removal of pillars and backs of stopes or the mining of virgin ground. Tracks have been laid in the crosscuts to the Tamarack Junior tracts, and tramming may be resumed in this part of the property. Some of the crosscuts to the vein from the Red Jacket shaft have also been cleared, making possible the resumption of mining there.

Ahmeek will probably start sending 1,500 tons of rock daily to the mill, this tonnage increasing as metal and labor conditions warrant. This property is in splendid condition and in position to get back to normal speedily. When Ahmeek shut down in 1921 it was producing in excess of 2,000,000 lb. of copper per month, and the rock was averaging close to 30 lb. to the ton. The fissure vein of almost pure mass copper will contribute materially to keeping costs down and is largely responsible for the fact that the cost per pound during the three months the mine was operated last year was under 8c., this being the actual mining cost. Other charges brought the cost up to 11.56c. For depletion and depreciation 4.7c. was charged. No. 1 shaft was drained during 1921 and it will again be possible to conduct mining operations here. Drifts were extended from this shaft early last year, and medium good ground was opened. It is Ahmeek's plan to explore the Kearsarge conglomerate this year, and for this purpose the crosscut from one of the drifts on the fissure vein in No. 2 shaft will be extended about 200 ft. to cut the lode.

Isle Royale will begin stamping rock April 10. Water has been turned into the boilers at the mill, and repair work is under way. Some of the tables are warped, but water has been turned over them and it is believed most of them can be placed in their former condition.

When Isle Royale was shut down on April 1 last year it was producing at the rate of approximately 65 per cent of normal. For the next few months at least, it probably will not produce more than 50 per cent, or between 500,000 and 600,000 lb. per month. Isle Royale will probably send no more than 1,000 tons of rock daily to the mill at the start, sufficient to keep two heads busy. Previous to the shutdown last spring, Isle Royale was in particularly good ground.

El Paso Smelter Overhauling All Lead Furnaces

The Erupcion Mining Co. and the Ahumada Lead Co., whose properties are situated in Chihuahua about forty-five miles west of Ahumada station on the Mexican Central, about sixty miles south of El Paso, are at present constructing a broad-gage railroad from the Mexican Central to their property, for the purpose of shipping a considerable deposit of lead carbonate ore, which has been developed in recent years. The El Paso Smelting Works has a contract for smelting this ore, and at the present time is rehabilitating to the necessary extent its lead-smelting department. This, it is said, is not especially of great importance, and as a matter of fact is involving no actual new construction, but rather the rehabilitation of a six-furnace lead-smelting plant which has been at El Paso for many years, but which during the last ten years has been only partly used.

The mining companies above mentioned expect to complete the railroad and begin deliveries some time during the coming summer, the exact date not having been determined. Press reports to the effect that the El Paso smelter will employ 1,000 additional men on account of this movement are greatly exaggerated, the company states. It expects to operate five or six furnaces at that time in place of three which are being operated at present.

Boston & Montana Mine Examined by C. S. Herzig

Asserts Tonnage in Sight Is Insufficient To Run Mill at Capacity—Assay Values Low

Charles S. Herzig has reported unfavorably on the Boston & Montana Development Co.'s property in Montana for Harris & Co., brokers of 25 Broad St., New York, who have made the report public. Mr. Herzig was asked to examine the mine, the brokers stated, for the reason that the new mill has been handling only 200 tons a day or less, although the promoters had announced that sufficient ore was blocked out and broken to keep the mill going at its rated 750-ton capacity from the start.

In the past the management of the Boston & Montana company has claimed that four veins have been developed. From one of these, the Idanha, according to Mr. Herzig, practically all the ore going to the mill is coming. After describing the scant amount of ore visible, Mr. Herzig says that it is "evident that the mine is dependent on the limited amount of ore opened up in the Idanha vein to supply what tonnage may be extracted, and it does not seem physically possible to take out over 200 to possibly 250 tons a day."

As to the assay value, Mr. Herzig says that it seems "that an average of the ore being treated in the mill is around 5 oz. to perhaps 6 oz. of silver, with possibly 1 per cent copper and a small amount of lead. . . Ore of this grade is of doubtful value. It does not seem possible to handle it at a profit."

In concluding, Mr. Herzig says, "The mine is not now on a self-supporting basis, and in my opinion there is no reasonable chance of it being so in the near future." Mine conditions, he says, do not warrant new financing.

Receiver and Accounting Asked for Calumet & Jerome

J. B. Brown and other stockholders have entered suit in Prescott, Ariz., asking appointment of a receiver for the Calumet & Jerome Copper Co. and for a general accounting. The action is directed against the corporation and George W. Avery, George H. Avery, and Joseph Larsen, directors. It is alleged that the Averys have been absent in California for two years, have neglected their duties, have sold stock for which no return has been made, have voted themselves stock to which they had no right and have mortgaged the company for $400,000 by trust deed.

President George W. Avery recently returned from New York, where, he stated, he had closed a stock deal with James O'Brien & Co. through which ample funds would be secured for development. Development work is to be undertaken, consisting of upraising from the upper tunnel to find ore located by drilling two years ago, and it is expected that extension of the upper tunnel, through United Verde ground, at 500 ft. depth, will cut a promising surface showing on the 101 Claim.

Brazilian Consulate Reports Discovery of Platinum

Deposit Found in Parahyba do Norte Within Reach of Transportation—Operator's Capital Limited

United States Consul Cameron has reported to the Department of Commerce that platinum has recently been discovered in Parahyba do Norte, Brazil. The deposit is on a mountain ridge three miles from the main automobile road leading from Campina Grande to Patos. Regular truck lines now operate over this line, and it is understood that a branch road from the main line to the deposit could be easily constructed. For the present the owner plans to establish an extracting plant at the deposit and bring the ore out by truck. His funds are limited, however, and he may require outside capital.

Platinum Reported in Albania

Discovery of deposits of platinum in Albania was announced on March 16 by Constantine A. Chekrezi, Commissioner from Albania to the United States. In a letter to H. Foster Bain, Director of the Bureau of Mines, he says the platinum was discovered several weeks ago by Professor Saderholm, of the University of Helsingfors, in Albania on a mission for the League of Nations. A deposit of coal has also been found.

Bureau of Mines Officials To Meet at Pittsburgh

Matters having arisen which made it advisable to call together all superintendents and chief clerks of the mining experiment stations of the Bureau of Mines, the original plan of having Western superintendents gather at Rolla, Mo., has been changed. The meeting will be held, instead, at Pittsburgh and at Washington. The first session will be in Pittsburgh on April 17.

Minnesota Tonnage Tax Hearing Up April 10

Attorney General Hilton of Minnesota has announced that the hearing on the granting of a permanent injunction to the iron-mining companies of Minnesota against the collection of the occupational or so-called tonnage tax will be held in Federal Court at St. Paul on April 10. The hearing will be before one judge, Tillman D. Johnson, of Salt Lake City, Utah.

Idaho Gold Corporation Refused Listing on Exchange

The Idaho Gold Corporation, incorporated under the Nevada laws, is the latest attempt of George Graham Rice to interest stock speculators. An unofficial request to list the stock in this new company upon the San Francisco Stock Exchange has been denied by the California State Corporation Department.

News from Washington

By PAUL WOOTON
Special Correspondent

War Minerals Relief Personnel To Be Kept Down

Appeal of Rowen Claim Results in Disallowance of Most of Amount Formerly Allowed

It is the desire of the Secretary of the Interior to hold to a minimum the personnel engaged in War Minerals Relief work. For that reason, he has suggested that the Bureau of Mines arrange to extend to the commission such engineering assistance as may be necessary. W. R. Crane, the superintendent of the Bureau of Mines' Southern experiment station, is now in Washington passing on some of the engineering matters which have arisen in connection with war minerals claims. As Mr. Crane's duties at Birmingham are such as to preclude any extended stay in Washington, C. E. Julihn, the superintendent of the Lake Superior experiment station, has been called to Washington for temporary duty with the War Minerals organization.

An appeal in the Rowen chrome claim has resulted in the elimination of a $17,500 item. Had the appeal not been made it is probable that the item never would have been questioned. In the investigation which followed the appeal, a questionnaire was sent out, which, by chance, revealed that the applicant could secure relief from that portion of his loss through a contract which was found still to be in force. The final recommendation in the claim was $3,988.41. The original amount claimed was $59,000. The commissioner disallowed a number of other items in addition to the one for $17,500.

Further recommendations for awards have been made by the commission in the following cases: W. A. Watson, Charlottesville, Va., pyrites, $1,198.92; Lewelling & Williams, Little Rock, Ark., manganese, $603.07; I. Lanski & Sons, Chicago, manganese, $8,085.36; Reeves Davis, Happy Camp, Cal., chrome, $334; Joseph Nigliore & Everton Mining & Development Co., Anderson, Ark., manganese, $6,802.79; Tom E. Plumridge, St. Louis (trustee for John E. Hannon), manganese, $1,157.52; American Refractories Co., chrome, $14,174.02.

Frequent mention of the passage by Congress of legislation reimbursing war minerals producers was made in the House debate on the soldier bonus bill by various members in justification for the bill and the fact that it contained no provisions for producing revenues to pay the bonus. These members pointed out that no complaint had been made when Congress passed legislation relieving war minerals contractors, which bills carried no provision for producing the revenue.

Representative Crisp, of Georgia, said Congress had passed a law authorizing an appropriation of several million dollars to pay "mineral and mining speculators for profits they would have made had the war gone on" and that no protest was made that the expenditure would injure the country.

Representative Schall, of Minnesota, stated that the Government had paid war minerals claims, thereby fulfilling its obligations under mining projects where the close of the war had caused their owners to suffer losses.

Congress had provided for the settlement of war minerals claims on the ground that the Government had encouraged and induced miners to engage in mining certain minerals needed in the prosecution of the war, according to Representative Osborn, of California. The close of the war found many of these mines just beginning to produce or not fully developed, as it takes time to develop the mines. When the war closed shipments of these minerals coming from foreign countries caused the American producers to lose practically their entire investment. Many were ruined financially, he asserted.

The charge was made by Representative Kelly, of Pennsylvania, that many of the war mineral claimants for whose relief Congress had provided "never produced a pound of mineral and their only claim lay in producing a newspaper article which set forth the needs of the Government," and yet they were compensated.

Heat Treatment of Drill Steel Will Be Studied

A mining engineer and a metallurgist are to be selected by the Bureau of Mines and by the Bureau of Standards in the near future to make an intensive study as to present practice in the heat treatment of drill steels and the extent to which breakage occurs. These engineers are to make a much more exhaustive survey than has ever been attempted before. They will submit a report to the advisory board which is co-operating with the bureaus in the study of rock drill steels and other steels which must withstand impact stresses. The advisory committee is composed of B. F. Tillson, T. R. Lawson, George T. Cousins, H. S. Brainard, J. A. Mathews, George H. Clark, H. M. Boylston, Van. H. Manning, F. W. Deonton, Walcott Remington, and Bradley Stoughton.

The survey about to be undertaken is under the immediate supervision of D. A. Lyon and G. K. Burgess.

Government's Silver Purchases

Purchases of silver by the Bureau of the Mint during the week ended March 25 amounted to 1,215,000 fine ounces. This brings the total purchases under the Pittman Act to 101,292,608.

Mexican Decree Remits Penalty for Mine Tax Delinquency

Action Results From Efforts of State Department — Affects Properties Not Re-denounced

As a result of persistent work on the part of the State Department, a decree has been issued by the Mexican government relieving owners of mining property in Mexico from the payment of penalties arising from failure to pay taxes on their claims during the revolutionary period. The issuance of the decree was made known by the Department of State in the following announcement:

"For some time past the Department of State has been informally endeavoring to bring about the issuance by the Mexican authorities of a decree relieving owners of mining property in Mexico from the payment of penalties arising out of failure to pay taxes on such properties during recently disturbed conditions in Mexico. A decree published March 10, 1922, by the Mexican government is intended to grant such relief.

"The decree provides that penalties in question shall be remitted if the property owners shall pay before July 1, 1922, the taxes assessed for the year 1921, and the first eight months of 1922, and further provides that such payments may be made in installments corresponding to the amount due for a four-month period, and on dates selected by the owner.

"The decree also provides that this relief shall be extended to the owners of property whose title thereto has lapsed under Mexican law because of non-payment of taxes, provided the properties shall not have been re-denounced either in whole or in part.

"It is further provided that owners of mines who have failed to pay taxes due previously to 1921 may, provided they make the payments for 1921 and the first eight months of 1922, pay arrearages prior to 1921 in as many installments as there are four-month periods in arrears.

"Provision is made for the receipt of the payments referred to by the principal Stamp Administrators, and it is provided that mine owners who have availed themselves of exemptions from surtaxes granted by previous laws and decrees shall continue paying their indebtedness in accordance with the terms of such laws and decrees."

O. S. L. May Establish Freight Rates Dependent on Value

The Oregon Short Line Railroad has been authorized by the Interstate Commerce Commission to establish rates on ore, concentrates, and slag dependent upon value declared in writing by the shipper.

News by Mining Districts

London Letter

E. P. Mathewson Reports on Burma Corporation—Shortcomings of Treatment Plant Pointed Out

By W. A. Doman

London, March 14—There is presumably no mining engineer who has not some sort of acquaintance with the Burma Corporation and the wonderful ore deposits in the properties which it owns. When the share markets were good, some few years ago, even the highest class of journals here published estimates of the value of Burma Corporation shares, and the figure of £100 was thought to be quite within the bounds of possibility. It is, however, one thing to have orebodies in situ and value them there, and quite another to recover the metals. The Burma Corporation is experiencing the recovery difficulty. Things have not gone well for some time, but the values are there.

The directors appointed E. P. Mathewson in a consulting capacity to visit the property. Mr. Mathewson has written a most illuminating report, in which he points out not only the possibilities of the undertaking, but what is equally important, the shortcomings of the treatment plant. The report is marked with candor throughout, and makes a greater appeal on that account. The writer does not commit himself in regard to the immediate future; there are various "ifs" and "whens" in the document. He does, however, approve the policy of the board, and says: "A daily average production of 700 tons of ore from the Bawdwin mine can be maintained when the necessary labor force is secured, when transportation facilities are adjusted to handle increased tonnage, and when improvements are made in the smelter." As regards the mill, he is equally outspoken: "The mill was built with a view to the production of zinc concentrate suitable for retorting and lead and silver concentrate suitable for smelting. Results have never equaled the expectations of the builders so far as the zinc concentrate is concerned. In fact, the taking out of a zinc concentrate has been discontinued." Further, he writes: "It is fallacious to consider the zinc in your ore as an asset under existing conditions."

Bawdwin ore is exceedingly complex, and no flotation reagent has been discovered that will solve the problem. Originally, considerable store had been set upon the zinc contents of the ore. Even the lead smelter, however, is not operated economically, for there has been "a great loss of lead and silver in the dust and fumes from the furnaces." With a baghouse, silver recovered will be increased to 98 per cent or over, and lead will be raised from 83 per cent to about 92 per cent. The construction of another blast furnace is recommended. Direct smelting is advised for about 40 per cent of the mine run. Though the process now in use for treating the ore is susceptible of considerable improvement, the cost of recovery when improvements are effected will, in Mr. Mathewson's opinion, compare favorably with any process with which he is acquainted. He is rather severe upon chemical processes, and perhaps he is wise. His actual words are "Namtu is not the place to experiment with new processes, particularly chemical processes which require skilled European operators." The suggestion of chemical processes for the corporation came under criticism generally among technical men at the time, and the criticisms have proved correct.

BURMA

Namtu—In February, 13,709 tons of ore was milled at the Burma Corporation's treatment plant, producing 9,402 tons of lead concentrate; 9,747 tons of lead-bearing material was smelted in the blast furnaces, producing 3,260 tons of hard lead for treatment in the refinery. Refinery products were 3,016 tons refined lead and 299,223 oz. of refined silver.

SCANDINAVIA

Edgar N. Rhodes Discusses Nickel and British America Corporation

Special Correspondence

Christiania—Interviewed during his recent visit to Christiania, by *Tidens Tegn*, Edgar N. Rhodes stated that there was no doubt that there is a future for nickel, given normal conditions of production and distribution. The metal, apart from its basic value, was possessed of many prominent qualities that could with advantage be applied in several fields hitherto unthought of. During the recent armament production practically the entire nickel output was absorbed, and there was little if anything done to obtain new spheres of use for the metal. At present the subject is having the most zealous consideration, and for the last ten months the British America Nickel Corporation has, in this direction, carried out a series of exhaustive experiments. The company's physical condition is first class, according to Mr. Rhodes.

Referring to the large Norwegian stake in the British America corporation, Mr. Rhodes said that interest on the capital invested would be realized and that the earnings would be good—as soon as operations could be started and the general depression gives place to life and activity. From that viewpoint he considered that the recent refinancing of the company was right, even at the cost of great efforts. Otherwise the works could not have been completed, and the most of the earlier capital invested would have been lost. The recent trouble in Norway over the company Mr. Rhodes seemed to consider an internal matter.

Johannesburg Letter

Events Preceding Recent Disorder—Strikers Had Been Slowly Returning to Work

By John Watson

The situation prior to the recent revolutionary disorder on the Rand is discussed by John Watson, the correspondent of the *Engineering and Mining Journal-Press* at Johannesburg, under date of Feb. 21. The strike has since been settled, as already announced. Mr. Watson's letter reads:

Johannesburg, Feb. 21—During the last week some little progress has been made toward restarting the gold mines of the Rand. The number of white men returning to work is said to be steadily though slow increasing. There are at present something like 4,500 white men at work. Out of this number 3,500 are officials on the staff of the various mines, about 500 men have been kept working on essential services, though not classed as officials, and the strikers returned to work number about 400.

When an attempt was made to resume work on the gold mines, the strikers still out adopted their usual picketing tactics. These pickets, however, were dispersed and some arrested by the police, mounted and foot. The pickets, sometimes marching as commandoes, or in mobs, including women in many camps, then adopted the plan of visiting the houses of those men who had returned to work.

The workers are escorted to and from their work by police; but there have been several instances where workers have been waylaid, overpowered, and maltreated.

The Union Parliament assembled at Cape Town on Feb. 17 when the Governor-General (H.R.H. Prince Arthur of Connaught) made the opening speech, in the course of which he said the diamond-mining industry had almost entirely ceased. The continual fall in the price of gold threatens with extinction a number of mines which for years have afforded employment to thousands of European and native workers. The strike on the gold mines had caused a stoppage of work in the Transvaal which produced a situation of great gravity. On the advice of ministers, a board would be appointed to deal with the issues raised by the strike.

A subcommittee of the joint executives of the South African Industrial Federation has issued a report giving proposals for a settlement of the strike. They recommend that assistance be given to the low-grade mines by means of a fund which would be contributed to by the state, the employers, and by all employees (whether on wage or salary). They also issue a suggested scale by which the underground contractors earnings should be reduced to some extent.

CALIFORNIA

J. T. Plunkett and Associates Get Surcease Property Near Las Plumas —La Grange Dredge Running

(San Francisco Correspondence)

San Francisco—Four stamp mills are operating in French Gulch, Shasta County. At the Gladstone, ten stamps are in operation; the Milkmaid is operating ten stamps and the Sybil and Washington are each operating five stamps. The zinc refinery of the Shasta Zinc & Copper Co. is well along, and operations are expected to be started in May.

The Surcease property, situated three miles from Las Plumas on the Western Pacific, Butte County, has been acquired by J. T. Plunkett and associates, of San Francisco. Preparations are being made to sink the present shaft deeper and develop further. Plans are in course of preparation for a 100-ton ball mill and flotation plant. Lloyd White is preparing the mill plans and J. G. Collier will be manager of the property.

On the Mother Lode, the 9-ft. gold dredge constructed by the Yuba Manufacturing Co. for the LaGrange Gold Dredging Co. was started March 18.

NEVADA

Betty O'Neal Mine Contracting for 100-Ton Mill—Tonopah Mining Co. in Good Condition

From Our Special Correspondent

Virginia City—The Con. Virginia is mining on the 1,600, 2,050, and 2,250 levels. Production is 100 tons per day, and average value about $14 per ton. In the Ophir mine, work is being done on the 1,800 and 1,900 levels, and about twenty-five tons of $20 ore is being shipped daily.

Battle Mountain—Contracts are being let for the construction of a 100-ton flotation plant for the Betty O'Neal mine, twelve miles southeast of Battle Mountain. Actual construction will not be started until weather conditions are more favorable than at present. Mine development continues on the 150 level and through two tunnels. Slow progress is being made in the main haulage and drainage tunnel on account of difficult ground.

Rochester—Gross production of the Rochester Silver Corporation for February was $50,696.25, and net operating profit $20,188.24. Tonnage treated was 4,271 tons, with average mill heads $11.87, as compared with $10.89 for January. The increase was due to the better grade of ore now being mined from the recent developments on the Windlass vein.

Tonopah—Underground conditions in the property of the Tonopah Mining Co. are said to be excellent. Production is at the rate of 1,500 tons per week, and ore reserves are increasing. Development for the week ended Feb. 13 totaled 326 ft. In the North Star mine, on the 1,000 level, a drift following the McDonald vein is in ore of shipping grade. This vein has been a large producer of high-grade ore in the Montana mine and on the upper levels of the North Star. The West End reports favorable developments in the vicinity of the 500 and 800 levels.

Royston—The Hudson shaft has been sunk 80 ft. below the 300 level. The shaft has passed into the foot wall of the vein. A level is to be established at the 400-ft. point and lateral work done. Some high-grade ore has recently been cut in the old workings above the 150 level, and a raise on the vein shows 16 in. of ore said to run over $500 per ton.

Goldfield—In the Silver Pick lease on the Red Top what may prove to be a valuable ore shoot has been cut in the hanging wall of the main vein. The ore is about 200 ft. northwest of the Red Top shaft and between the 265 and 333 levels. Eight carloads of ore were shipped last month and at present the face of the stope shows 14 ft. of $56 ore for a length of 20 ft.

Ely—Definite news as to when the Nevada Consolidated Copper Co. will resume active operations is still lacking, though it is felt that with improved markets and other properties resuming gradually the date will not be long delayed. The large body of higher grade copper ore developed in the Ruth mine of the company is an asset which should be an important factor in the plans of the company and may mean an earlier resumption than originally planned.

Properties under development in the district at present are the Ely Northern mine of the Boston-Ely company, the Ely-Calumet, and the Nevada United. Outside districts are practically idle on account of the severe weather.

Pioche—The Stella Mines Co. will increase shipments of silver ore, sampling of the fissure vein having demonstrated that a portion of the fissure on the Ronnow claim, when screened, will average 50 oz. in silver to the ton, with a small lead content. Shipments are being made from the Stella and Lyndon mines, the hauling of this ore to the Union Pacific Railroad Switch at Comet having been completed.

The new shaft at the Bristol Silver mine is nearing completion. It is being raised from the 100, 200, and 500 ft. levels. This property is shipping about fifty tons of ore daily, recent settlements assaying 40c. in gold, 23.2 oz. silver, 24.8 per cent lead, 2.2 per cent copper, 6.3 per cent lime, 9.18 per cent insoluble, and 13.2 per cent iron. Ore is derived principally from the 900 level stope.

Leasers working above water level at the Prince Consolidated mine have 200 tons of ore in bin awaiting shipment. The ore is now being hauled by trucks to Pioche, as the railroad is not being operated. Eastern Interests have purchased for a substantial cash consideration the Silver Dale and Silver Peer mines, situated in the Silverhorn district.

Spokane Letter

Backward Spring Retards Operations—Trail To Take Silver-Zinc Ores on Custom Basis

By H. W. Power

Spokane—Cold weather has continued well past the middle of March in the Pacific Northwest, and early prophecies of a late spring are being confirmed. This backwardness has had little effect upon the scale of operations of such large producers as maintained output during 1921. It has, however, delayed resumption of operations at many of the remote and smaller properties, where development is the chief aim. It has hampered some of the smaller enterprises using mills, but not to such an extent as to make any material difference in the amount of ore received at Tacoma, Trail, and Bunker Hill smelters.

Hopes of resumption of mining and milling operations of the Day family properties in the Cœur d'Alenes, the Tamarack & Custer, and the Hercules, and a possible resumption of smelting operations at the Northport smelter, as a result, have been abandoned on account of the death on Feb. 11, of Eugene R. Day. No provision is made in the will of the deceased for his widow, and, as a result, litigation is considered possible. It is believed that no attempt will be made on the part of the surviving members of the partnership to conduct mining operations until a settlement is reached.

The outstanding feature of the situation in southeastern British Columbia is announcement on part of the Consolidated Mining & Smelting Co., of Canada, that the company is not only in a position to treat custom silver-lead ores again on what is practically a cash basis, but that plans perfected provide for handling of the silver-zinc ores at the Trail plant on a custom basis. It is understood that the necessary work and alterations at Tadanac, as the smelter site is known, are now in progress, and that by midsummer the company will be able to accept and pay for ores containing an excess of zinc, at least on such terms as to make available a class of ore that is frequently thrown over the dump in the Slocan and Ainsworth mining divisions. These sections have many properties carrying fairly high values in silver more or less intimately associated with zinc, which accumulate heavy penalties under latter-day smelter tariffs.

Washington has had little that can be called startling, with the possible exception of encouraging developments at the Chloride Queen property, near Colville, and interest in the Keller district as a result of success reported from small-scale operations at what is known as the Iron Creek mine. In Spokane, where so many mining men or prospectors go to raise capital or buy supplies, from within a radius of 300 to 500 miles, optimism is apparent, in contrast to the down-in-the-mouth attitude of a few months ago.

Opposition to the Denison "Blue-Sky" bill, now before Congress, against which mining men of the Northwest are protesting, holding it to interfere with legitimate mine promotion, finds vigorous expression in Spokane.

Two new developments, the Independence strike on the third level, and Rex consolidation with Red Monarch property, are regarded as important in the Coeur d'Alenes.

Deep snow continues to retard operations in central and southern Idaho, with the indications of a late spring, postponing prospecting and small development operations. Aside from that the immediate outlook for this long-neglected territory is good. Important transactions affecting mining property continue. One of these was closed early in March, when the Gold Dredging & Power Corporation took over 5,860 acres of rich placer lands in the Boise basin, together with all the equipment of the Boston & Idaho Gold Dredging Co., including a power plant on the Payette River, the Centerville Mining & Milling Co.'s holdings and equipment, and the patented gold-dredging grounds on Grimes Creek owned by W. H. Eastbrook. The transfer involves property aggregating $750,000 in value.

WASHINGTON

Newly Organized Company May Build Zinc-Oxide Plant

Metaline—The Metaline Minerals Co. has been incorporated under Washington laws by New York capital for operation and development of the property of the Metaline Oriole Co., upon which considerable money was expended some years ago. It is proposed to expend about $100,000, according to official information. Among other things, it is planned to supersede steam with electric power, increase the mill capacity to 200 tons daily, and install a zinc-oxide plant.

Chewelah—Much disappointment has been manifested by local magnesite producers at word from Washington to the effect that the magnestite tariff is likely to be fixed at $7.50 on crude and $10 on dead burned. An effort is to be made to have the rate raised to $15 in the Senate.

It is said that work at the Blue Star mine, near here, is to be resumed at an early date. Owners of the property have options on a considerable acreage of adjoining ground.

Valley—Admiral Mining Co. expects to resume development on its property near this point this spring.

I. C. C. Permits Rates Based on Declared Value

Railroads have been authorized by the Interstate Commerce Commission to establish rates on ore dependent upon declared value by the shipper from El Paso, Tex., to Blende, Minnequa, and Pueblo, Col., and on zinc ore from Brownsville, Eagle Pass, and Laredo, Tex., to the same points.

MONTANA

Anaconda Starts Neversweat — 8,500 Men Employed at Butte—Tuolumne Copper Elects Board

By A. B. Keith

Butte—The Anaconda Copper Mining Co. has put the Neversweat mine, one of its larger copper producers, in operation, affording employment for 400 men. As soon as the company can secure experienced men work will be resumed at all of its large mines at Butte.

The company is turning out marketable metal at its Great Falls refinery, which, however, is going to the rod and wire plant in large part.

The labor situation generally throughout the Northwest is improving rapidly, and a resumption of independent mining operations is noted, the effect of which is already beginning to be apparent in waning numbers of the army of unemployed that headed toward Butte upon word going forth that the mines would resume. The Coeur d'Alene district has no surplus of miners, whether experienced or otherwise, and in the spring months the usual quota of miners go into the "hills," prospecting for themselves. However, the old-time miner is coming back, and though a general resumption is yet some distance in the future, operations are progressing steadily in that direction.

Survey of the mining properties in the Butte district shows an employment roll of 8,585 men, Anaconda leading with 6,000, Butte & Superior second with 900, and the W. A. Clark properties third with 600. The East Butte is employing 400. Owing to the fact that custom smelting has not yet been resumed by the Anaconda company, a number of the mines of this district have not resumed production, and either are closed entirely or are doing development work only. In this group are found the Davis-Daly, the North Butte, and the Tuolumne, besides a considerable number of leasers. The Davis-Daly is employing 150 men on development work, principally at the Hibernia property. These labor statistics give the Butte district a rating of about 60 per cent of normal.

The Tuolumne Copper Mining Co. at its annual meeting of stockholders at Phoenix, Ariz., elected the following directors: William P. Jahn, of Milwaukee; T. E. Murray, of St. Paul; and Paul A. Gow, Frank K. Wilson, Daniel Coleman, John J. Harrington and Arthur Perham, all of Butte.

Great Falls—Announcement has been made of the purchase by the American Zinc, Lead & Smelting Co. of a controlling interest in the Silver Dike mine, in the Neihart district, for $145,000. American Zinc has had an option on this property for about a year and has had thirty men developing the mine for the greater part of the time. The Silver Dike is a low-grade property, with the development work thus far indicating about 500,000 tons of silver-lead-zinc values running from $10 to $13 in value.

UTAH

Ophir Hill Mine Resumes Work—Tintic Standard Shipping to International Smelter

From Our Special Correspondent

Park City—Shipments for the week ended March 18 amounted to 2,697 tons. Shippers were: Judge companies, 1,564; Silver King Coalition, 606; Ontario, 527.

Ophir—The Ophir Hill mine resumed work about the middle of March, shipping to the International smelter at Tooele. During the time of the shutdown the mill was overhauled and new machinery installed.

Alta—The Columbus-Rexall has just declared a dividend of 3c. a share, amounting to $17,587. The Alta Tunnel & Transportation Co. has made twenty shipments from the new orebody. At the Michigan-Utah construction of a new aerial tram is under way.

Eureka—Ore shipments from the Tintic district for the week ended March 18 amounted to 144 cars, as compared with 141 the week preceding. Shippers were: Tintic Standard, 43 cars; Chief Consolidated, 39; Colorado, 17; Eagle & Blue Bell, 18; Victoria, 7; Iron Blossom, 5; Swansea, 6; Grand Central, 5; Gemini, 3; Centennial-Eureka, 3; Bullion-Beck, 1; Sunbeam, 1; Mammoth, 1. Tintic Standard shipments are being made to the International at Tooele.

COLORADO

Operations in Ouray District—Mountain Top Mill Enlarged

Ouray—The Mountain Top Mining Co. has completed the enlarging of its mill at its underground plant and is now treating about 50 tons daily, with a corresponding increase in returns from ore sales.

The Atlas M. & M. Co. has purchased a new Hardinge ball mill of large diameter. This is the first step taken by the company to improve its mill, the Hardinge being designed to replace the stamps. The company is handling a good tonnage of much better ore than formerly, mine development having opened some reserves of good ore.

A long crosscut is being driven on contract by the Lucky Twenty Mining Co. to cut the Guadaloupe vein. This is expected to develop into a good mine by next year. Lessees Jackson and Stone continue mining good ore in the old workings of the upper levels, but are unable to ship because of snow.

The Ouray Leasing Co. and the Imogene Leasing Co. have been steadily drifting ahead on both tunnel levels of the Barstow and have both passed through some good ground. Recent assays by the former indicate that it is probably on the edge of another of the well-known Barstow ore shoots, the quartz streak giving assays as high as $32 per ton. Both leases have opened up a considerable stretch of good quartz and sulphide, which is expected to develop an orebody later, when raising and further exploration work has been completed.

The Chipeta M. M. & R. Co. has been drifting with air drills on the H. A. C. in the Amphitheatre without developing and orebody. The vein has been large and strong, with much quartz, but only occasional mineralization. The objective being still some distance ahead, it is not expected that much ore will be developed for several months.

Wilfley and Ingersoll have begun work on the Pony Express, with several partners. A raise is being driven from the lower tunnel to connect with the upper workings, and shipping ore is being mined from the old stopes. This operation, and leasing by Nick Hutter & Co. on the Newsboy and by Martin Borlatti on the Bachelor, constitute the only work in the silver mines of the north end of the country. All find it difficult to keep going under present high rates, but slightly lower smelting rates, with an already lower freight rate to Durango, have been promised and these have stimulated prospecting and leasing to a small degree.

Georgetown—J. P. Ruth & Co., of Denver, has begun the construction of a fifty-ton flotation mill on Democrat Mountain, to treat the dump material from the Sunburst mine and to do custom work for adjacent mines. In crosscutting from the bottom of a shaft recently sunk by the Gilpin Development Co., a promising body of ore was discovered. A drift is being run to ascertain the extent of the deposit. Leasers on the Sunburst are getting out a good grade of smelting ore. It is stated that the Georgetown Tunnel Co. will soon resume operations.

Rico—As fast as the condition of the roads will permit, machinery for the new cyanide mill for the Emma mine, at Dunton, is being taken in. During the winter a large tonnage of mill ore has been blocked out or broken, and it is expected that the new mill will start operations in about sixty days. The Mount Pleasant Mining Co., operating the Smuggler at Dunton, encouraged by the showing on the second level, is increasing its force at the mine.

NEW MEXICO

Mine Taxation Discussed at Silver City and Santa Fe

Lordsburg—J. R. Finlay, who has been making a valuation of the mines of New Mexico for the State Tax Commission, has completed his work. His report has been published and is ready for distribution. A meeting of mining interests was held on March 20, at Silver City, N. M., in an effort to get together on some plan of taxation as between the present net output tax on mines and the Finlay report on mine valuations. This was followed by a meeting in Santa Fe on March 22, when the matter was discussed before the State Tax Commission.

Santa Rita—No effort is being made to resume mining operations at the Chino Copper Co.'s property. Machine repairs and necessary upkeep work only is being done.

ARIZONA

Magma Stockholders Ratify Proposal To Issue Bonds—Lucky Tiger Directors Re-elected

By James H. McClintock

Phoenix—The most interesting feature of the week's news is the announcement that Magma stockholders have ratified the proposal of the directors to issue $4,000,000 in bonds, the proceeds to be used in providing a new smelter and in increasing its milling capacity and broadening the gage of its thirty-mile railroad. The mine, at Superior, is at its best at 1,400 ft. depth, and is said to have been prospected to 3,500 ft. by drilling.

At Globe a stack of the Old Dominion smelter is to be started soon. Ray has been visited by a party headed by C. S. Cates, but no announcement has been made concerning early operation.

In the south, the Copper Queen, Calumet & Arizona, and New Cornelia are producing on a limited scale, as are the two principle properties at Miami. At Jerome, United Verde is making important improvements and the United Verde Extension is producing to a moderate extent. A number of gold and silver mines are opening in the Bradshaw Mountain districts, south of Prescott, in the hope of the early opening of the Humboldt smelter. Real activity is general in the gold-mining districts of Mohave County, with much diamond drilling planned at Oatman and Katherine.

Renewal of production in the copper mines of Arizona is to be on an economical scale, to overcome the handicap of high freights and increased material and labol costs.

In Tucson a meeting of mine purchasing agents was held recently, and a new policy of using Arizona products wherever possible was announced. Heretofore little save lumber has been bought by the mines within the state.

No change was made in the directors of the Lucky Tiger-Combination Gold Mining Co. at the annual meeting, held in Douglas. A number of stockholders from Kansas City were present and later inspected the company's property, south of Douglas.

Kelvin—The entire surface equipment of the Kelvin Sultana Copper Co., at Kelvin, has been sold to George U. Young, of Phoenix. The property is being dismantled, and the equipment is to be moved to the mines operated by Mr. Young at Goldfield, nineteen miles from Mesa, Ariz. The equipment includes a complete steam-electric plant for operating the mine and mill equipment.

Hayden—The Continental Commission Co., operating the old 79 mine, near Hayden Junction, has resumed shipments to El Paso smelter. A small pilot mill is to be built. The company has developed a large tonnage of milling ore during the last three years, in addition to the higher grade ores that have been shipped.

JOPLIN-MIAMI DISTRICT

Missouri-Kansas-Oklahoma

Value of Ottawa County Indian Lands To Be Determined Before Leasing

By P. R. Coldren

Joplin—It has developed that an attempt will be made by the Department of the Interior to estimate the value of Indian lands in Ottawa County, Okla., before they are leased for zinc- and lead-mining purposes this year. The Department has sent J. E. Dawson, Indian supervisor, T. B. Roberts, an inspector, and Mr. Van Siclen, mining engineer with the Bureau of Mines, who have arrived at Miami, and through O. K. Chandler, local Indian agent, are preparing to get data on the different properties.

A questionnaire has been sent to the mining companies by Mr. Chandler, in which he asks that the operators submit maps outlining the concentrate tonnage remaining in the property, logs of drill holes, average assay records, an estimate of the ore reserve on Jan. 1, the average selling prices in 1920 and 1921, the average selling price for ten years prior to the war, the cost of the plant, lease and development up to Jan. 1, 1922, and numerous other questions.

The questionnaire was sent out under date of March 20, and since then another letter has been sent out by Mr. Chandler, asking that the answers be made as rapidly as possible, and a thirty-day period has been suggested as the probable limit for the filing of the questionnaire.

There is a general impression among operators that the Interior Department is going to treat them fairly, but there is also a feeling just now that in all probability a higher royalty will be asked for the richer mines, and it was not previously believed that this would be done. However, there is no objection to this on the part of the operators, provided too high a royalty is not asked.

The Eldorado Development Co. has been organized at Eldorado Springs, Mo., to develop a zinc and lead tract in the Waco, Mo., camp. A number of test holes already have been put down on the tract, and it is planned to erect a concentrator at once. The lease consists of forty acres and adjoins that of the Tulsa-Pittsburgh Co., situated on the west.

ILLINOIS

Strikers at Fluorspar Mines Wound Workman

Elizabethtown — The strike at the fluorspar mines in the Elizabethtown district, Illinois, is still in progress. On March 22, following a meeting held by a small number of union men at Rosiclare, an employee of the Hillside Fluorspar Mines was shot by one of the strikers and wounded. The offender was arrested. The continuance of the strike is said to be arousing public feeling against it.

MICHIGAN

Gogebic Range

Orders To Increase Output in April Hoped For

Ironwood—Mining operations are continuing on the same scale as during the last few months, but it is hoped that when the shipping season opens, in April, the mines will receive orders to increase production. This range did not experience as drastic curtailment as some of the others, but it has not enjoyed as great a revival this spring. A small amount of ore is being shipped by rail to the furnaces at Mayville, Wis.

Marquette and Menominee Ranges

Oliver Iron Mining Co.'s Plans Unchanged—Chapin Mine Being Put in Good Condition

By W. H. Newett

Ishpeming—John H. McLean and Pentacost Mitchell, officers of the Oliver Iron Mining Co., the iron mining subsidiary of the U. S. Steel Corporation, have just concluded a visit to the company's mines in Michigan. No changes in the mining forces have been ordered, nor have any instructions been issued for an increase in the number of days of operation. The needs of any furnaces that may start soon can be supplied from ore stocks now at lower Lake ports.

Negaunee—The Mary Charlotte mine has received orders for a cargo of ore which will be taken from ore now in stock. It will be shipped by rail, and as the ore is frozen, the shipment will be attended with some difficulty and extra expense. The need of the ore is said to be due to calls by the bankers for interest charges.

Iron Mountain—About two weeks more will be required to place the Chapin mine, where work was recently resumed, in condition for active production. Work thus far has been devoted largely to repairs. The timbering is in bad condition. Practically every man formerly employed has been given a place, and there are now 550 on the payroll, these working two shifts.

The McKinney Steel Co. has installed a complete set of rotary car dumpers operated by compressed air at its Odgers mine, the work being done by the Chicago Car Dumping Equipment Co. Two of the dumpers are located on surface to handle rock from the mine, and a third is placed underground to handle the ore. Automatic loading equipment is installed.

Iron River—Work is to be resumed at once, it is announced, at the Hiawatha and Rogers mine, by the Munro Iron Mining Co. About 200 men will be employed, working one shift. The Rogers is in Bates Township, and the Hiawatha in Stambaugh Township. The Chicagoan, the remaining mine of the company on this range, will remain idle until further notice.

The Tobin mine, of the McKinney Steel Co., will likewise resume soon on one shift.

MINNESOTA

Mesabi Range

Stripping Work To Be Resumed at Boeing Mine

Hibbing—The pumps of the Philbin mine, operated by the Oliver Iron Mining Co., are being pulled, and indications are that the mine will continue down for some time. The mine shut down last fall, and since then it has been unwatered.

Stripping at the Boeing mine, a property of the Mesaba Cliffs Iron Mining Co., is to be resumed by the Winston-Dear Co. in the near future. The work was suspended during the winter months, but it is expected that the two shovels will operate to capacity this season, which will practically complete the work.

Cuyuna Range

Armour Mine, Last Producer, Shuts Down — Stockpiles Involved in Proposed Merger Estimated

Crosby—The Inland Steel Co. has closed down its Armour No. 2 mine for an indefinite period, letting out about 200 men. The Armour mine has been the only property operating to capacity on the Cuyuna Range for some months, and its shutdown leaves the range without ore production. Approximately 140,000 tons of iron and manganiferous ore is stockpiled at the mine, which material the operators expect to start moving to the docks early next month. It is anticipated that with the opening of navigation, mining will be resumed at the Armour No. 2.

The stockpile committee of those interested in the independent steel and iron ore merger, comprised of engineers representing the Pickands Mather Co., the Inland Steel Co., the Youngstown Sheet & Tube Co., and Rogers-Brown Ore Co., have recently completed estimates of the Kennedy, Meacham and Armour mines stockpiles, which will be involved in the proposed merger. It is understood that the final report of engineers upon the iron-ore properties and steel plants of the negotiating companies has been placed in the hands of the directing officials, and that final decision upon the combine of the Youngstown Sheet & Tube Co. with the Inland Steel Co. and Rogers-Brown Ore Co. may be expected soon.

Trommald—The Marquette Ore Co. is sinking a new drainage shaft to facilitate open-pit operation at its Maroco mine. A crosscut will be driven from the bottom of this shaft at depth of 100 ft. under the pit area.

Cuyuna—Diamond drilling is being carried on by the Biwanago Mining Co. at the Kennedy mine, for the purpose of outlining the limits of the new ore reserve discovered at the property last year by the Rogers-Brown Ore Co.

Ironton—Though ore production remains at a standstill in the district, several of the operators of open-pit mines have begun active plans for stripping campaigns in anticipation of a livelier market after the opening of navigation. The Mahnomen mine will start a pit crew early in April, as will also the Hillcrest Mining Co., the latter on stripping work with steam shovel. At the Sagamore mine (John A. Savage & Co.) at Riverton, hydraulic stripping has been resumed and plans are being made for adding a drag-line unit to the stripping at an early date. The Maroco mine, at Trommald, operated by the Marquette Ore Co., has taken on a crew of forty men after two months of idleness, and stripping with steam shovels has been resumed.

The Clement K. Quinn Co. is installing a new 1,200-gal. Layne & Bowler deep-well pump in its drainage shaft.

ALABAMA

Tennessee Company Starts New Stack at Bessemer—Muscoda and Raimund Mine Add Men—Graphite Situation Better

By George Huntington Clark

Birmingham—The latest increase to Alabama iron making is due to the blowing in during the past week of No. 2 stack of the Tennessee company at Bessemer, now running on increased basic iron production required for the Ensley steel plant. In all, this makes seven blast furnaces which that company now has in operation, three having been blown in during the last four weeks. As a result of the resumption at No. 2, the Muscoda iron mine is reported to be getting ready to put on a night shift giving employment for 200 more men. It is also stated that another slope of the Raimund ore mine will start operation before the close of the month.

The Tennessee company will also be in position to bring in Ensley No. 1 furnace within thirty days, if desirable or required. This furnace, recently rebuilt and greatly enlarged, has now a larger capacity than any other stack in the district.

It is understood that No. 2 Bessemer may soon be put back on making ferromanganese from Brazilian ore.

If occasion should demand it by reason of the threatened coal strike next month, Alabama coal will probably be available to an extent in excess of 300,000 tons a week, as the amount of union labor now employed is practically negligible, and production is approaching normal.

Conditions in the graphite field appear much more encouraging. Two of the plants of the Dixie Consolidated Graphite Co. have already resumed operation, and if market conditions warrant other plants may also be again started.

Active quarrying is in progress at the three plants of the Alabama, Madras, and Moretti-Harrah marble companies near Sylacauga. Statuary marble, said to compare well with the finest Carrara in texture, color, and in tooling quality, has long been to some extent recovered in these quarries and used for interior finish.

THE MARKET REPORT

Daily Prices of Metals

Mar.	Copper, N. Y., net refinery* Electrolytic	Tin		Lead		Zinc
		99 Per Cent	Straits	N. Y.	St. L.	St. L.
23	12.50@12.625	28.75	29.375	4.70@4.75	4.425@4.45	4.65@4.70
24	12.50@12.625	28.625	29.375	4.70@4.75	4.425@4.45	4.65
25	12.50@12.625	28.75	29.375	4.70@4.75	4.425@4.45	4.65
27	12.50	28.375	29.00	4.75	4.425@4.45	4.65
28	12.50	28.50	29.125	4.75	4.425@4.45	4.625@4.65
29	12.40@12.50	28.50	29.125	4.75	4.425@4.50	4.625@4.65

*These prices correspond to the following quotations for copper delivered: March 23d, 24th, and 25th, 12.75 @ 12.875c.; 27th, and 28th, 12.75c.; 29th, 12.65 @ 12.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Mar.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
23	$58\frac{1}{4}$	$59\frac{1}{8}$	65	$144\frac{1}{4}$	$145\frac{3}{4}$	$21\frac{1}{8}$	$20\frac{7}{8}$	$25\frac{3}{8}$	$25\frac{1}{2}$
24	$57\frac{5}{8}$	$58\frac{1}{2}$	$64\frac{1}{2}$	$144\frac{3}{8}$	$145\frac{7}{8}$	$21\frac{1}{4}$	21	$25\frac{3}{8}$	$25\frac{1}{2}$
25	...	...	...	....	....	..	...	..	..
27	$58\frac{1}{8}$	59	$64\frac{1}{4}$	$143\frac{5}{8}$	$145\frac{1}{8}$	$21\frac{5}{8}$	$21\frac{3}{8}$	$25\frac{1}{4}$	$25\frac{3}{8}$
28	58	$58\frac{7}{8}$	$64\frac{1}{2}$	$142\frac{5}{8}$	$144\frac{1}{4}$	$21\frac{7}{8}$	$21\frac{1}{2}$	$25\frac{5}{8}$	$25\frac{3}{4}$
29	$57\frac{5}{8}$	$58\frac{1}{2}$	64	$143\frac{3}{4}$	$145\frac{1}{4}$	$21\frac{5}{8}$	$21\frac{1}{4}$	$25\frac{5}{8}$	$25\frac{3}{4}$

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Mar.	Sterling Exchange "Checks"	Silver			Mar.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
23	$437\frac{3}{4}$	$99\frac{5}{8}$	$64\frac{7}{8}$	$33\frac{3}{8}$	27	$436\frac{1}{2}$	$99\frac{5}{8}$	$64\frac{7}{8}$	$33\frac{1}{2}$
24	$438\frac{3}{8}$	$99\frac{5}{8}$	65	$33\frac{1}{2}$	28	$435\frac{1}{2}$	$99\frac{5}{8}$	65	$33\frac{5}{8}$
25	438	$99\frac{5}{8}$	$64\frac{3}{4}$	$33\frac{1}{4}$	29	437	$99\frac{5}{8}$	$65\frac{1}{2}$	$33\frac{3}{4}$

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

The lead and tin markets have been more active than usual during the last week, and prices for the more common metal are somewhat stronger. Copper and zinc have been in small demand, and prices have sagged off somewhat, though zinc is, in general, strongly held. The coal strike which has been called for April 1 does not seem to be worrying any one perceptibly. Most manufacturers are well supplied and feel that should the strike be prolonged there will be no difficulty in securing fuel from non-union mines or from foreign sources.

Transatlantic freight rates are substantially unchanged from the figures published in the Feb. 11 issue, but transpacific rates are reported higher, at $8 per long ton to Hongkong and Kobe.

Copper

Little business was done on Thursday, Friday and Saturday. On inquiries of any size $12\frac{7}{8}$@13c., delivered, was the general quotation, though some small orders for prompt delivery were placed at as low as 12.75c. On Monday, however, a marked tendency to establish the 12.75c. level was noted, and today practically all producers were willing to sell at the price quoted. In some instances it would no doubt be possible to place orders for delivery as late as June on this basis. Domestic business improved somewhat with the lower prices, but outside of one order for 750 tons and another for 1,000 tons, the buying is of small individual volume, largely confined to the outside market.

With the expected early resumption of the porphyries and the weakness in London, conditions in the market are not strong, but producers are hopeful.

The demand from brass makers shows signs of improving, though the wire business continues to be the chief reliance of the producers. Export business has been of satisfactory volume, both through the Copper Export Association and independent channels. The copper sold by the association has netted producers about 12.75c., or slightly more, but some of the other sales for export have had to be made on a lower basis.

Lead

The official contract price of the American Smelting & Refining Co. continues at 4.70c. New York, and for desilverized, 4.50c. St. Louis. Federal lead has commanded 4.45c. in the St. Louis market all week.

Lead continues strong. Little is now obtainable at 4.70c., the price which has ruled in New York for several months, and some producers are so indifferent about selling that they are quoting 4.80c. today, though we have no reports of actual sales higher than 4.775c. Mexican lead continues to go abroad, for the comparative markets here and in Europe do not indicate any profit in paying the duty and selling it to United States consumers.

Demand has been good in the Middle West, and inquiries have been well distributed. The rubber business seems to be quiet, but most other consumers of lead seem to be doing well. One producer who accumulated fairly large stocks some time ago has sold for 4.425c. all week, but most interests are asking 4.45c. and slightly above. Today a good order was placed at 4.50c. Practically all business has been for April delivery, producers in general not caring to go beyond this.

Zinc

The market has become slightly weaker. Prices have dropped, but without inducing purchases, business being lighter than last week. Several producers are out of the market at the present level of 4.625c., and one has bought a fair-sized tonnage at that attractive price. A small-sized sale was made on Monday for shipment to Europe to net about the same as domestic quotations. High-grade metal continues to be in satisfactory demand at unchanged prices on the basis of 6c. with freight allowed. No interest is manifested in forward deliveries.

Tin

The tin market has been active all week, and exceptionally so yesterday. Consumer demand was especially marked, and some orders were placed for delivery over the remainder of the year at slightly advanced prices. Manufacturers of tin plate did not share in much of the business, but most of the other regular consumers of tin took a dip in the market. Among them, foil and mixed-metal manufacturers were particularly noted. Not a great deal of electrolytic tin is available, but it is in general selling on an equivalent basis to the best grades of Straits tin. Tin for delivery three months in the future was quoted all week at the same prices as were asked for spot.

Arrivals of tin, in long tons: March 18th, Liverpool, 15; 23d, Rotterdam, 75; London, 250; 24th, Liverpool, 25; 25th, Batavia, 75; Straits, 700; 27th, London, 50; 28th, Straits, 525; London, 310.

Gold

Gold in London: March 23d, 94s. 8d.; 24th, 94s. 10d.; 27th, 95s. 3d.; 28th, 96s.; 29th, 95s. 3d.

Foreign Exchange

The foreign exchanges have fluctuated in comparatively narrow limits during the week. On Tuesday, March 28, francs were 9.0375c.; lire, 5.0775c.; marks, 0.30375c.; and Canadian dollars, 97.25c. German marks touched a new low owing to reparation difficulties.

Silver

Silver prices have improved in both London and New York, and the undertone is firmer. The feature of the market recently has been the demand for San Francisco delivery for China account, business having been done in the early part of the week at levels well above New York and the London parity. The market closes steady, with the future dependent upon China rates and sterling exchange.

Mexican Dollars—March 23d, 49⅝; 24th, [illegible]; 25th, 49⅝; 27th, [illegible]; 28th, 49¾; 29th, 50⅛.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 4⅜@4½c.; market dull. W.C.C. brand, 5@5½c. per lb. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard **powdered needle antimony** (200 mesh), **nominal at 5.25c. per lb.**

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6¾@7c.

Arsenic—7c. per lb.

Bismuth—$2@$2.10 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Iridium—Nominal, $160@$170 per oz.

Nickel—Standard market, ingot and shot, 41c.; electrolytic, 44c. Small tonnages, spot, nominal at 32c.

Palladium—Nominal, $55@$60.

Platinum—$85@$90 per oz.

Quicksilver—$50 per 75-lb. flask. San Francisco wires $49.30.

The prices of **Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of March 4.

Metallic Ores

The prices of **Bauxite, Chrome, Manganese, Tungsten, Molybdenum, Tantalum, Uranium, Vanadium,** and **Iron Ore, Zircon** and **Zirkite** are unchanged from the prices in the issue of March 4.

Zinc and Lead Ore Markets

Joplin, Mo., March 25—Zinc blende, per ton, high, $31.10; basis 60 per cent zinc, premium, $28; Prime Western, $27@$26; fines and slimes, $26@$25. Calamine, basis 40 per cent zinc, $14. Average settling price, all grades of blende, $25.84.

Lead, high, $65; basis 80 per cent lead, $62. Average settling price, all grades of lead, $63.40 per ton. One carload of picked chunk lead ore sold for radio purposes at a premium of $3 per ton.

Shipments for the week: Blende, 8,406; calamine, 57; lead, 2,344 tons. Value, all ores the week, $365,330.

The advance of $2 per ton on lead brought over a thousand tons of reserve ore onto the market, a part of which is included in this week's shipment. Sellers of zinc ore are holding firm for the prices quoted, and some of the buyers are holding off on bidding, and the purchases this week decreased about 1,500 tons. Shipments continue to move the weekly production, with slight inroads on reserve stocks of zinc.

Platteville, Wis., March 25—Blende, basis 60 per cent zinc, $28 per ton. Lead ore, basis 80 per cent lead, $61 per ton. Shipments for the week: Blende, 639 tons; lead, 41 tons. Shipped during the week to separating plants, 767 tons blende. Shipments for the year: Blende, 266; lead, 601 tons.

Non-Metallic Minerals

Barytes—Crude, $6@$8 per ton, f.o.b. mines. Ground, white, $17@$23; off-color grades, $13@$21 per ton, f.o.b. mills. Foreign importations of crude are being laid down at Atlantic ports for $7.80@$8.25, c.i.f.

Fluorspar—Fluxing lump, $20; fluxing gravel, $17.50; No. 1 ground, $50@$55, No. 2 ground $40 per ton, f.o.b. Illinois mines.

There are no price changes from those indicated in the market report of the issue of March 4 covering **Asbestos, Borax, Chalk, China Clay, Emery, Feldspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, and Talc.**

Mineral Products

Copper Sulphate—Large crystals, 5.50c. per lb.; small crystals, 5.40c. per lb., f.o.b. New York. Export demand has been excellent all winter, and with the South American demand coming on prices are expected to advance soon.

Sodium Nitrate—$2.85 per hundredweight, ex vessel, Atlantic ports.

The prices of **Potassium Sulphate** and **Sodium Sulphate** are unchanged from the issue of March 4.

Ferro-Alloys

Ferromanganese—Domestic, 78 to 82 per cent, $62@$64, f.o.b. furnace.

Ferrovanadium—$3.55 per lb. of V contained, according to analyses and quantity.

The prices of **Ferrotitanium, Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotungsten and Ferrouranium** are unchanged from issue of March 4.

Metal Products

Zinc Sheets—$7.50 per 100 lb. less 8 per cent on carload lots, f.o.b. works.

The prices of **Copper Sheets, Lead Sheets, Nickel Silver, and Yellow Metal** are unchanged from issue of March 4.

Refractories

The prices of **Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick,** and **Silica Brick** are unchanged from the issue of March 4.

The Iron Trade

Pittsburgh, March 28, 1922

In several branches of the steel trade mills are engaged in an effort to lift prices a trifle, not by agreement but by the natural process of first accumulating a backlog. In bars, shapes, and plates prices below 1.40c. practically disappeared two weeks or so ago, and lately some business, of the less desirable sort, has gone at 1.45c. and 1.50c. Seven sheet mills have announced that on April 1 or thereabouts their prices will advance $3 a ton, orders being taken meanwhile at current prices, perhaps for the whole second quarter. Nails are quite firm at $2.40.

The Carnegie Steel Co. named $31 as its second-quarter price on quarterly adjustment sheet-bar contracts, against $30 for first quarter, and independent mills are advancing from $29 to $31, customers being already covered to an extent at $29.

Steel ingot production has increased only a trifle in the last thirty days, being almost stationary at between 29,000,000 and 30,000,000 tons a year. Steel market prospects appear to have brightened farther. There is no prospect of the steel mills running short of coal.

Pig Iron.—The market is a trifle less inactive, and former prices are firmly maintained: Bessemer, $19.50; basic, $18; foundry, $19, f.o.b. Valley furnaces, freight to Pittsburgh being $1.96.

Coke

Connellsville—Furnace, $3.50; foundry, $4.25@$4.75.

Aluminum Industry Has Greatly Expanded

Production Has Increased Rapidly During Last Ten Years—World's Output Is Controlled by a Few Large Companies -United States Most Important Producer and Consumer—Metal Now Selling for Unusually Low Prices

BY FELIX EDGAR WORMSER

Assistant Editor *Engineering and Mining Journal-Press*

THE WORLD'S PRODUCTION of aluminum has risen by leaps and bounds, but demand has lagged behind production, so that the price of the metal for the last twenty-five years has irregularly declined. Back in 1895 aluminum sold for 59c. per lb.; in 1900 for 32.7c.; in 1910 for 22.25c., and today it is selling for between 17 and 18c. Compared with the drop in the prices of other non-ferrous metals, aluminum has been unusually severely deflated:

	Aluminum	Copper	Lead, N. Y.	Zinc, St. L.
Five year pre-war average (1909-1913).	22.00c.	13.94c.	4.40c.	5.73c.
March, 1922	17.50c.	12.75c.	4.70c.	4.70c.

The low price for which aluminum is now selling is due to intense European competition and the great stimulus given to aluminum production during the Great War. Although American production of the metal declined after the Armistice, the output of Europe shows little change; in fact, a tendency exists abroad to enter more extensively than ever into the manufacture and sale of aluminum and its manufactures. The production of Europe, however, is still far behind that of the United States and Canada. America has always taken a lead in the development of the metallurgical recovery of aluminum from its ores, and stands pre-eminent in both production and consumption.

Aluminum is the commonest metal in the earth's crust, although the only source of the metal used in its commercial production is bauxite, an oxide of aluminum which contains from 26.5 to 32 per cent of aluminum. Experiments are continually being made in an effort to recover aluminum from clays, labradorite, and other minerals rich in alumina. The economical production of aluminum is a matter of cheap hydro-electric power, as its recovery is strictly an electrometallurgical process. Great initial expense is involved.

Unlike the production of other metals, aluminum plants are confined to a few large companies scattered about in Europe and America where cheap water power is available. The names of the companies follow:

Aluminum Company of America, United States.
Northern Aluminum Co.[1], Canada.
British Aluminium Co., Great Britain.
L'Aluminium Françaisе, France.
Aluminium Corporation, Ltd., Great Britain.
Aluminium Industrie Aktien Gesellschaft, Germany-Switzerland.
German Government Works (Horrem, Bitterfeld, Erftwerk, Lauta), Germany.
L'Aluminia Italiano, Italy.
Hoyang Falden Norsk Aluminium, Norway.

This list is in striking contrast to the large numbers of companies engaged in the production of other important non-ferrous metals. The accompanying table of world's production shows the strong position of the American industry.

The production of aluminum in the United States is a monopoly and is confined to one producer, the Aluminum Company of America, whose position, however, has been attained through the expansion of its own business. The company issues no financial reports which are available to the public and is exceptionally conservative in its management. Besides producing the virgin metal it is engaged in the production of various manufactured products. It owns extensive bauxite deposits in Saline County, Ark., producing most of its aluminum ore, which is reduced at Niagara Falls and Massena, N. Y.; Alcoa, Tenn., and Badin, N. C. The latter plant was originally planned by French capital, but was taken over by the present American operator in 1915. Subsidiary companies conduct the different processes from mining to the manufacture of aluminum products.

Germany will probably be the keenest competitor in the world market. Cut off from the rest of the world during the war, the aluminum industry was developed intensively and sponsored by the Government.

Expansion of aluminum plants during the war was carried to excess. The world's production before the war was about 140,000,000 lb. annually. It jumped to over 375,000,000 lb. in 1918, and its capacity at the present time is easily 450,000,000 lb. This rapid growth has been much faster than has been beneficial for the industry and has created strong competition for whatever market exists for the metal. The depressed state of business for the last two years has accentuated competition. The American industry is handicapped by having to use a domestic ore of lower grade than that of France, India, or Guiana. However, great efforts were made early in the history of the aluminum industry to introduce the metal, and no doubt just as intelligent direction will widen the market for aluminum today, so that the world's capacity can be efficiently used.

Aluminum has a great variety of uses, in which advantage is taken mainly of its remarkable lightness and immunity from tarnish. The automobile and airplane industries consume large amounts each year, not only for engine manufacture but also in body construction. Aluminum vessels are common in chemical manufacture. Few kitchens are unsupplied with aluminum cooking utensils. Powdered aluminum is used in the cyanide process, and the foil is finding favor as a wrapping. Aluminum wire is a strong and at present an active competitor of copper in the high-tension transmission-line field.

Much foreign aluminum has come into the United States in ingot and manufactured form from various European producers, which has not been without its effect upon prices. It has been difficult for some to understand why, with the low cost of aluminum wire to European consumers in Germany, larger amounts are not used there. The difference between the price of copper and aluminum in Europe is much less than in the United States. Aluminum is probably being used wherever possible, but as aluminum cannot be substituted for copper in the manufacture of motors and other electrical machinery, large amounts of the red metal must be imported, to be subsequently exported in some finished electrical manufacture. Consequently copper importations are but little affected.

WORLD PRODUCTION OF ALUMINUM (a)
In Metric Tons

	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920
France	10,000	13,000	18,000	10,000	6,000	9,600	11,100	12,000	15,000	15,000
Switzerland, Germany and Austria	8,000	12,000	12,000	150	12,000	20,800	26,000	34,000	31,500	31,200
England	5,000	7,500	7,600	7,500	7,100	7,700	7,100	8,300	8,100	8,000
Norway	900	1,500	1,500	2,500	2,300	4,300	7,600	6,900	3,100	5,600
Italy	800	800	800	900	900	1,100	1,700	1,700	1,700	1,700
Europe	24,700	34,800	39,900	35,900	28,300	43,500	53,500	62,900	59,400	61,500
United States	18,000	19,500	22,500	40,800	44,900	63,100	90,700	102,000	81,600	87,300
Canada	2,300	8,300	5,900	6,800	8,500	8,500	11,800	15,000	15,000	12,000
North America	20,300	27,800	28,400	47,600	53,400	71,600	102,500	117,000	96,600	99,300
Total world	45,000	62,600	68,300	83,500	81,700	115,100	156,000	179,900	156,000	160,800
Average price, cents per lb.	20.07	22.01	23.63	18.63	33.98	60.71	51.59	33.53	32.14	32.70

(a) Taken from compilation of Metallgesellschaft, Frankfort-am-Main.

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[1] Subsidiary of Aluminum Company of America.

COMPANY REPORTS

American Smelting & Refining Co.

A report of operations of the American Smelting & Refining Co. for 1921 states that $4,168,043.75 was paid in dividends. Consolidated income account follows:

AMERICAN SMELTING & REFINING CO. AND AMERICAN SMELTERS SECURITIES CO.—SUMMARY OF CONSOLIDATED INCOME ACCOUNT

	Year Ended Dec. 31, 1921	Year Ended Dec. 31, 1920
Net earnings of smelting and refining plants	$8,652,332.72	$11,933,493.96
Net earnings from mining properties	426,054.15	2,242,199.48
Total net earnings of operating properties	$9,078,386.87	$14,175,693.44
Other income—Net:		
Interest, rents, dividends and commissions	403,084.76	1,572,021.83
Net earnings before deducting general and administrative expenses and corporate taxes	$9,481,471.63	$15,747,715.27
Deduct:		
General and administrative expenses	$962,094.84	$1,166,340.87
Research and examination expenses..	94,437.42	312,295.87
Corporate taxes	243,969.24	979,458.96
Total to deduct	$1,300,501.50	$2,458,095.70
Net income from current operations before providing for bond interest, depreciation, obsolescence and depletion and after providing for all taxes	$8,180,970.13	$13,289,619.57
Less:		
Interest on A. S. & R. Co. 5 per cent first mortage bonds outstanding............	$1,618,029.64	$1,592,834.94
Interest on Rosita Coal & Coke Co. 6 percent Collateral Trust bonds outstanding	54,402.78	71,135.00
Miscellaneous adjustments	119,032.19	485,642.60
Depreciation and obsolescence	3,713,836.37	3,500,244.69
Ore depletion	1,083,760.23	964,983.64
Total	$6,589,061.21	$6,614,840.87
Balance of income for year	$1,591,908.92	$6,674,778.70

SUMMARY CONSOLIDATED PROFIT-AND-LOSS SURPLUS ACCOUNT

Balance at beginning of year..............................	$25,987,292.65
Income for year	1,591,908.92
Transferred from enlargement and extension reserve	3,000,000.00
Appreciated value of mining properties	577,020.85
	$31,156,222.42
Deduct dividends on:	
A. S. & R. Co., preferred stock	$3,500,000.00
Am. Sm. Sec. Co., preferred "A" stock	540,600.00
Am. Sm. Sec. Co., preferred "B" stock	127,443.75
Ore depletion on appreciated value on mining properties	577,020.85
Appropriation for metal reserve account to provide for realized or contingent losses on surplus metal stocks accumulated in prior years, based on Dec. 31, 1921, inventory at cost or market, whichever lower	5,000,000.00
Amortization of war facilities, 1918	1,089,080.58
	$10,834,145.18
Balance at end of year	$20,322,077.24

The following table shows production for the year.

METAL PRODUCTS PRODUCED

	1921	1920	1914
Gold, oz	1,780,205	1,849,048	2,540,911
Silver, oz	75,354,443	77,732,911	77,604,483
Platinum and palladium, oz..	863	936	1,664
Lead, tons	207,612	205,249	316,591
Copper, lb	348,888,000	590,850,000	529,686,000
Spelter, lb..................	14,628,614	44,106,253	15,748,000
Nickel, lb.	120,080	375,167	356,187
Tin, lb..	11,915,954	18,511,160	....
Sulphuric acid, lb	9,952,000	51,688,000	24,296,000
Arsenic, lb..........	5,155,522	17,695,266	6,184,000
Copper sulphate, lb..	2,237,471	3,618,172	6,798,000
Byproduct metals, lb	3,232,488	1,549,426	1,678,228
Sulphur dioxide, lb	154,794	8,154,734	......

La Salle Copper Co.

A report of operations of the La Salle Copper Co. for 1921 states that no copper was produced during the year. Operations show a gain for the year of $2,602.49. Balance of current assets on Dec. 31, 1920, was $327,806.19, and Dec. 31, 1921, $331,885.71.

Chile Copper Co.

A report of the operations of the Chile Exploration Co. for the fourth quarter of 1921 states that 375,004 tons of ore was treated in the period covered by the report, averaging 1.76 per cent copper; and in the preceding quarter 379,417 tons, averaging 1.67 per cent copper, yielding 12,023,177 lb. and 11,976,241 lb. of copper respectively.

The cost of copper produced during the quarter was 9.111c. per lb., including selling and delivery expense, but excluding depreciation and Federal taxes and with no credit for miscellaneous income, compared with 11.405c. per lb. for the previous quarter.

The financial outcome of the Chile Copper Co. and the Chile Exploration Co. combined (earnings based on copper actually delivered), compares as follows:

	Fourth Quarter 1921	Third Quarter 1921
Pounds copper delivered..........	21,575,340	17,300,005
Net profit on copper delivered.........	$333,536.68	$429,652.07
Miscellaneous income...............	89,987.78	44,594.24
Interest on call loans and bank balances	80,679.24	86,055.87
Total income.....................	$504,203.70	$560,302.18
Depreciation.........................	$801,403.88	$789,402.19
Amortized discount on fifteen year 6 per cent convertible bonds.........	35,000.00	35,000.00
Accrued bond interest of Chile Copper Co............................	787,500.00	787,500.00
Expenses of Chile Copper Co.......	12,161.80	8,280.00
Total charges....................	$1,636,065.68	$1,620,182.19
Balance undivided profits for quarter, both companies..................	$1,131,861.98 (*a*)	$1,059,880.01 (*a*)

(*a*) Loss

The Exploration Company, Ltd.

A report of operations of The Exploration Company, Ltd., for 1921 shows a net realized profit of £9,969 15s. 4d., which, added to the balance of £87,046 12s. 9d. brought forward from the preceding year, makes a total of £97,016 8s. 1d. to the credit of profit-and-loss account. The general depression which prevailed in all markets during the year and the adverse exchange between London and the United States and Mexico did not encourage the directors to undertake new business.

The shares and interests of the company stand in the balance sheet at book cost for £309,335 7s. 9d. At market prices on Dec. 31 and on the directors' valuation for unquoted securities, they would, with the exception of the company's holding in the Buena Tierra Mining Co., which amounts to £112,463 11s. 7d., show an appreciation. Owing to the inability of that mine to earn profits with present high operating costs and low prices of silver and lead, and to disappointment in the development of the mine, operations were suspended on June 30 last. The directors find great difficulty at this juncture in making a reliable valuation of this company's investment therein, and therefore will, for the time being, retain the balance to credit of profit and loss account as provision for any contingency that may arise. They express regret that this decision prevents their recommending a dividend distribution on the shares of this company for the last year.

The El Oro Mining & Railway Co. had a successful year, earning the largest profit in its history, but the sum available for dividends was again seriously reduced by taxation at home and abroad.

The Suchi Timber Co. made satisfactory profits. The Santa Rosa Mine has remained closed down. The Tomboy Mine has had many difficulties, both physical and economic, to contend with during the year.

Isle Royale Copper Co.

A report of operations of Isle Royale Copper Co. for 1921 states that a loss of $383,369.45 was recorded, as the following account shows:

PRODUCTION COSTS

		Cost per Lb.	Total Cost
Mining		11 22	$279,595 17
Smelting and refining		4 65	115,893 33
Boston office, mine, and corporation taxes		1 24	30 697 74
Depreciation and depletion		3 46	86,199.34
Production cost of	2,491,000 lb. at	20 57	$512,385 58
On hand Jan. 1, 1921	8,172,284 lb. at	13 00	1,062,396 92
	10,663,284 lb. at	14 77	$1,574,782 50
Sold in year	6,607,163 lb. at	13 00	858 931 19
	4,056,121 lb. at	17.65	$715,851 31
Less to reduce to market value			147,994 37
On hand Dec. 31, 1921	4,056,121 lb. at	14.00	$567,856 94

EARNINGS STATEMENT

Received for copper sold	6,607,163 lb. at	12 86	$849,593 94
Cost of copper sold			
Production cost at 13c	$858,931 19		
Selling and delivery cost at 0 58c	38,536 71	13 58	897,467.90
Loss on copper sold		0 72	$47 873 96
Loss by reduction to market value			147,994 37
			$195,868 33
Maintenance costs (April 1-Dec 31)			
Mine		$111,987.22	
Boston office and taxes		98,514 82	
Depreciation		15,227.44	225,729 48
			$421,597 81
Interest, silver and other numerous metals		$68,873 01	
Losses by sale of Liberty Loan bonds, Government copper, and other metals		30,644 65	38,228 36
Loss for year			$383,369 45
Capital assets:			
Increased —Plant new construction		$7,442.68	
Obsolescence		2,459 95	
Net increase in capital assets			4,982 73
			$388,352 18
Increase in reserves for depreciation and depletion		$101,426 78	
Less decrease in reserve for depreciation by obsolete construction		1,509 23	99,917 55
Decrease in balance of current assets			$288,434 63
Balance of current assets Dec. 31, 1920			1,624,992 45
Balance of current assets Dec. 31, 1921			$1,336,557 82

Copper production for the year amounted to 2,491,000 lb. produced from Jan. 1 to March 31, 1921, at a cost of 20.57c. per lb., including depletion and depreciation. Copper on hand Jan. 1, 1921, was 8,172,284 lb. and on Dec. 31, 1921, 4,056,121 lb. Sold during year, 6,607,163 lb.

Bingham Mines Co.

A report of operations of the Bingham Mines Co. for 1921 shows a balance to surplus of $52,703.15. No dividends were paid. Operating statement follows:

GROSS INCOME

Ore shipments	$764,112 01	
Royalties	11,443 22	
Rents	1,866 40	$777,421 63

EXPENSES

Smelting, freight, sampling and assaying	$370,457 33	
Mine operations	152,316 84	
Management, office, legal expenses and Federal taxes	25,156 27	
Insurance and miscellaneous taxes	30,283 02	578,213 46
Net earnings and revenues		$199,208 17
Prospecting and development of mines		77,832 01
Net operating gain		$121,376 16

PROFIT-AND-LOSS ACCOUNT

Credits		
Net operating gain	$121,376 16	
Dividends from mining stocks	42,949 10	
Total credits		$164,325 26
Debits		
Construction and equipment depreciation	$5,057 53	
Mine depletion	106,564 58	
Total debits		111,622 11
Balance to earned surplus		$52,703 15
Earned surplus balance, Dec. 31, 1920		520,758 60
Earned surplus balance, Dec. 31, 1921		$573,461.75

Balance sheet as of Dec. 31, 1921 is given as follows:

ASSETS

Real estate and mines		$1,312,546 57
Construction and equipment		43,448 [illegible]
Mining stocks	$971,924 30	
Less—"Return of Capital" dividends	338,100 55	633,823 75
Prepaid insurance and other expenses		414 69
Supplies at mines		7,733 [illegible]
Accounts receivable (subsidiary companies)		63,696 94
Accounts receivable (miscellaneous)		4,840 58
Notes receivable (subsidiary companies)		59,050 28
Cash		48,005 [illegible]
		$2,173,359 98

LIABILITIES

Capital stock (150,000 shares)	$1,500,000 00	
Less—stock in treasury (54,847 shares)	548,470 00	
Outstanding stock (95,153 shares at par $10)		951,530 00
Accounts payable (including Federal taxes)		3,489 62
Reserve for depreciation		32,941 07
Reserve for depletion (March 1, 1913, to Dec. 31, 1921)		611,937 54
Earned surplus		573,461 75
		$2,173,359 98

Production from the various properties of the company is given in the following table:

	Dry Tons	Smelter Returns
Victoria (a)	26,845	$313,140 00
Eagle & Blue Bell	26,554	303,135.43
Dalton & Lark and Commercial (a)	27,666	120,864 40
Yosemite	281	1 763 60
Totals	81,346	738,903 43

(a) Includes lease ore

	Lead, Pounds	Gold, Ounces	Silver Ounces	Copper Pounds
Victoria	5,464,571	789.20	393,050	
Eagle & Blue Bell	1,986	3,653 7	518,533	2,235
Dalton & Lark and Commercial	157,136	1,655 3	69,488	245,417
Yosemite	76,068	11 1	2,014	949

The Goldfield Consolidated Mines Co.

The fifteenth annual report of the Goldfield Consolidated Mines Co. for 1921 states that no dividends were paid.

The receipts to the company on account of royalties and sales amounted to $82,369.52, and disbursements (exclusive of special Income Tax payment) totaled $53,340.77, leaving net receipts of $29,028.75. The treatment of tailing was not resumed.

PROFIT AND LOSS ACCOUNT

Earnings		
Rentals	$728 00	
Royalty	14,749 52	
Interest	10,738.65	
Miscellaneous receipts	17.64	
Refund industrial insurance	508 80	
Total earnings		$26,742 61
Expenses and losses		
Goldfield operating expense	$3,005 38	
General expenses	11,174 31	
Leasing expense	4,382.92	
Maintenance of property	5,169.43	
Taxes—		
State, county and federal	6,462.85	
Exploration	4,304.51	
Commissions on sale of equipment	3,315 04	
Uncollectible accounts	41 33	
Loss on sale of office building and furniture	11,820 00	
Depreciation of buildings and equipment	209,777.79	
Depletion of ores: 2,543 tons extracted at Government allowance of $3.43 per ton	8,722.49	
Total expenses and losses		$268,176 05
Reduction of surplus		$241,433 44
Surplus: Dec 31, 1920	$627,795.95	
Less settlement of income taxes of previous years	64,716.94	
	$563,079.01	
Reduction as above	241,433.44	
Surplus: Dec. 31, 1921		$321,645 57

BALANCE SHEET
Dec. 31, 1921

Assets			
Mine properties		$28,550,400.72	
Buildings and equipment		728,799.01	
Depletion reserve		6,014,525.12	
Cash		246,414.89	
Accounts receivable		207,309.66	
Securities		97,500 00	
Supplies on hand		68,176.17	
Total			$35,913,125 57
Liabilities			
Capital stock			
Authorized	$50,000,000		
Unissued	14,408,520	$35,591,480.00	
Surplus		321,645.57	
Total			$35,913,125.57

MINING STOCKS

Week Ended March 25, 1922

Stock	Exch.	High	Low	Last	Last Div.	
			COPPER			
Ahmeek	Boston	64	62	62	Sept. '20, Q	$0.50
Alaska-Br. Col. new	N. Y. Curb	3¼	2⅞	3¼		
Allouez	Boston	28½	26	27	Mar. '19	1.00
Anaconda	New York	52¾	50	50½	Nov. '20, Q	1.00
Arcadian Consol.	Boston	2¾	2½	2½		
Ariz. Coml.	Boston	9½	9¼	9¼	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*22	*20	*21		
Bingham Mines	Boston	14	13½	13¾	Sept. '19, Q	0.25
Calumet & Arizona	Boston	60½	58	58	Mar. '22, Q	0.50
Calumet & Hecla	Boston	280	275	276	June '20, Q	5.00
Canada Copper	N. Y. Curb	*22	*20	*21		
Centennial	Boston	†12½	†10	12	Dec. '18, SA	1.00
Cerro de Pasco	New York	36	34½	34½	Mar. '21, Q	0.50
Chile Copper	New York	18¼	17	17		
Chino	New York	28⅞	26¼	26¼	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*35	*33	*33		
Con. Arizona	N. Y. Curb	*4	*4	*4	Dec. '18, Q	0.05
Cons. Copper Mines	N. Y. Curb	1¼	1 3/16	1¼		
Copper Range	Boston	45	42½	42½	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	*91	*53	*91		
Davis-Daly	Boston	7¼	7¼	7¼	Mar. '20, Q	0.25
East Butte	Boston	11⅜	10¼	10⅞	Dec. '19, A	0.50
First National	Boston Curb	*70	*65	*70	Feb. '19, SA	0.15
Franklin	Boston	1½	1½	1½		
Gadsden Copper	Boston Curb	*80	*70	*70		
Granby Consol.	New York	29¼	27	27	May '19, Q	1.25
Greene-Cananea	New York	28	27	27¼	Nov. '20, Q	0.50
Hancock	Boston	2¾	2½	2⅝		
Howe Sound	N. Y. Curb	3⅛	2¼	2¼	Jan. '21, Q	0.05
Inspiration Consol.	New York	42	39⅝	40⅛	Oct. '20, Q	1.00
Iron Cap	Boston Curb	7½	7½	7½	Sept. '20, K	0.25
Isle Royale	Boston	23½	23½	23½	Sept. '19, SA	0.50
Kennecott	New York	31	29⅜	29⅞	Dec. '20, Q	0.50
Keweenaw	Boston	†1½	†1¼	1½		
Lake Copper	Boston	3	3	3		
La Salle	Boston	1½	1½	1½		
Magma Copper	N. Y. Curb	29½	28¾	29¼	Jan. '19, Q	0.50
Majestic	Boston Curb	*5	*5	*5		
Mason Valley	Boston	2⅛	1⅞	1⅞		
Mass Consolidated	Boston	3	2	2	Nov. '17, Q	1.00
Miami Copper	New York	28⅝	27⅛	27⅝	Feb. '22 Q	0.50
Michigan	Boston	†2¼	†1¼	2		
Mohawk	Boston	59½	57	57	Feb. '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	8⅞	7½	7½		
Nevada Consol.	New York	15¼	14⅝	14¾	Sept. '20, Q	0.25
New Cornelia	Boston	18	17¾	11⅝	Feb. '22, K	0.25
North Butte	Boston	13½	12	12	Oct. '18, Q	0.25
North Lake	Boston	*25	*10	*10		
Ohio Copper	N. Y. Curb	*10	*9	*9		
Old Dominion	Boston	25	25	25	Dec. '18, Q	1.00
Osceola	Boston	35¼	34	34	June '20, Q	0.50
Phelps Dodge	Open Mar.	†170	†160		Jan. '22, Q	1.00
Quincy	Boston	47¼	44	44½	Mar. '20, Q	1.00
Ray Consolidated	New York	15½	14⅝	14⅞	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*1	*1	*1		
St. Mary's Min. Ld.	Boston	47	45½	47	Dec. '21, K	1.00
Seneca Copper	Boston	13¼	13¼	13¼		
Shannon	Boston	*97	*90	*90	Nov. '17, Q	0.25
Shattuck Arizona	New York	9	8¼	8⅜	Jan. '20, Q	0.25
South Lake	Boston	†1.00	†*65	*80		
Superior & Boston	Boston	1⅛	*91	*91		
Tenn. C. & C. cfs.	New York	11⅞	10¾	11¼	May '18, I	1.00
Tuolumne	Boston	*70	*56	*56	May '13,	0.10
United Verde Ex.	Boston Curb	29	27½	28	Feb. '22, Q	0.25
Utah Consol.	Boston	2¼	1⅞	2⅛	Sept. '18,	0.25
Utah Copper	New York	65	62⅞	63¼	Dec. '21, Q	0.50
Utah Metal & T.	Boston	1½	1 3/16	1⅜	Dec. '17,	0.30
Victoria	Boston	1¾	1¾	1¾		....
Winona	Boston	*35	*35	*35		
Wolverine	Boston	12½	12	12		
			NICKEL-COPPER			
Internat. Nickel	New York	16½	14¾	16⅛	Mar. '19,	0.50
Internat. Nickel, pfd	New York	74	70¼	74	Feb. '22, Q	1.50
			LEAD			
National Lead	New York	90½	88⅛	88⅛	Dec. '21, Q	1.50
National Lead, pfd	New York	†115	†110	112	Mar. '22, Q	1.75
St. Joseph Lead	New York	13¾	13½	13½	Mar. '22, Q	0.25
			QUICKSILVER			
New Idria	Boston	2⅛	1	2⅛		..
			ZINC			
Am. Z. L. & S.	New York	16½	14	14½	May '20,	1.00
Am. Z. L. & S. pfd	New York	39⅞	37	37½	Nov. '20, Q	1.50
Butte C. & Z.	New York	6½	6	6	June '18,	0.50
Butte & Superior	New York	26¾	25½	26	Sept. '20,	1.25
Callahan Zn-Ld.	New York	7	6⅞	6⅝	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	145	144	144	Feb. '22, Q	2.00
Yellow Pine	Los Angeles			*43	Sept. '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills, Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.	
			GOLD			
Alaska Gold	New York	¾	½	¾	....	...
Alaska Juneau	New York	1⅛	⅞	⅞	....	...
Carson Hill	New York	16	14⅞	16		
Cresson Consol. G.	N. Y. Curb	2 15/16	2¾	2¾	Jan. '22, Q, X	$0.10
Dome Extension	Toronto	...		*85	....	....
Dome Mines	New York	28⅝	26½	27⅞	Jan. '22, Q	0.25
Florence Goldfield	N. Y. Curb	*22	*20	*20		
Golden Cycle	Colo. Springs	*75	*75	*75	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*6	*4	*6	Dec. '19,	0.05
Hollinger Consol.	Toronto	10.00	9.20	9.85	Mar. '22,	0.05
Homestake Mining	New York	62⅝	62	62	Mar. '22, M	0.25
Kirkland Lake	Toronto	*49	*42	*45	....	....
Lake Shore	Toronto	2.49	2.00	2.29	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	21.50	18.80	20.15	Jan. '22, K	0.05
Porcupine Crown	Toronto	*31	*29	*30	July '17,	0.03
Porcupine V. N. T.	Toronto	*34	*29	*33	....	
Portland	Colo. Springs	†*40	†*36	*28	Oct. '20, Q	0.01
Schumacher	Toronto	*61	*58	*59	....	...
Silver Pick	N. Y. Curb	*10	*8	*8	....	....
Teck Hughes	Toronto	*50	*44½	*49	....	....
Tom Reed	Los Angeles	*70	*63	*69	Dec. '19,	0.02
United Eastern	N. Y. Curb	2	1⅞	1 15/16	Jan. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*20	*18	*18	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*5	*4	*4	....	....
Yukon Gold	N. Y. Curb	1⅛	1	1	June '18,	0.02½
			SILVER			
Batopilas Mining	New York	1⅝	1	1⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*36½	*33	*34½	May '20, K	0.03
Coniagas	Toronto	1.30	1.00	1.00	May '21, Q	0.12½
Crown Reserve	Toronto	*23	*20	*22	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3⅜	3⅛	3½	Jan. '22, Q	0.12½
La Rose	Toronto	*54	*38	*38	Apr. '18,	0.02
McKinley-Dar.-Sav.	Toronto	*19	*17	*17	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.15	1.05	1.15	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅞	6⅝	6¾	Jan. '22, Q, X	0.30
Ontario Silver	New York	9⅜	6½	9	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	.		*12	Jan. '12,	0.10
Temiskaming	Toronto	*39	*35	*38	Jan. '20, K	0.04
Trethewey	Toronto	*4½	*4	*4½	Jan. '19,	0.05
			GOLD AND SILVER			
Boston & Montana	N. Y. Curb	*48	*33	*36	....	..
Cash Boy	N. Y. Curb	*5	*5	*5	....	....
Dolores Esperanza	N. Y. Curb	1⅜	*95	1⅜	....	....
El Salvador	N. Y. Curb	*5	*3	*5	....	
Jim Butler	N. Y. Curb	..		*5	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	.		*3	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*13	*12	*13	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1⅝	1⅝	1⅝	Jan. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*64	*60	*60	...	.
Tonopah Extension	N. Y. Curb	1½	1⅜	1 7/16	Jan. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1 15/16	1⅞	1⅞	Oct. '21, SA	0.05
West End Consol.	N. Y. Curb	1 1/16	*99	1 1/16	Dec. '19, SA	0.05
			SILVER-LEAD			
Caledonia	N. Y. Curb	*7	*5	*6	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	†1.00	†*95	1.00	Dec. '20,	0.15
Chief Consol.	Boston Curb	4	3⅝	4	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	20	19	20	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†3.00	†1.50	.	July '20, Q	0.10
Daly-West	Boston	2¼	2⅛	2¼	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	2⅝	2⅝	2⅝	Apr. '21, K	0.05
Electric Point	Spokane	*7	*5½	*6½	May '20, SA	0.03
Federal M. & S.	New York	†11¾	†9	11⅞	Jan. '09,	1.50
Federal M. & S. pfd.	New York	40	38	38	Mar. '22, Q	1.00
Florence Silver	Spokane	*24	*23½	*24	Apr. '19,	0.01½
Grand Central	Salt Lake	*52	*52	*52	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	6	5¾	5⅞	Dec. '21, Q	0.17
Iron Blossom Con.	N. Y. Curb	*21	*20	*20	Dec. '21, Q	0.02½
Judge M. & S.	Salt Lake	3	3	3	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*6	*5	*5	June '21, I	0.02
Prince Consol.	Salt Lake	*9½	*8	*9	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*6	*5	*6	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*8	*7	*7	....	.
South Hecla	Salt Lake	†*60	†*35	.	Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*18	*15	*15	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*10	*7	*9	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.25	2.20	2.25	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.05	1.85	2.05	Dec. '21, Q	0.05
Utah Apex	Boston	4	3½	3⅝	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	....	...	*2	Nov. '17,	0.01
			VANADIUM			
Vanadium Corp.	New York	39½	37¼	38	Jan. '21, Q	1.00
			ASBESTOS			
Asbestos Corp.	Montreal	55¼	54½	55¼	Jan. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	78	74	78	Jan. '22, Q	1.75
			SULPHUR			
Freeport, Texas	New York	19⅜	17⅛	17⅛	Nov. '19, Q	1.00
Texas Gulf	New York	45	40¼	42	Mar. '22, QX	1.00
			MINING, SMELTING AND REFINING			
Amer. Sm. & Ref.	New York	53¾	50⅞	51	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	98½	96¾	96⅞	Mar. '22 Q	1.75
Am. Sm. Sec. pf. A.	New York	†91	†88	90	Jan. '22, Q	1.50
U. S. Sm. R. & M.	New York	37½	35½	35½	Jan. '21, Q	0.50
U.S. Sm. R. & M. pf.	New York	45½	45	45	Jan. '22, Q	0.87½

NEW MACHINERY AND INVENTIONS

The Nevill-Soanes Process for Extracting Copper From Oxidized Ores

Pulp Is Heated With Acid, Salt, and Metallic Iron, and Cement Copper Recovered by Elutriation or Flotation—Process Was Developed in Australia.

The Australian Minerals Recovery Co., Box 453, Perth, Western Australia, has been formed to take over the rights to a new process for the hydrometallurgical recovery of copper from oxidized ores invented by P. W. Nevill and H. Soanes. The ore pulp, after fine crushing, is heated to 70 deg. C. in pachucas with metallic iron and a little free acid or a salt. The cement copper thus precipitated is then separated from the gangue by elutriation or flotation. The process is a regenerative one, requiring only the addition of metallic iron with each cycle. It is claimed that the process consumes less than one-hundredth of the acid required by older hydrometallurgical methods; that there is relative economy in iron, ranging up to almost 100 per cent in some instances; that wear and tear on plant is light owing to the non-corrosive nature of the dilute solutions used; and that the reaction is much faster than with older methods, thus resulting in an increase in plant capacity.

In a laboratory test on a small scale, a 20-g. sample, heated by steam in a large test tube with a little 0.5 per cent sulphuric acid or a ferrous sulphate solution, in the presence of metallic iron, yielded its copper in three or four minutes, with rapid effervescence of carbon dioxide. On filtering, the ferrous sulphate in the filtrate was found to bring about equally quick decomposition of a fresh batch of ore in the presence of added iron. Gold or silver, if present, is carried down with the copper. No metallic salt appears to interfere with the reaction, thus reducing the necessity of discarding foul solutions to a minimum. The largest tests so far made have been on 200-lb. samples.

In commercial work several questions would arise: What would it cost to heat large quantities of pulp to 70 deg. C.? What would be the cost of the iron required? What are the mechanical difficulties of separating the cement copper from the gangue? What will be the losses in copper?

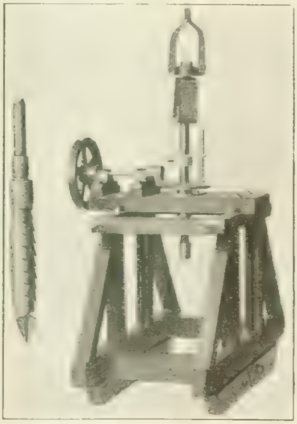
In working the process with ferrous sulphate and iron, it is found that when the iron solution becomes too strong there is an excessive precipitation of ferrous oxide, which impedes the recovery of the copper precipitate. This, however, may be easily averted by the addition of a little free acid or soluble chloride, such as sodium chloride.

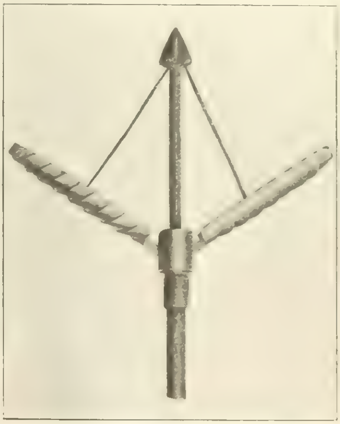
Anyone wishing to make a rough test on an oxidized ore can take a 10 x 2-in. boiling flask, and into this place 50 g. of minus-150-mesh ore, and finely ground metallic iron—the finer the better. About one unit of the iron should be added to each unit of copper contained in the ore being treated. Add 2 per cent of sodium chloride, 5 per cent of ferrous sulphate ($FeSO_4.7H_2O$), and 50 c.c. of water. Blow steam into and through the pulp for fifteen minutes, and then pan off.

The process has been patented in the United States and about thirty other countries. So far, it is understood, only Australian rights have been alotted.

A Machine for Cleaning Oil Wells

Wells that are apparently non-productive or exhausted can be cleaned out and made productive by a new machine recently developed by a Kansas City man. A double bit with bias cutters is screwed to the tubing which is used for pumping the oil and then lowered to the bottom of the sand. On top of the tubing is screwed a ball-bearing swivel after it has been passed through a rotary device. Attaching the cable to the swivel, the rotary is operated at a speed of about ninety revolutions to the minute by the belt from the drilling rig. This action causes the bit to flare out by centrifugal force, and the well walls receive the force of the cutting arms. The sand being cut away under this continued action causes any packed or obstructed condition to give way, and if oil is present a free flow is secured. The device is a product of the Oil Restoring Reamer Co., Chambers Building, Kansas City, Mo.


THE ROTARY DEVICE AND THE DOUBLE BIT USED IN CLEANING OIL WELLS


SHOWING THE DOUBLE BIT WITH ITS PARTS FLARED OUT AS WHEN IN OPERATION IN THE WELL

New Types of Small Electric Shovels

Since the successful operation of electric shovels up to twelve-ton capacity has established the practicability of electric drive for this class of machines, the Marion Steam Shovel Co. has developed three new types of small revolving electric shovels, with capacities of ¾, 1, and 1½ cu.yd. These machines have been designed to meet the demand for a small electric shovel that could be used for work in quarries, open-pit mines, and on street or road construction, lumber reclamation work, and other places where the steam shovel is either impracticable or undesirable. The electric generators, motors, and control equipment are of the General Electric Co. type. Ordinarily, the shovels are equipped with the Marion "crawling traction," but they may be supplied with wide traction or standard railway wheels if desired.

The new shovels carry their own generating plant, of which there are two varieties, gasolene engine-driven electric or straight electric. The two smaller types may be equipped with either class of power plant, but the 1½-cu.yd. type always has the straight electric. The gasolene-electric plant for the smallest shovel consists of a 53-hp., four-cylinder, four-cycle, heavy-duty Matthews gas engine, directly connected to a 250-v., compound-wound d.c. generator.

The electric power plants also vary in horsepower for the different capacities of shovels, although the general layout is the same in all types. They consist of an induction motor of 40, 50, or 75 hp., driving a 250-v. shunt-wound generator. The primary current is usually 440 v., 60 cycle, and is brought to the shovel by means of a specially wound and insulated cable. A slip-ring arrangement is used to transmit the current to the main part of the shovel.

The motor-generator set for straight electric power is interchangeable with the gas-engine generator set on the two smaller types.

The salient feature in the design of these shovels is the use of separate motors for each motion, which constitutes a great improvement over former types. Hitherto, the small electric or gasolene shovel has been of the friction type, using a single motor or engine, and transmitting the power to the various points of application by means of a series of friction clutches. This caused considerable loss of power through friction in gearing, clutches, and brakes, and wastage due to turning the machinery over while running idle. In addition, the complication of gears caused endless maintenance charges and annoyance.

The motors used on the various motions, swing, hoist, and crowd are all series wound, mill type, 230 v. d.c., varying in horsepower according to the size of the shovel. The hoist and swing motors are mounted on rigid bases in the body of the shovel, and the crowd motor is mounted on the boom. They are all placed so as not to interfere with the use of standard drums, bearings, and shafts, so much so, in fact, that the motors and generating set can be dispensed with, and the machine converted into a standard steam outfit, if necessary. Being series motors, they have high speed at light loads and slow speed with high torque at heavy ones, characteristics that are also found in steam shovels, and which have much to do with their success.

A motor-driven air compressor which furnishes air for the hoisting clutch and crowding brake is placed at the front of the upper frame on the side opposite the control levers.

INDUSTRIAL NOTES

Byron C. Riblet, of the Riblet Tramway Co., has returned to Spokane, after a trip of inspection to the recently completed 11¾-mile aërial tramway lately installed at the Premier mine, Portland Canal district, British Columbia.

Announcement has been made by the Air Reduction Co., Inc., that it has purchased all of the assets, trademarks, including patents and trade names, of the Davis-Bournonville Co. The latter company has been the pioneer in the development of oxyacetylene apparatus.

W. C. Allen, former manager of the Black & Decker, Philadelphia branch, and subsequently special representative, has been made branch manager of the Black & Decker Chicago territory, which takes in the states of Wisconsin, Illinois, Missouri, Iowa, Minnesota and North Dakota.

Noel Cunningham, formerly connected with the Coal Washing Equipment Co., has now become associated with the Hardinge Co., Inc., 120 Broadway, New York. This change is due to the acquirement by the Hardinge Co. of all manufacturing and sales rights of the James Coal Washing Equipment, formerly handled by the Coal Washing Equipment Co.

Technical representatives of E. I. DuPont de Nemours & Co. whose work takes them into every important mining section of the United States held their annual convention at Wilmington, Del., March 2, 3 and 4. Exhaustive discussions were carried on regarding the problems that confront the miner in the best use of explosives. An especially interesting paper was read by F. W. Hukill, on "Mining in Mexico." A talk on the best use of explosives in salt mines was given by C. S. Hurter, of Wilmington. Arthur LaMotte, manager of the Technical Bureau, presided at the meeting and directed the discussions. At the end of the session, a visit was made to the Du Pont dynamite plant at Gibbstown, N. J.

The Pittsburgh Testing Laboratory, Pittsburgh, Pa., recently announced the retirement of its president, George H. Clapp, his reappointment as a member of the board of directors of the company, and the election of Colonel James Hilliken to the presidency of the company. This corporation conducts a large business of civil, mechanical, electrical engineering, metallurgical, mining and chemical investigations, and also makes a specialty of inspection, testing and analysis in other kindred fields, special attention being devoted to the inspection of railroad locomotives, cars, steel rails, track appliances, bridges, and buildings.

Hollinger Buys Oliver Filters

According to information published in the press, the Hollinger Consolidated Gold Mines has purchased six more 14 x 16 ft. oscillating type Oliver filters, together with complete vacuum and solution-pump equipment and all accessories.

One Oliver filter of the same size and type was installed at the end of the Dorr counter-current section of the mill some months ago. This filter has been operating continuously with highly satisfactory results, having decreased the soluble loss in both gold and cyanide practically to zero. The one machine, together with the additional filters just ordered, all seven of which will be placed at the lower end of the present cyanide plant and take the underflow from the Dorr tanks (what has normally been the final tailing), will have a capacity of at least 4,000 tons of dry slime per day. The total filtering area will be about 5,000 sq.ft.

The exact price of the entire filtering equipment is not stated, but is understood to amount to about $70,000. This sum may at first appear to be a large capital expenditure. However, when it is realized that it takes an additional recovery of even less than 5c. per ton for one year on 4,000 tons per day to save $70,000 in a single year it resolves itself into a profitable investment.

The residue from the filters will contain about 20 per cent moisture, and it is planned to discharge this comparatively dry cake to conveyor belts which will deliver to the final tailing disposal system.

TRADE CATALOGS

Cement Gun Construction—The Cement Gun Construction Co., of Chicago, Ill., has issued Gunite Book No. 7, which contains illustrations showing various types of construction done by this company in a number of industrial plants.

Wood Preservation — "Storing and Seasoning Cross Ties" is the title of Bulletin No. 20, issued by the Century Wood Preserving Co., of Pittsburgh, Pa. The bulletin outlines the methods of seasoning, causes of deterioration, and the handling and storage of ties, together with a description of the service rendered by the company.

Cableways—The Deschanel Engineering Corporation, 90 West St., New York City, has issued the Deschanel Cableway Bulletin, which describes this company's single-line cableway. It is claimed that by means of this cableway material, such as coal, can be unloaded direct from railroad cars into storage and reclaimed again for further transportation.

Laboratory Rheostats — The Allen-Bradley Co., Milwaukee, Wis., has issued Bulletin E-2910, which describes the Allen-Bradley rheostat, designed to meet a need in the laboratory where fine current control is necessary for electric muffle and combustion furnaces and where a portable, flexible instrument finds daily application in general laboratory work.

Material Handling Equipment—The Wellman-Seaver Morgan Co., of Cleveland, Ohio, has issued Bulletin No. 71, "Material Handling Equipment as Applied to the Copper Industry." This pamphlet is well illustrated with photographs and wash drawings, which show many installations that have been made by this company at the larger copper properties, including car-dumper installations at the Utah Copper Co., Arthur, Utah, and the Chile Copper Co. at Chuquicamata, Chile; the excavating bridge of the Chile Copper Co., and the excavator at the leaching plant of the New Cornelia Copper Co., Ajo, Ariz. Suitable explanatory text accompanies each illustration.

Hydraulic Giants—The Joshua Hendy Iron Works, of San Francisco, Cal., has recently issued, for limited circulation, Bulletin 128, which features the applications of the Hendy hydraulic giants. Outside of its mining field the hydraulic giant has been extensively used for excavation and the transportation of the excavated material in flumes. A number of important dams have been constructed in this way. An interesting application of the hydraulic giant for prospecting was made by the Nipissing Mining Co., Ltd., at Cobalt. Here the giant was used to wash off the superficial soil and debris covering the formations containing the silver veins. The bulletin is splendidly illustrated.

T. A. RICKARD
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E. H. ROBIE, Metallurgical Editor

ENGINEERING & MINING
JOURNAL-PRESS

J. E. SPURR, Editor

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W. N. P. REED
[illegible]
[illegible]
Assistant Editors
BENJAMIN L. MILLER
[illegible]
[illegible]

Volume 113 New York, April 8, 1922 Number 14

Trade Associations and Labor Associations

THE STRIKE SCHEDULED by the coal miners was discussed illuminatingly at a recent meeting of the Mining and Metallurgical Society of America by a coal operator who conducts a union operation and by another whose mine is on a non-union basis. The coal problem affects all industries and all individuals, and therefore interests us all. Both men plainly had the confidence and co-operation of their men. One works with a "pit" committee of union employees, but under such conditions that the balance of power and the ultimate right of decision rests not with the local or regional unions, but with the international union, which is dominated by the "central competitive field," including western Pennsylvania, Ohio, Indiana, and Illinois. The loss of time and money borne by the workers as well as the company due to strikes and other unnecessary interruptions was great in the union district, but the non-union operator reported no such wastage whatever.

The remarks we have made in preceding editorials with respect to trade associations apply pretty well also to labor unions. Each represents the same principle—the principle of organization, which is a right and is essentially a benefit to the organized parties and to the commonwealth. But just as there are good and bad individuals and good and bad trade associations, so there are good and bad labor unions. More accurately speaking, since there is "so much good in the worst of us and so much bad in the best of us," the individual may so conduct himself as to win public applause or be haled into court for punishment, for sinning against the common welfare; and the lesson is that he must not so sin. And the same applies to the trade association and labor unions.

As labor unions represent a greater mass of individuals, and as each individual has a vote, there has, perhaps, been a greater tendency among legislators to overlook labor union activities in restraint of trade, than those of trade associations. Price fixing by trade associations is held unlawful; yet unquestionably a certain amount of price manipulation is accomplished by their methods without their incurring censure, as in the conduct of the business of the California Fruit Growers' Association, and others that could be mentioned offhand; and even President Harding advised the farmers to market co-operatively. Price fixing by unions has been regarded more leniently, as in the coal situation, where the discrimination as to privilege allowed the miner as against the operator is more uneven than usual.

We do not intend to involve ourselves in the catch question as to whether or not labor is a commodity. It is not; but its cost is immediately translated into that of a commodity, in which it stands in the same category as taxes and management and the interest on capital, none of which are commodities; yet they are all translated into fractions of the price of a ton of coal, and that is the commodity which we must buy at the sum total so determined.

The remedy is the proper administration of the union, with an eye to the *public* welfare; and it is doubtless for the purpose of encouraging labor associations as well as warning them, when their activities become so opposed to the public welfare that they become injurious instead of an element of strength, that the Department of Labor was organized. Thus the Department of Labor stands in the same relation to the labor association as the Department of Commerce does to the trade association.

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Boston & Montana Again Questioned

IF OUR READERS will turn back to the issue of Jan. 28 they will find that we there editorially questioned the Boston & Montana project, then being extensively exploited by stock-selling. The outlook seems far from bright. We have just been reading a report on the property by C. S. Herzig. Mr. Herzig reports that estimates of the ore reserves which have been published are gross exaggerations and his "inspection of the mine demonstrated that the enterprise is threatened with disaster, due to the fact that not enough ore of commercial grade has been developed in the mine to maintain an output at all commensurate with the size of the mill. . . . The mine is not now on a self-supporting basis, and in my opinion there is no reasonable chance of it being so in the near future." It would seem that Mr. Herzig's examination was somewhat superficial, but it nevertheless confirms our opinion that the enterprise is open to question.

In the last six months no mining company has been so highly touted by all of the lighter class of brokers as Boston & Montana. A short time ago the stock of the Island Oil & Transport Corporation was given almost equal prominence. That company has just gone into the hands of a receiver, and although it seems to have earned about seven million dollars in one year, when the oil business was at its peak, it has never paid a dividend. We trust a better fate awaits B. & M.

We hope that those of our readers who are on the mailing lists of those brokers who publish market bulletins will be warned. It has been our experience that data which they publish are always inaccurate and often wilfully misleading. The mere fact that they always advise one to buy and never to sell is in itself significant to the thinking man. Most of these letters are written by poorly paid clerks who know absolutely nothing of the properties about which they rave.

It is unfortunate that the wolves of downtown New York usually select mining and oil companies for their attention. When they establish connections with incompetent mine operators the result is particularly dangerous, and tends to throw a light of suspicion on all mining enterprises, which, despite what Mark Twain said, are, as a general rule, straightforward enterprises, the same as most other lines of human endeavor.

A Felicitous Award

ON MARCH 7 the council of the Institution of Mining and Metallurgy voted unanimously to bestow its gold medal on Mr. Edward T. McCarthy "in recognition of his services to the mining industry and the mining engineering profession, and as an expression of the high regard in which he is held by his fellow engineers." To those who know Mr. McCarthy—and they are in every quarter of the globe—this award will seem as felicitous as the terms in which it is expressed. Of his services to the mining industry, we venture to mention his sterling good sense, which has recognized the need for applying sound business principles even to such a speculative venture as a mining enterprise. Of his services to the profession, we shall lay stress on the sincerity and integrity of his work, the expression of high character and a humane spirit. In mining operations there are many opportunities for a proper consideration of employees and for intellectual honesty toward employers. Mr. McCarthy has been an exemplar of both. The Institution has done honor not only to the recipient of its medal but to itself and to the profession in selecting for the award one who stands for the highest ideals of mining engineering as an art and a vocation.

One Is Born Every Minute

IN THE LATTER PART OF 1920 (page 948 of the Nov. 13, 1920, issue of *Engineering and Mining Journal*), we published an account of the muddled affairs of the Broken Hills Silver Corporation. The strategic organization of that foray upon the public was, you will remember, the incorporation of a mining property with a capitalization of 3,000,000 shares, par value 10c. each, and 2,000,000 shares of treasury stock, the stock being fully paid and non-assessable. The treasury stock was underwritten by a company known as the Fidelity, Finance & Funding Co., of Nevada, for a lump sum to be paid in installments, the aggregate purchase price being $380,000.

After manipulations through the San Francisco Stock Exchange, from aggregate sales amounting to several hundred thousand dollars by the speculating or gambling public, the mining company received a total of approximately $156,000 from this "Financing Company." The payments were to be used for the operation and equipment of the mine. The underwriting company placed its shares, together with large amounts of promotion stock, upon the market, and initiated a campaign to sell them at as high an advance over the price paid for the stock as possible. Frequent reports of "selling short" or failure to deliver shares when purchased attended these manipulations. The results of this campaign were more or less disastrous, and the control of the mine was taken over by a few sad and disheartened stockholders.

In this misadventure, you will also remember that George Graham Rice was the instigator and presumably the chief beneficiary. We next heard from George Graham Rice in connection with a Utah property, the Bingham-Galena, with similarly spectacular and disastrous underwriting and promotion of stock sales.

Recently, it was authoritatively reported to us that George Graham Rice's unquenchable belief in the truth of the caption which heads this editorial has led him to plan the flotation of another promotion known as the Idaho Gold Corporation, incorporated under the Nevada laws by Idaho and Utah men. The capitalization is 5,000,000 shares, of a par value of 10c. per share, 2,000,000 shares to be promotion stock. The Utah-Idaho Finance Company, a Nevada corporation having a capitalization of $50,000, par value, offers to buy the 3,000,000 remaining shares of the Idaho Gold Corporation on the basis of a sliding scale of prices and deferred payments; the details are not germane at this time. Of this money, 70 per cent is to be used in mine development. It appears that the management of the property is to be controlled by the Utah-Idaho Finance Company. The physical property of the company was called the Neptune Consolidated, formerly known as the Vishnu Mine property, and is in Elmore County, Idaho. It consists of lode claims, placers, and certain water rights. We know nothing about the property, nor can we find mention of it in recent volumes of "Mineral Resources," the "Mines Hand Book," or other general sources of information.

Let us look critically at the financial arrangements, for here we may get an insight into an obscure game of finance. Of the 5,000,000 shares, 2,000,000 remain in the hands of certain persons in lieu of cash payment for mining claims, property, or for miscellaneous services. In transactions of this kind, the promotion stock is usually held in a pool. This is of course to give sufficient time for the stock to mature in price, or in other words, to prevent "gumming up the game." The remaining 3,000,000 shares are to be purchased by the "intermediate" or underwriting company for a total sum of $600,000.

The ultimate owners of these 3,000,000 shares will own 60 per cent of the property. For every dollar they contribute, 42c. will, if the promise is kept, go into the mine, 28c. will indirectly enrich the promotion stockholders, and 30c. will be dissipated in a manner not disclosed.

Suppose it sells for an average of 40c. per share. This would return to it double the amount for which it bought the shares and would signify that the stock purchaser would have his money distributed as follows: 50c. to the "finance corporation," 21c. to the mine, 14c. to indirect enrichment of promotion stockholders and 15c. to an unknown direction or control. In other words, for every dollar the mine gets, the stockholder puts up $4.76. For a sale price of $1 per share, the figures are 80c. to the "finance corporation," 8.4c. to the mine, 8c. to promotion stockholders and 3.6c. to an undeclared and unknown purpose. For every dollar going into the mine, $11.90 leaves the stockholder's pocket (excluding the promotion stock).

We think that you will agree with us that this is indeed a type of finance that warrants the presence of a handy policeman. The dismayed and deluded stockholders of the Broken Hills Silver Corporation are pathetically holding their almost empty sack and peering around in the dim light of the flickering candle that George Graham Rice gave them to hold. Can this new foray, if it is allowed to go forth, result in any other than a similar outcome?

Remarks by the Editor

JUST A FEW WORDS about our contents this week and what we are trying to do. Please take special note of the article on the marketing of pyrites by our Western Editor, George J. Young, because this is the result of a plan we have had for two or three years and have just succeeded in bringing to fruition. We feel that the marketing end of the mining business is least understood, and that it is perhaps the phase of the business that will pay best to study and comprehend, so that we may devise better methods for marketing, or profit by knowledge of existing conditions. The first step in this program is to find out the existing facts. Mr. Young's article does this for pyrite. It is the first of the series.

Every other week we shall publish another of the series till we have gone the round of the metals and the directly marketed minerals. Then we shall publish them all together in a book. We visualized and planned the book before we arranged for any of the articles. These articles are being written on a common plan, but by different authors. We have now on hand for publication an article on "Marketing Silver Bullion," by Parker D. Handy, senior member of the firm of Handy & Harman, which establishes the official New York price for silver (just as *Engineering and Mining Journal-Press* does for copper, lead, and zinc); another article on the marketing of arsenic, by F. Y. Robertson, vice-president of the United States Smelting, Refining & Mining Co.; one on the marketing of tungsten, by Charles Hardy, of Hardy & Ruperti, the principal American dealers in tungsten, and articles on the marketing of talc and of soapstone, by Raymond B. Ladoo, of the U. S. Bureau of Mines, specialist on the non-metallic ores and a student of their marketing conditions. Other articles are in preparation.

As to the present issue, we want to point out briefly the diversity and the value of the contributed articles. An interesting article is that on the proposed mining of limestone through a four-compartment inclined shaft, written by J. H. Stovel, who has previously contributed papers on shaft-sinking to *Engineering and Mining Journal*. One thinks of the mining of limestone as purely a quarrying operation: so it will be interesting to read this article, especially as it discusses the method of sinking, the costs, records of progress, and an outline of the proposed mining system.

For the metallurgist, the article on "Lead Losses in Smelting Low-Grade Material" will be interesting, as a foreign viewpoint on smelting conditions, for certain differences are manifest between American and foreign practices.

Lately attention has been repeatedly directed to new mineral discoveries in various parts of Canada, so that the discussion on "Canada as a Gold Producer," by Alexander Gray, former editor of the *Canadian Mining Journal*, is timely, and it also is able. The author properly points out that Canada is a promising field for gold mining.

Mining geology in the South American field is represented by the articles on the Huantajaya silver district, discovered before the Spanish conquest of Peru.

We still have something to say about the elimination of waste in the mining industry, and we are going to say it, not with flowers, but with dollars. It is this: Our circulation department, after a long period of slumber of the disturbing kind, has waked up with an idea that is really brilliant. Our new circulation manager, George E. Andrews, springs this one: why not give a one year's subscription for $4, as per schedule, and two years for $6? "Bully!" say we, being always for economy and for the elimination, etc. You will at once inquire, how we can afford to lose so much money—an off-hand calculation might indicate that we would stand to lose $28,000 or $30,000 next year. And here's the secret: we make money out of the deal. And so do you. The red tape, stencil making, transferring, card indexing, literature-sending and all the rest of the complicated costs that come out of your second $4 is saved, and we are money in pocket—not so much as you naturally—you get 50 per cent—but we save enough so that we win also. This is the new journalism. Let the good work go on! Formerly a man who took *Engineering and Mining Journal* and *Mining and Scientific Press* for two years paid $18. Now he pays $6. Next year in this item alone we figure that we shall save the mining industry, if the men comprising it wish (and who wouldn't?)—around $50,000, by this reduced cost of subscription alone. If the mining industries could make similar increases in efficiency and reduction of costs all along the line they would soon be booming. Let's go!

The *Northwest Mining Truth*, published in Spokane, bewails the consolidation of *Engineering and Mining Journal* and *Mining and Scientific Press*, and opines that *Engineering and Mining Journal* has "never leaned towards the independent." Most extraordinary, we should say. We wonder if the editor of *Mining Truth* is himself independent; for if he is, he should recognize it in others. True independence is a quiet and assured characteristic; it goes with fairness, truth, and good will.

J. R. Finlay, writing personally to the editor, makes some remarks that will bear printing. Mr. Finlay has the faculty of making you think—twice. Unless you think twice you don't get him. He observes:

> "I have noted with considerable interest the consolidation of the *Engineering and Mining Journal* with the *Mining and Scientific Press*. I hope and believe it will be a good thing. The combined paper ought to cover the country quite thoroughly.
>
> "I have a distinct idea that the functions of technical publications are broader than most people believe them to be; for instance, I suppose you have gained the impression that nothing should be said in your paper that does not apply directly to mining. Of course that should be generally the case, because your paper or papers are avowedly technical journals for the mining industries; but have you thought of this view, that just such publications may and probably do have a greater effect on public opinion than the so-called popular papers and magazines? Take for instance a magazine like the *Atlantic Monthly*, which deals with public questions in a general way and with matters with general intellectual interest: I doubt very much whether it affects public opinion as it is perhaps popularly supposed to affect it, because the kind of people who read the *Atlantic Monthly* are not very active in the ordinary pursuits by which people get a living, but ten or twelve million people in this country get a living through mining, or from the industries that are based upon mining, and if they can see that they can get that living better in one way than in another way, they are going to stick to the way that is most promising. When you deal with ten or twelve million people you deal with politics. Therefore I believe that inasmuch as economics is a more fundamental subject than politics, trade journals such as yours have a deep influence on politics through public opinion. It does not seem to me that I am expressing myself very well, but my general idea is that your paper should go into the whys and wherefores of the processes by which general prosperity is furthered or retarded."

A Golden Myth

By T. A. Rickard

AT A RECENT MEETING of the Mining Committee of the Spokane Chamber of Commerce "a voluminous brief" was submitted by Colonel Chester T. Kennan on the subject of an alleged conspiracy for the control of the gold supply of the United States. That Mr. Kennan's statement was voluminous I can well believe; like a cuttlefish, he covers his tracks with an inky darkening of the waters of thought—in short, he is a man that writes freely on subjects concerning which he is inadequately informed; he ought to be a reporter on a Hearst newspaper.

This is not the first time that the "Colonel" has uncovered a mare's nest. Two years ago he unearthed a "swindle" that had been perpetrated by a "McAdoo syndicate," and at the same time he asserted in public that the smelters were paying only $20 per ounce for gold that they sold—in Europe presumably—at $35 per ounce, and that they were "pocketing the difference." In regard to his latest "conspiracy," he has misled many people in the Northwest by means of a myth born of his own disordered imagination. Mr. Kennan's "conspirators" are the directors of the Federal Reserve Bank. He charges the directors with having dishonored the notes of the bank by refusing to redeem them in gold; nay, even the Government of the United States is in a conspiracy to withhold gold coin from the people, according to the "Colonel." His statements would be important if true. They are not. He can obtain from his banker a draft on a Federal Reserve bank and exchange the draft for the equivalent in gold coin, or, simpler still, he can get what gold he wants at his bank on his personal check up to the limit of his credit. His bank is under no obligation to do this, but it will. Anybody can get $1,000,000 in $20 gold-pieces tomorrow without any hocus-pocus. The Mint of the United States will sell gold bullion to Mr. Kennan on the terms fixed by law—namely, not less than $5,000 worth at $20.67 per ounce. Moreover, he can sell his gold to the Government at the same price, but not less than $50 worth at a time. The United States maintains a free market for gold. At the present moment any outward movement of gold would be facilitated by those in authority, for there is in this country today $4,000,000,000 in gold, which is more than is needed.

Mr. Kennan asserts that gold is now worth $40 per ounce on the foreign market, and inferentially that our miners are not receiving the right price for it, seeing that they can sell it for only $20.67. He asserts that most of the world's current supply of gold comes from mines in the British dominions and that this British-mined gold is sold in London for 125 shillings per ounce; so he deduces the existence of a "premium" of about 47 per cent, because normally gold sells in London for 84.95 shillings per ounce. He overlooks or disregards the fact that the payment is made in paper currency that is at a discount equivalent to the so-called premium—that is, the gold sovereign was worth 47 per cent more than the paper pound sterling on the day when gold was selling for 125 shillings. Great Britain has suspended specie payment, while the United States maintains its currency on a gold basis, so that the price of gold in this country is maintained at the normal rate. Since the date when the "Colonel" relieved himself of his "brief" the rate of exchange has improved, the British paper pound has gone up to $4.44, and the price of gold in London has gone down concurrently to 94 shillings per ounce. If a mine-owner ships gold from California to London he will receive the quoted price, which will be as much more proportionately than the normal in paper shillings as the shillings are below normal in exchange with the American dollar; in other words, the dollar remains on a parity with gold, so that the price of gold from Johannesburg in terms of dollars or sovereigns has not changed from the normal ratio, as it was before the war.

It is not surprising that many people are mentally adrift on this subject, because not only such irresponsible scribes as Mr. Kennan but the so-called statisticians of the American Mining Congress have issued much half-baked propaganda on the gold problem. In the effort to win the support of the mining community, the Mining Congress, in its monthly "Journal" and in loose-lipped talk at its conventions, has spread the fallacy that there is something sinister in the selling of South African gold in London at a "premium." The McFadden Bill gained support partly by reason of a popular misunderstanding on the subject. Of that attempted legislation I shall say only that it might have been justifiable during the war, but the conditions that excused such a piece of special pleading have passed, and the gold-mining industry of this country, I am glad to add, is now in a position in which it needs no fictitious aid. It is regrettable that the officials of the Mining Congress should have played a part in misleading the public on matters concerning which they could have informed themselves correctly. For example, the notion that we needed an enlarged supply of gold from domestic mines in order to fortify the gold reserve in the U. S. Treasury was mistaken, for during the last five years the inflow of gold from abroad has been much more than sufficient for that purpose. Moreover, the idea that the gold produced from our own mines necessarily would be available for such a purpose was childish, for the simple reason that gold does not remain in the country of its origin; on the contrary, it is at the mercy of the tides of commerce and moves outward or inward in accordance with the balance of international trade. The gold of South Africa will come to New York so long as the United States is a creditor nation and the metal is needed to settle obligations between the peoples of Great Britain and the United States. Moreover, the amount of gold produced annually in this country is a mere drop in the bucket of international commerce. Recently, our mines have been producing about fifty million dollars' worth of gold per annum; what is that compared with a foreign trade of twelve to fifteen billion dollars per annum? As much as ninety million dollars of gold has been imported in one month—namely, October of 1920. These are simple facts that have been ignored by the Mining Congress in its efforts to push the passage of a gold-bounty bill through the national legislature at Washington. The miner is to be congratulated that he can sell his gold at the old stand at the old rate, while the general level of commodity prices has gone down nearly 50 per cent in two years.

DISCUSSION

Moroccan Phosphate Deposits

Operations Subject to Local Governmental Decrees —Not Competitive With American Product Unless Improved Methods Are Adopted

In the *Engineering and Mining Journal* of Feb. 11, 1922, Warren M. Foote has an article on the "Non-Metallic Minerals," and on page 246 of that article I note the following statement: "Exports have been seriously affected, and those well informed appear to feel that American export trade of phosphate will be lost in a few years to the Moroccan deposits. Hundreds of millions of tons of rock which is said to be geologically the same as the Tunisian rock have been uncovered by the French government in Morocco. The French are hopeful of eventually controlling the entire European market, following their shipment about the end of 1921 of a first lot of 500 tons."

In the spring of 1920 I was associated with some French mining engineers, and made an examination of the above-named deposits, and I estimated that they contained 1,000,000,000 tons. These deposits were discovered in 1912, about ninety-three miles to the southeast of Casablanca, near El-Boroudj. It soon became evident that they were of considerable extent and promised formidable tonnage, because successively the discoveries at Oued-Zem, Marrakech, and Chichaoua were announced. The last-named deposit was said to be not so rich but of considerable tonnage and extent. Finally, other layers were discovered, of which up to now little has been known. Research work has been continued by the Moroccan administration and by individuals.

The deposit of El-Boroudj, the first discovered, stretches from the east to the west over a zone of sixty-two miles, from Oued-Zem to Dar-Chafai. Its northern limit approaches Guisser, and to the south the boundary line of the bed is the El-Boroudj cliff, which looks down on the plain. At this point the erosion has caused the phosphate formation to disappear, but one sees it reappear further on in the region of El-Kelaa. In the valleys cut out in the table-land by the streams of water descending toward Oum-Er-Rebia—valleys which follow the road from El-Boroudj to Guisser—beds are to be seen midway on the slope.

From research undertaken by the mine service of the protectorate it is estimated that the deposit recognized in that zone will reach a thousand million tons of phosphate.

Reports and publications on these riches of Morocco foresaw their rapid working in the perimeter of El-Boroudj, Ouallatou, and Biar Meskoura, and more notably in the southern and western parts of that perimeter, where the cliffs permit the opening of the trenches uncovering the bed of phosphate. On other points shafts of moderate depth, or trenches on the sides of the cliffs, would allow easy and remunerative working. Elsewhere exploitation would have to be by tunneling.

The localities are of technical and commercial interest because of the apparent stratigraphic regularity of the formation and the facilities for prospecting. It is said that this region contains more than 100,000,000 tons of phosphate grading 65 per cent for the upper bed. Twenty-three analyses, representing a number of samples, show from 49 to 73 per cent bone phosphate of lime, with an average for all samples of 62.74 per cent. The layers of phosphate of the deposits are not continuous through the district above described, and their value naturally varies with the grade of the beds.

At many places the phosphate is too poor in grade to be commercially recovered, and this is often the condition, as in Algiers and Tunis, of the thickest and most important beds.

The formation at El-Boroudj is about ninety-eight feet thick, with four beds of phosphate, and at Oued-Zem sixty-five feet, with three layers of phosphate. In both deposits the phosphate is grayish and easily friable. The phosphate beds are separated by calcareous beds, clays, and a low percentage of phosphatic marls. In some places six beds are shown, two of them only fifteen to twenty inches thick, and not workable; two forty to sixty-four inches, and two sixteen and twenty-six feet thick.

POLITICAL STATUS UNCERTAIN

Concerning the working of these deposits there have successively been proposed adjudication, cession to an Anglo-Italian group, and sale of the deposits or part of them to the United States to pay off the French war debt to this country. Some were strongly against the adjudication, which, at the current rate of exchange, would appear to be greatly to the disadvantage of France. Certain groups in Algiers and Tunis have been publicly censured for causing delay in the working of the deposits, others maintaining, however, that the phosphates, constituting a rich asset of the Moroccan state, should be developed by the state for its own profit.

Actually, the future working of the deposits is regulated by the Dahir of January last (6 Djoumada 1, 1338), which reserves solely to the Makhzen their research and working, but with the understanding that consideration be given to the rights of prospectors which were acquired before the said Dahir was in force. The Dahir of Jan. 19, 1914, afforded to foreign groups a possibility of making mineral researches.

It is understood that the French government opposes state development, and consequently there is no definite understanding as to the manner in which the work is to be undertaken. The French administration mined a limited amount last year. At that time it was clear that the development of the deposits had been the subect of discussion and that the grade of the phosphate had been grossly exaggerated, with the sole purpose of securing a big loan to the Cherifian state from the French government. It was rumored that the French government has granted to the Cherifian state the right to spend 700,000,000 fr., and I understood at the same time that 32,000,000 fr. was to be used in the construction of a railroad from the mines to the seaboard, and for improvements at the port and works in the mines.

Grade Generally Inferior to American Product

Concerning the grade of the phosphate, twenty-three analyses of material from the district of El-Boroudj include two analyses below 50 per cent; eight from 50 to 60 per cent; seven from 60 to 70 per cent, and six from 70 to 73 per cent, bone phosphate of lime. The twenty-five analyses of the district of Oued-Zem show five from 50 to 60 per cent; seven from 60 to 70 per cent; eleven from 70 to 80 per cent; and two slightly above 80 per cent. But it has been said that it would be wrong to attach a great importance to a few analyses that cannot represent the composition of such an immense tonnage of phosphate. Further, and significant in this connection, is the fact that the deposits which were to be worked are those that are now being worked in the district of El-Boroudj, and yet they are poorer, and situated at a greater distance from the seaboard, than the deposits of the Oued-Zem region, the so-called 80 per cent deposits.

The best analyses came from the Oued-Zem district, but the average grade of the phosphate beds is probably not much higher than the beds of other regions, since, as already stated, it had been decided to open the deposits of El-Boroudj and to build a railroad, which I understand has been done, from there to Casablanca.

The deposits found in the region of Mogador are of low grade: 40 to 45 per cent tricalcium phosphate.

All phosphate that has been shipped from Florida to Europe has been under contract to run not less than 77 per cent bone phosphate of lime, not over 3 per cent of iron and alumina, and 3 per cent of moisture. Averages analyses of the best of the Moroccan phosphate ore are only 62.74 per cent tricalcium phosphate.

Acid Treatment of Low-Grade Ores Not Efficient

Before the Great War, Florida exported 1,400,000 tons of phosphate of grade superior to either that of Algeria or Tunis, the Florida phosphate running from 68 to 75 per cent for pebble, and the hard rock 77 per cent and over. Considering the fact that the Algerian and Tunisian phosphates are sold under a guarantee of from 53 to 58 and 63 to 68 per cent, there does not seem to be much danger of Florida's export trade being effected, if quality is taken into consideration, and if the future is to be judged by the past, and all phosphate ore shipped from America to Europe should be sold under a contract guarantee, as heretofore. The Algerian, Tunisian, and Moroccan phosphate cannot compete with the American unless the foreign miners should resort to some improved method, as a modification of the Cottrell process, for the recovery of the phosphoric acid. It is self-evident that the use of the acid treatment in low-grade ores does not pay and, in fact, entails great loss to miners even in the manufacture of high-grade ore. Strauss L. Lloyd.

Inverness, Fla.

Mining Engineers a Commodity

Are mining engineers a commodity? If so, why not have us listed on the Stock Exchange, along with wheat and corn? Witness the following:

A certain mining engineer, technically educated and with some twenty years' experience in the operation of mines, was requested by a Boston syndicate to act in the capacity of general manager of two mines, one in Utah and one in Nevada. This particular mining engineer is one of those lucky ones who has been able to hold on to a job through this long, unhappy period.

The Boston syndicate asked the engineer to name his price. In reply he named a moderate salary—less than would have been considered normal before the war. The answer he received was as follows: "There are some experienced business and mining men on the board, and they are proceeding with the idea that economy must prevail. One of the men, well acquainted with mining, offered to supply a manager at a salary of $200 a month, whom he could recommend most highly."

This Boston syndicate has no office in the West and suggested that if the manager needed one he could pay for it out of his salary. One of the mines referred to is a producing and self-supporting property, and the miners are paid $5 per day, but the manager of the two mines, because, they added, "there are so many first-class mining engineers out of employment," is expected to give all his time and pay for an office for a compensation of $200 per month.

Let's hope that tomorrow's market report reads about as follows: "Moderate new upturns in the price of wheat. Corn, oats, and mining engineers were governed by the action of wheat. M. Es. closed at 201½."

Salt Lake City, Utah. The Guilty One.

Replying to Dean Probert

A letter of Dean Frank H. Probert's appeared in the issue of March 4 commenting on my article in the Jan. 7 issue on the College of Mining of the University of California.

The following are the points, in order, which he makes in this letter: First, he seeks to discredit the witness; second, he ridicules my article and says, "See what we do"; third, he says, "See how our courses compare with those of other colleges"; fourth, he enumerates various accomplishments of students and graduates; fifth, he points to entrances from other schools, and lastly he marshals some old "grads" and tells us to look at them.

This is all very well, but if Mr. Probert will read my article over in a more generous spirit he will find that I have commended the mining course and that I have certainly not reflected in any way upon the graduates of the school. I have made no comparisons with other schools. My article, in common with the other articles in the series, was designed to be critical, and I felt free to raise a number of questions which are common to most mining schools. In the instance of the mining course of the University of California, I found only partial answers to my queries, sufficient in most instances, however, to warrant raising the query.

Two important questions have received my attention in all cases: First, how far has recent discussion affected the curricula of mining colleges and, second, in what way is the total time of the undergraduate utilized? In handling the first question, I have generally noted the absence or presence of courses bearing upon the question. In answering the second, I have made a time analysis from the schedules as published and obtained information from instructors as far as possible upon the time requirement outside of classes. In some schools I have found that a definite policy was being followed, but in the instance at hand I found only a loose system apparently loosely administered.

In indicating trends, I characterized the mining course as a service course. This is no reflection upon the course nor upon the men who take it. It is an attempt to make the educational problem more definite by determining, first, the average ability of the men who constitute a class, and, second, finding out just where these men may find lodgment in the industry. Is it not true that the bulk of the men graduated from our schools find service positions? I exclude the fortunate ones who may have special assistance as well as the men of exceptional ability. If this be so, why should not a course be definitely directed to the needs of the "average student"?

Giving Mr. Probert the benefit of every doubt, I can see nothing in my article that requires change or restatement. It stands for what it is—an independent estimate of the mining curriculum. I can see no reason why I should not definitely express my opinions and deductions in the case in point. In regard to Mr. Probert's aspersions upon myself, I can only say that they are unpardonable. GEORGE J. YOUNG.

San Francisco, Cal.

The Hope for the Graphite Industry

I have read with interest G. H. Clark's article in *Engineering and Mining Journal* of March 11 on the graphite industry in Alabama. I note that he favors a tariff for graphite as necessary for the revival of the industry. It is curious that the miners will sit around and depend upon Congress to pass a tariff that at best will only be a makeshift and in the end will not benefit them to a great extent. It would be better if we would get down to hard work, and study to make it possible to compete with the foreign product. This can be done, and when it is done the industry will be on a firmer basis than it will by the establishment of a high tariff, as every change in the party in power will make for a change in the tariff policy, and it would be much better for the industry to be able to compete without such uncertain help.

The fault lies with improper methods and reckless expense of money in large buildings and equipment without regard to the most important essentials, such as the proper layout of the plant. In nearly all if not all of the mills in Pennsylvania these essentials were ignored, and failure of the plants was a foregone conclusion.

The mines in this section can all be made to pay a good profit if properly built and efficiently equipped and managed. It is necessary that the mine be close to the mill, and that a good supply of water and an easy disposal of the tailings be provided. The next consideration is the proper concentration of the flake with the least possible amount of machinery. The flotation machine is the best means of making a high-grade concentrate with a high extraction, and if handled properly a 98 per cent extraction of the loose flake can be obtained. Flotation machines can be installed at a small cost, and the upkeep and repairs are trifles in comparison with other types of concentration machinery. One machine will produce from three-quarters of a ton to a ton of concentrate daily at a cost of about one-half a cent a pound. The proper milling of the concentrate has been correctly done with burr mills.

The cost of a plant to produce five tons of 80 per cent concentrate daily would be less than $5,000, not including the land. In this region a plant of the capacity above stated can be constructed at the cost named, at nearly all of the available mines, and from what I knew of the Alabama mines similar conditions prevail there also.

Another thing that should be looked into is making a commercial product of the dust produced by the burr mill in refining the flake. This material can be made into a high-grade lubricant at small expense, and in the future more and more graphite will be put to this use.

I am of the opinion that a high tariff will work for more reckless waste of money in this industry and will further harm those interests which are honestly attempting to make a success of the venture.

Chester Springs, Pa. HARRY A. SCHMEHL.

The Miner and the Forest Service

Anyone who has had anything to do with mining in the Western states in recent years must have been struck by the hostility which the miner feels for the Forest Service. Personally, I have regretted this and have endeavored wherever possible to allay this irritation. It is evident, however, that the miner is often right in his contention that the Forest Service is hostile to the mining industry. As an evidence of this I would call attention to a recent decision of the U. S. Land Office, at Cœur d'Alene, Idaho, as it shows clearly the lengths to which the Forest Service will go. The case is that of the Hamburg-American Copper Mining & Milling Co., which sought to patent claims located *prior* to the establishment of the forest reserve in which they are now included, which application for patent had been protested by the Forest Service. The Land Office in its opinion says:

> "The mining claims here involved were located more than twenty years ago and are in an undeveloped part of the Cœur d'Alene mining district. The land involved was withdrawn from homestead entry and included within the Cœur d'Alene national forest, subsequent to the location of the mining claims, nearly all of which are covered with a substantial growth of timber.
>
> "But at the time of their location these claims were very difficult of access and remote from market. In case commercial ore is found, all of the timber now on the claims would be necessary for use in the operation of the mine. At the time of the location of these claims there were large areas of public land bearing equally valuable timber much more conveniently located with reference to market which were subject to entry under the timber and stone and homestead laws; so that it appears to us that any reasonable person of average judgment seeking to beat the Government out of title to valuable timber would have chosen some other easier and cheaper method, for in this case more than $15,000 has been expended in apparent good faith in trying to develop the group into a mine. We are convinced that these claims were located in entirely good faith without thought of speculation in the timber."

The Land Office is to be congratulated on the soundness of its reasoning and the justice of its decision. The case serves, however, to show the obstacles which are constantly thrown in the way of mining development in the national forests.

Moscow, Idaho. FRANCIS A. THOMSON,
Dean, School of Mines, and Director
State Bureau of Mines and Geology.

Geology of the Huantajaya Silver District

Characteristics of the Country—Discovery Antedated Spanish Conquest of Peru—Limestones and Porphyritic Rocks Associated — Different Fault Systems — Partial Explanation of Genesis

BY HERBERT G. OFFICER

THE MINING DISTRICT of Huantajaya is in the Province of Tarapaca, Chile, about eight miles due east of Iquique. The elevation at the mines is 850 m. above the sea, and 600 m. of this is represented by the abrupt drop from a hilly table-land to sea level. Going to the mines from Iquique the 600 m. rise is accomplished in the first two miles, and once the plateau is reached the grades are easy. The district is about two miles long by one mile wide, the length being in the direction of the average strike of the lodes, N. 60 deg. E.

Eight miles from Huantajaya, in a southeasterly direction, is the silver district of Santa Rosa, once richly productive but now idle. Four miles in a northwesterly direction, in Huantaca, is another group of mines which once produced small quantities of silver-cobalt ores. The latter mines were never large producers, and have only paid expenses. Twenty miles to the east of the Huantajaya mines lie the "pampas" or "salitre." The nearest railway to the Huantajaya district is the Nitrate Railway, which passes eight miles to the southeast. At present access is by horse, and transportation of supplies by pack train or cart. The cart road is so arranged that gradients are easy, but even under the conditions noted, a five-mule cart is limited to a net load inward of one ton and a net load outward of two tons.

The climate is excellent, as might be expected in a desert table-land. The total absence of rainfall implies a lack of vegetation. For nine months of the year, September to June, the days are cloudless, with cool breezes from the sea. The nights are always cool. During June, July, and August, notably the latter month, mists are prevalent and occasion the only natural discomfort that the inhabitants have to suffer. The water supply for the village and mines is obtained from a branch pipe line connecting with the line from Pica to Iquique. The water is of an excellent quality for domestic purposes, but leaves much to be desired when used in steam boilers.

HISTORICAL ASPECTS OF GREAT INTEREST

The first discovery of silver in the district was before the Spanish conquest of Peru. The Indians worked the mines in a superficial manner, but only from the outcrops in the western section; and these mines undoubtedly contributed to the fabulous wealth of the Incas. With the advent of the Spaniards, work was done on a larger scale, and the 70-m. mantle of alluvium covering the eastern section was first penetrated by them. The exact date of the discovery by the Spaniards is not known, but they knew of the mines as early as 1540. Copies of a surface plan made by one O'Brien for the Viceroy in 1765 are now at the mines, and the original is in the museum in Madrid. In 1826, when Darwin paid a visit to the Tarapaca nitrate fields, he passed on horseback between Huantajaya and Santa Rosa. He remarked that the mines seemed to be very little worked at that time.

As will be shown later, the district can be considered in four parts. The eastern and western are separated by a fault of 200 m. vertical displacement, the eastern side being stratigraphically lower; and these are divided into upper and lower "regions" by the 100 m. sheet of porphyry. It is interesting to note that the Indians worked the western part where the lodes outcrop in the first region limestone. The Spaniards worked the lodes in the eastern section in the first region limestone, but had to pass through 70 m. of unconsolidated conglomerate to do so. Later the English and Chileans penetrated the porphyry in the western section and found big bonanzas; and still later, in 1911, a company was formed to work the lodes below the porphyry in the eastern section, but the work was not continued.

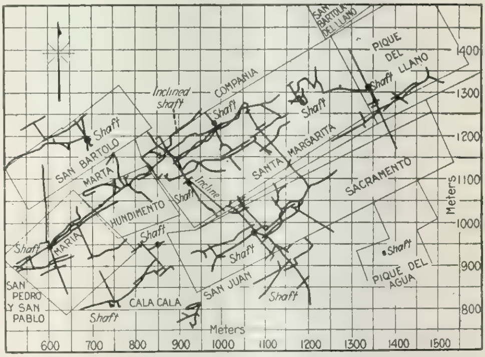


Fig. 1. Eastern section Huantajaya mines

The hills are all rounded, and their contours smoothed, by deposits of debris from the weathered rocks. The valleys are covered by thick mantles of alluvium washed from the hills. The eastern portion is practically level, due to the filling of an old river bed and flood plain by a 70 m. mantle of alluvium or "accarreo." The western part of the district is about 150 m. higher than the eastern and is cut by numerous small gulches. The outcrops of the lodes are always marked by small ridges or welts where the mineralized vein has been more resistant than the unaltered rock.

In the productive part of the district, the rocks are limestone, but the surrounding country is made up almost entirely of igneous rocks. Granites and diorites predominate. Quartz-porphyry is less abundant, but is present in considerable areas. In Santa Rosa, to the southeast, and in Huantaca, to the northwest, the sedimentaries found are the same as those occurring in Huantajaya. In Santa Rosa, there is some variation in the character of the limestones, which are more siliceous, but the thickness and arrangement of the intrusives are significantly like the Huantajaya formations.

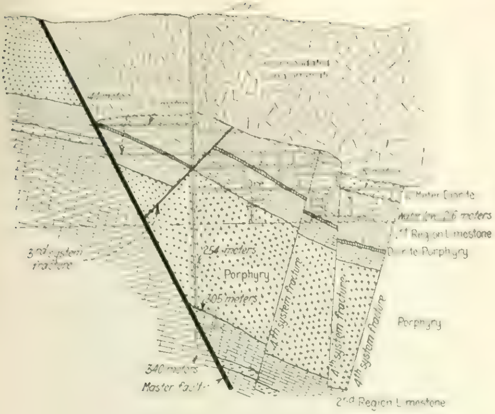


Fig. 2. Vertical projection of Sacramento lode

Fig. 2 shows the arrangement of the rocks on either side of the fault of 200 m. displacement. It is to be noted that some of the rocks shown in the eastern part are now eroded from the western section. Beginning at the top, the following formations occur:

70 - 90 m.	Alluvium (Quaternary)
30 m.	Limestone
6 - 8 m.	Shell limestone
16 m.	Limestone (Jura-Triassic)
12 m.	Diorite, medium grained
50 m.	Limestone, reddish, ore-bearing
6 m.	Diorite, fine grained
30 m.	Limestone, blue-black, ore-bearing
90-150 m.	Quartz-porphyry, reddish
30 - 40 m.	Limestone, white, slightly sandy, ore-bearing
12 - 15 m.	Diorite
80 m.	Limestone, with diorite intrusions

The alluvium covers only the region east of the master fault. It is made up of limestone, diorite, porphyry, felsite, and other rock fragments. These fragments are sharply angular, and there are few large boulders. At a depth of 30 to 50 m. there is a layer of volcanic ash 1 m. thick and in some parts of the district this is mined for the making of "sapolio," oil filters, and similar products. This stratum extends throughout the old river bed now occupied by the alluvium.

The limestones, which are the rocks influencing ore deposition, grade from a sandy, white rock, through red and bluish-black to white again. The first 30 m. of limestone listed in the geological column are eroded from most of the district, and none of the lodes are known to intersect these rocks. The shell limestone is found throughout the district and has been useful in correlating the strata. It is made up of shell remains. The 50 m. bed of reddish limestone grades into the blue-black limestone below, with the diorite presenting an unnatural line of division. This limestone is rather siliceous in places, contains considerable ferric oxide, and does not seem to have been favorable for ore deposition. Fossil ammonites found in this bed determine its age to be Jura-Triassic.

QUARTZ-PORPHYRY INTRUSIVE THROUGHOUT DISTRICT

The 30 m. blue-black limestone is probably made up of the same material as the shell limestone, but metamorphism has been so complete that it appears as a dense, fine-grained, exceedingly pure limestone. The limestone is often intruded by stringers and thin sheets of diorite porphyry. Below it is found the reddish quartz-porphyry. The quartz-porphyry, found everywhere in the district, is uniform in character, although its thickness varies considerably. The lodes in passing through this large intrusive sheet have everywhere proved barren. They are pinched into mere veinlets of calcite. Where the limestone is in contact with the porphyry it shows considerably more metamorphism than elsewhere.

The 30 or 40 m. of limestone below the porphyry was the most richly productive of all the strata, although it is not as pure a limestone as the blue-black variety immediately above the porphyry, nor does it seem to be so greatly metamorphosed. The last known 80 m. of limestone is similar to the limestone immediately below the large intrusive sheet, but has never been productive.

The three sheets of diorite are alike in character and texture, the middle one being slightly finer grained. Each sheet is remarkably uniform in thickness throughout the district. Upon their contacts with the limestones the calcination of the latter, both above and below, is plainly visible. The diorites produced an effect similar to that of the porphyry in their action upon the ore deposition.

FOUR PERIODS OF FAULTING

The district has been subjected to four distinct periods of fracturing. The periods or systems will be treated in the order of their economic importance, which, except in relation to the first two, is also, probably, their chronological order. Fig. 3 is a plan of the systems, which are as follows:

First, the main silver-bearing lodes, striking N. 50 deg. to 60 deg. E.; second, the cross lodes (barren), striking N. 80 deg. to 85 deg. E. (probably formed previous to the first); third, the system of faults striking N. 40 deg. to 45 deg. W.; fourth, the faults related to the master fault. In the western portion of the district, including all that area not blanketed by the alluvium, two distinct series of vein fissures are found.

The most important series of veins, economically, are those striking N. 50 deg. to 60 deg. E. and dipping from 70 to 90 deg. S. These veins show remarkable constancy in dip, strike, length, and depth of mineralization. In most formations, and always if large and well formed, they show a relative displacement vertically of from 8 m. in one to a few centimeters in others, and the greater this faulting along the fissure the greater has been the importance of the lode.

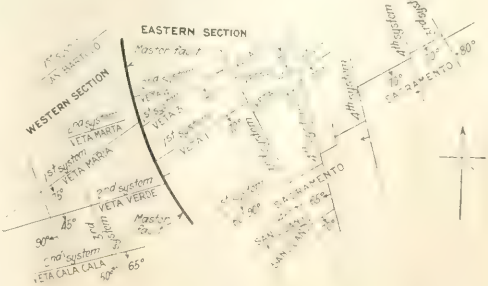


Fig. 3. Plan of the four systems of fractures

In some of the fractures displacement is not evident. They are narrow and barren, and probably resulted from the same stresses which produced the more important lodes. These minor fractures of the first system, although sometimes mineralized near the surface, seldom extend, except as mere stringers of calcite, to the deeper portions of the mines.

In attempting to generalize about the lodes of this system one is at once confronted with the necessity of distinguishing between those of the eastern section and those of the western section. In the eastern part of the district there are about 100 m. of limestone and diorite above the porphyry, whereas in the western part the porphyry outcrops.

The Veta Maria is a good example of the first system lodes in the western area. From the master fault it extends S. 55 deg. to 60 deg. W. for 420 m. to its intersection with the Verde lode. The intersection occupies a distance of about 100 m., where the two lodes are indistinguishable, and after their separation it extends for 200 m. S. 60 deg. to 65 deg. W. The average dip is 80 deg. south. (It is to be noted that the intersection with the Verde deflected the Maria about 5 deg. further west). This lode has been explored for 100 m. below the porphyry, but was only productive in the 30 m. of limestone adjacent to and below the porphyry. In some occurrences the ore extended up into the porphyry for several meters. The mineralization was not defined by well-formed rock surfaces, and deposition of ore in the adjacent limestone seems to have been the rule. The parts of the lode now remaining show no banded structure and no regularity of deposition, and it is difficult to tell where the vein filling ends and the wall rock begins. The wall rock is usually metamorphosed and impregnated with chalcocite, and is stained with copper carbonates. Judging from reports, and from the appearance of the stopes, the richest parts of the orebodies were within limestones which had been affected by the intrusions of porphyry and diorite. The average width of the lode is about half a meter, though in the rich parts payable ore was extracted from a total width of 2 m., and at the intersection with the Verde lode the stopes are 10 m. wide.

CHIEF SILVER MINERALS, NATIVE SILVER AND ARGENTITE

The silver minerals found in this lode were chiefly native silver and argentite, and more rarely cerargyrite. The gangue minerals were calcite, chalcocite, malachite, azurite, and more rarely silver-bearing galena. It is to be noted that native silver was the predominating mineral, and that galena, chalcocite, and argentite were the only sulphides present. There is evidence, in the presence of limonite, of the former existence of iron pyrite.

As an example of the first system fissures east of the master fault, the Sacramento lode is given. This lode, although much faulted, was explored for 700 m. on an average strike of N. 55 deg. E. The dip, owing to faults, varies from 65 deg. to 90 deg. S. The most productive part of the lode was between the 12 m. and 6 m. diorite bands, and in few instances has ore extended down to the porphyry. The ore shoots were remarkably persistent in following certain preferred strata of limestone. Owing to the dip of the strata and the subsidence caused by faults, the rich zone is now often found under water. The Sacramento lode has been displaced by two sets of faults and a series of "arrastras," and consequently presents a shattered appearance. The dip is variable because some of the faults were rotary in character. The richest ores were found where the dip was nearly vertical. Where the angle of dip was as small as 60 deg., the lode was usually poor.

The width of the lode averages about 1 m. Smooth wall-rock surfaces are presented, differing from the Maria in this respect. The silver mineralization appears to have been confined to the lode itself. Wherever branches came into the main lode they produced bonanzas. The silver minerals of the Sacramento lode were the green and white varieties of silver chloride, both crystalline and amorphous, and some of it beautifully transparent. Silver sulphide was also found in large quantities. Native silver, iodyrite, bromyerite, proustite, pyrargyrite, stromeyerite, and the double chloride of silver and sodium were found in less amount. The gangue minerals were calcite and chalcocite. No galena was observed. There is much limonite and there are also stains of copper carbonate. No pyrite has been found in the region above the porphyry.

In this lode below the porphyry fairly rich ore, approximately 1,500 oz. per ton, was found, and 52,000 oz. of silver was extracted. For some reason, the work was discontinued. This was at a depth of 340 m., and 135 m. below the present water level. The ores at that point were said to be similar to those from the upper workings, but a sample said to have come from there contained chalcopyrite which was about half altered to chalcocite. Apparently, oxidation had not proceeded as far there as it had in the upper part of the lode.

THE SECOND SYSTEM FRACTURES

The veins of the second system strike about N. 80 deg. to 86 deg. E. and dip from 30 deg. to 70 deg. S. They are characterized by flat dips, uniformity in dip and strike, and few irregularities in the surface of fracture. They show vertical displacement along the fracture, but owing to the immense stopes at the intersections of these veins with those of the first system it is impossible to determine by displacement which of the two systems is the older. In describing the Maria lode it was noted that the lode was deflected by the Verde lode, the Verde being a second system vein.

The first series of veins dip to the south at right angles to the stratification. The second system veins cut the lines of stratification at angles from 80 deg. to 45 deg. as shown in Fig. 4. The second system veins seldom carry ores of silver, except at or near their intersections with veins of the first system. They are filled with calcite, contain a greater amount of chalcocite, and are heavily stained with the carbonates of copper. Neither pyrite nor chalcopyrite is found, and limonite strains are more rare. The silver minerals found in these lodes are of the same character as those in the lodes intersected by them.

Considering the character of the second system veins, one is puzzled to account for their lack of silver minerals. In the same rock 30 m. away, the first system vein may be richly productive, whereas the second system vein is barren of silver and considerably richer in copper. If they were previous in formation to the first system veins, could the fissures have already been filled before the period of activity of the silver-bearing solutions? Or is it that the flat dips did not reach the source of the silver solutions in depth? It is suggested that they are older than all the others; at the time of fracturing the strata dipped 20 deg. to 30 deg. to the south, instead of, as now, to the north; the fractures were never channels for uprising silver solutions; their effect upon the deposition of ore was limited to enlarging the cavities at the intersections with the first system, slowing up circulation at these points, and otherwise aiding the solutions to deposit their metallic content; and the lateral flow of the solutions along the fissures was much restricted.

In one lode, worked by the Spaniards, the bromide and iodide of silver must have been found in considerable amounts, for even today the old stopes give perceptible amounts of bromine and chlorine gases, due to the decomposition of the minerals in the waste and the ore left in the vein. The occurrence of these two silver minerals is chiefly confined to that part of the district now covered by the alluvium. Not far away are the "pampas" containing deposits of sodium nitrate and with the nitrate are found iodine compounds. The occurrence of "huantajayite," or the double chloride of sodium and silver, is unique. This mineral occurs only as incrustations on the other vein matter, and sometimes in minute fractures in the rock close to the vein. It is plainly secondary, and as the other minerals found are secondary, the huantajayite must be a secondary derivative from them. As this mineral is soluble in cold water, with precipitation of silver chloride, it is rather difficult to account for its origin by the ordinary processes of secondary action. It is interesting to note that F. Corfu produced this mineral artificially by dissolving silver chloride in a strong ammoniacal solution of sodium chlorite, and then evaporating. The proximity of the nitrate fields, with their sodium nitrate and sodium chloride deposits, suggests that a similar process might have produced the huantajayite, the ammonia in some way being derived from the nitrate.

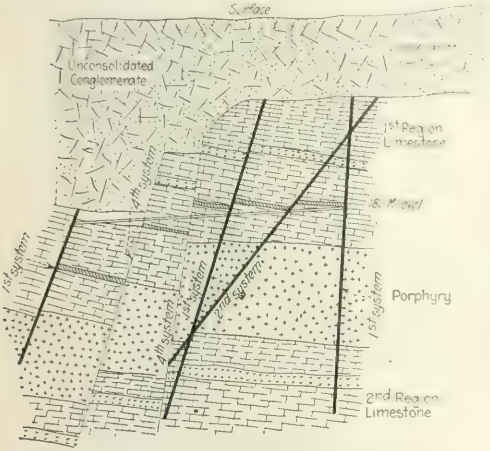


Fig. 4. Cross-section of Mina San Juan Level 5, showing dips of fracture system

The Third System of Fractures

Following the fracturing which produced the vein fissures there was another set of fault movements which was general throughout the district. This series of faults was formed while the strata were still practically horizontal, and some of them now appear as reversed faults, but originally they were all normal. The faults strike about N. 45 deg. W. and have various dip angles. A good example is a fault striking N. 44 deg. W. and dipping 45 deg. SW. It is believed to have originally dipped about 60 deg. SW. These fractures vary from 2 to 12 m. in width and are filled with calcite, but are barren of silver minerals and have no copper stains. Their economic importance is due to the displacement of the silver veins and to their directing influence upon the downward percolating waters which produced the secondary enrichment. Some of the bonanzas have occurred in the parts of the silver veins above the flat dipping faults.

The Master Fault

In the eastern part of the district the principal mass of porphyry is found about 200 m. lower than in the western section. This is also true of the shell limestone and of the diorite sheets. At the point where the break in the strata occurs, there is a broad broken zone, slightly variable in strike, but with a constant dip of 58 deg. E. This zone of broken material is, in places, 10 m. wide, though often not more than 4 or 5 m. The average width is about 8 m. The side to the east is usually composed of badly broken porphyry. The limestone adjacent to the zone usually presents a calcined appearance. There are one or two layers of red clay several inches thick on the foot-wall side. An old theory regarded this zone as a diorite dike. Another theory was that it was a fault zone. The lodes east and west of the zone cannot be correlated. After allowing for the displacement of 200 m. vertically and considering the fault as a normal fault, it is impossible to fit the lodes together on each side of the fault. Not only are the positions different on each side, but the number is not the same. It is suggested that originally there might have been a diorite dike dipping 45 deg. to the east, and that this dike was formed earlier than any of the known fissures or faults. Then occurred the second, first, and third system fractures, in the order named. The first system fissures, or silver lodes, in propagating in the practically homogeneous country rock, would have encountered the break, and might emerge on the other side at different points, and some might have died out at the break.

After the first three systems of fractures, and even after a large part of the secondary enrichment had taken place, strains were set up which found relief in a 200 m. movement along the old dike. For reasons which it is not germane here to discuss it seems certain that the hanging wall or eastern side subsided, and that the western part remained stationary. This is of course important in considering the secondary mineralization in conjunction with the ground-water level.

The Fourth System of Fractures

As a result of the faulting along the old dike, and contemporaneously with it, a series of faults striking N. 20 deg. to 30 deg. W., and usually dipping to the west, was formed. Being the most recent disturbances, the faults have cut across everything except the master fault, in which they terminate. The eastern part is the only section which shows these faults, but they are numerous there and have large displacements, both vertically and horizontally. A glance at Fig. 1 will show the difficulties presented to exploration by them. These faults invariably have the foot-wall side lower than the hanging, and are therefore reversed as to dip, but are normal as to strike. By solving a few of the fault problems it was concluded that vertical as well as horizontal forces were in play. In the southern part of the eastern section of the district the lodes are sometimes displaced several meters by movements along bedding planes in the limestone. These were apparently without effect on ore deposition, and are probably local movements resulting from the 200-m. fault along the old dike. In some instances they are displaced by the fourth system faults, but their origin must have been contemporaneous.

GENESIS TO PRIMARY DEPOSITION

It is most probable that the first system of fissures tapped the source of silver, copper, and iron-bearing solutions in depth. With upward flow, and loss of pressure and temperature as the solutions neared the surface, the metallic sulphides began to be deposited. This probably began in the limestone immediately below the porphyry and continued for a considerable distance beyond the present surface. The porphyry and diorites were not active precipitating agents. The minerals were deposited as pyrite, chalcopyrite, tetrahedrite, polybasite, and other minerals, and the deposition was practically uniform wherever the lodes were in limestone, with perhaps bonanzas at the intersections with the second system fissures.

SUBSEQUENT CHANGES

The relative amounts of the various sulphides originally present would in large measure determine the character of the secondary ore. If pyrite was present originally, in proportion to its amount chalcocite would result as a secondary mineral, provided the chalcocite was not in turn replaced by silver sulphide. Also, if the silver sulphate solutions from above should migrate to a region rich in ferrous sulphate and poor in pyrite and chalcocite, the resulting ore would contain native silver and no copper. Silver sulphate coming from above might find chalcocite the only reducing agent, in which circumstance the silver sulphide would continue to be formed until all the chalcocite had been used up. The resulting copper sulphate might not find a precipitating agent in the vicinity and might move to another locality before being converted to chalcocite. This is conformable with the evidence found today. Wherever the lodes were richest in silver sulphide there was a marked absence of copper stains on the lode and wall rock. Wherever much copper was found, the silver content was usually low.

According to the foregoing reasoning, the big bonanzas were chiefly the result of the action of the primary sulphides upon the silver sulphate brought in solution by downward-percolating waters from the upper leached parts of the lode. It is probable that the ground-water level stood at about the base of the porphyry for a considerable period. During that time a large part of the limestone was eroded and the silver contents of the lodes, in part, were concentrated below. How far the processes of secondary enrichment had proceeded before the 200 m. fault allowed the eastern section to subside, and thus stop concentration below the porphyry, is a question in the solution of which lies the future history of the district.

Monazite Found in Nevada

Examinations for various rare metals recently made at the Rare and Precious Metals Station of the Bureau of Mines, at Reno, Nev., have disclosed remarkably rich specimens of monazite from New Mexico and some high-grade carnotite in gold-silver placer metal from Nevada.

Graphite Crucible Tests of Bureau of Mines

Early in 1918 the Columbus station of the U. S. Bureau of Mines began an investigation of American bond clays and graphites to determine their crucible-making properties in comparison with foreign clays and graphites. Work on the bond clays, which was completed in the fiscal year 1920, showed that better crucibles could be made from domestic clay than from imported clays. The testing of graphites, on which some preliminary work had been done, was then undertaken by the Bureau of Mines. Samples of seven graphites, from Ceylon, Madagascar, Canada, New York, Alaska, Texas, and Montana, of 400 lb. each, were obtained. Then crucibles of No. 70 size were made from each graphite for brass-melting purposes, and six crucibles of No. 60 size for testing under steel-melting practice. These crucibles were made in the plant of the Vesuvius Crucible Co., at Swissvale, Pa. The brass-melting crucibles were shipped to the plant of the Detroit Lubricator Co., at Detroit, Mich., where they were tested under regular brass-melting practice.

Arrangements were made for testing the steel-melting crucibles in the plant of the Simonds Manufacturing Co., at Lockport, N. Y., but when the crucibles were ready for shipment word was received that the pit furnaces of the Simonds steel plant were not in operation, and as they have not been in operation since that time, it has been impossible to test the steel-melting crucibles.

In the brass-melting tests, the average number of heats of the crucibles shown by the different graphites are as follows: Alabama, 13.09; Madagascar, 12.44; Ceylon, 10.50; New York, 9.60; Texas, 6.80; Montana, 6.11; Canadian, 5.80. These results indicate that good brass-melting crucibles can be made from Alabama graphite, and agree with the findings of previous work.

Lack of Transportation Restricts Copper Production of India

Speaking of the metallurgical industries of India, the *Journal of Indian Industries & Labour* for November, 1921, says:

"For many years the existence of a long narrow vein of copper ore running from northwest to southeast across the Dalbhum pargana of the Singhbhum district has been known. Early attempts to work the vein failed, chiefly on account of lack of railway communication. Soon after the building of the main Nagpur line, the old mines at Rakha, just to the east of Jamshedpur, were taken over by the Cape Copper Co., which, after many delays and difficulties, caused chiefly by the Great War, is at last producing refined copper of 99.5 per cent purity and, given adequate supplies of fuel and flux, which owing to the 'wagon shortage' are not forthcoming, could turn out 2,000 tons per annum. Its actual production is near 1,200 tons—a convincing example of the great loss which India suffers from the restricted development of her railways. A second company, called the Cordoba Copper Co., is engaged in exploiting the same vein further to the west, but it will be some time before it is in a position to produce metallic copper.

"No attempt is now being made to refine the chromite and manganese ores occurring in the district, although they are mined and exported or else used as refractory material. Ferromanganese was made by the Bengal Iron Co. during the war at the special request of the government as an emergency measure, but it seems improbable that this industry will ever attain much prosperity, owing to the high average content of phosphorus in Indian coal, which finds its way into the finished product."

The Marketing of Pyrites

Atlantic Seaboard and Southern States Principal Markets—Foreign Pyrites Favored by Low Ocean Rates and Large Deposits Contiguous to Huelva, Spain —Competition Mainly Between Domestic and Foreign Pyrites and Brimstone

By George J. Young
Western Editor, *Engineering and Mining Journal-Press*

PYRITES is a trade name applied to commercially valuable pyrite, marcasite, and pyrrhotite, together with accessory sulphide and other minerals in greater or less amount. Pyrrhotite is relatively unimportant. The marketing of pyrites, and particularly of foreign pyrites, upon the Atlantic seaboard is due to the presence of large, cheaply mined deposits of pyrites of an unusual grade in the Rio Tinto region of Spain and the comparatively low ocean transportation rates that prevail between Huelva, Spain, and the Atlantic seaboard of the United States. Both domestic and Canadian pyrites are sold in the eastern markets of the United States, but as the bulk of the transactions are in Spanish pyrites, the conditions under which this is sold and purchased may be assumed to be typical of the commercial practice.

Pyrites of Wide Commercial Application

Pyrites in a comparatively pure state is one of the raw materials of the sulphuric-acid manufacturer. Brimstone or sulphur is the important competing mineral, although considerable sulphuric acid is manufactured from the sulphur dioxide resulting from the roasting of various metalliferous concentrates high in sulphur. Sulphuric acid is used in the chemical industries, in the manufacture of fertilizers, in petroleum refining, and in the steel industry. Pyrites is used principally in the manufacture of sulphuric acid for the fertilizer trade, although where acid plants are equipped for the purification of the acid the resulting product can be used in any industry.

Consumption of pyrites is restricted to those localities which either by proximity to deposits or by reason of low transportation charges can secure pyrites at a lower cost than a commercially equivalent amount of sulphur in the form of brimstone. As only about 50 per cent of the pyrites is sulphur, there is involved the transportation of a relatively large bulk and the handling of a residue equal in weight to about 75 per cent of the original pyrites. Thus, the important consuming localities for foreign pyrites are situated on or close to the Atlantic seaboard. The centers of sulphuric-acid manufacture in the Atlantic seaboard and Gulf States are as follows, the seaports being on the left and the inland centers on the right:

Massachusetts	
Boston	Lowell
Connecticut	
Fairfield	Naugatuck
New York	
New York	Buffalo
New Jersey	
Chrome Bayonne Newark	Carteret
Virginia	
Alexandria Norfolk	Richmond Roanoke Staunton Lynchburg Petersburg Pulaski
North Carolina	
Wilmington Newbern	Raleigh Charlotte Winston-Salem Salisbury
Louisiana	
New Orleans	Shreveport
Pennsylvania	
Philadelphia Marcushook	Bradford Pittsburgh Warren York Lancaster
Georgia	
Savannah	Atlanta Macon Carrollton Social Circle Pelham Lagrange Newman Rome Blackshear Athens Valdosta Columbus Augusta Albany
South Carolina	
Charleston	Columbia Blacksburg Greenville Anderson
Delaware	
Wilmington	
Florida	
Pensacola Jacksonville	Dunnellon Sanford
Alabama	
Mobile	Selma Gadsden Bessemer Birmingham Gainsville Opelika Grasselli Dothan Talladega Troy

Of the interior states contiguous to the Great Lakes the following are the centers of sulphuric-acid manufacture: Ohio: Cincinnati, Cleveland, and Columbus. Indiana: Indianapolis. Michigan: Marquette and Detroit. Illinois: Chicago and Springfield. Missouri: St. Louis. A small amount of pyrites is consumed in the San Francisco Bay region of California and is supplied from Shasta County.

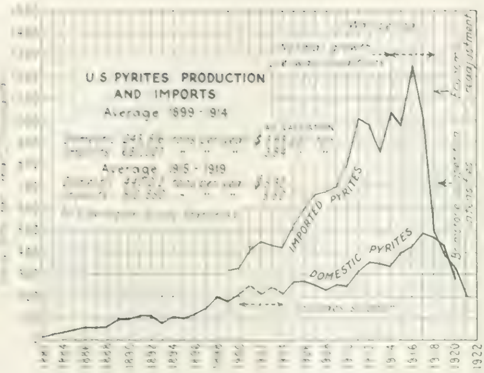
The chief marketing point is New York. There are subagents in important consuming points. Locally produced pyrites is usually sold under long-continued contracts and there is comparatively little competition under such conditions.

Peak Consumption During War Period

Previous to 1918, the annual consumption of imported pyrites, for the most part Spanish, was approximately 1,000,000 tons. Owing to the disturbance in business trends resulting from the war and the intensive development of brimstone deposits in the Gulf region, the market for foreign pyrites has greatly diminished, and its potential capacity will be unknown until equilibrium between brimstone and pyrites is established.

According to the U. S. Geological Survey statistics, the average annual consumption of domestic pyrites for the period 1899-1914, inclusive, was 243,516 tons, of an average value of $3.63; imported pyrites for the same period, 631,027 tons of an average value of $3.84 per ton. For the period 1915-1919, inclusive, the average annual consumption of domestic pyrites was 440,212 tons, of a value of $5.32 per ton; of imported pyrites, 812,850 tons of a value of $5.52 per ton. In 1920, domestic pyrites had fallen to 275,000 tons and foreign pyrites to 332,606 tons. In 1921, foreign pyrites had receded to practically 200,000 tons, of a value of $3.87 per ton. Figures for 1921 domestic pyrites are not yet available. Industrial depression, economic readjustment, and competition from domestic brimstone are the causes of the slump in consumption.

There is no well-marked seasonal demand for pyrites, but buyers of foreign pyrites do not especially want to



Production and imports of pyrites

take large quantities in the early spring or fall. Usually, sufficient stocks are carried which enable the acid producers to meet fluctuations in demand for acid without going into the market for prompt deliveries.

Pure pyrites contains 53.3 per cent sulphur and 46.7 per cent iron. The nearest quality to this theoretical purity is Spanish pyrites. Two analyses are given in the following table:

ANALYSES OF SPANISH HIGH-GRADE PYRITES

	Per Cent	Per Cent
Iron	44 00	43 07
Silica	0 64	6 06
Antimony	0 08	
Arsenic	0 45	0 05
Lead	1 08	Trace
Bismuth	0 005	
Zinc	1 70	0 12
Nickel	Trace	
Cobalt	Trace	
[illegible]	0 08	
Manganese	0 07	
[illegible]	0 37	
Copper	0 70	0.85
[illegible]		0 06
Sulphur	50 00	49 00
	99 175	99.75

THEORETICAL PERCENTAGES OF SULPHUR AND IRON

Pyrites, Per Cent	Sulphur, Per Cent	Iron, Per Cent	Units of Ferric Oxide in Cinder	Units of Ferric Oxide Plus Impurities	Percentage of Iron in Cinder
100	53 3	46 7	66 68	66 68	70
90	48 0	42 0	60 02	70 02	60
80	42 6	37 4	53 35	73 35	51

The impurities usually present in relatively small amounts are insoluble (including silica), zinc, lead, antimony, arsenic, and copper. Zinc and lead, when percentages approximate 3 per cent or over, are objectionable, as their presence increases the amount of sulphur retained by the cinder or residue. Arsenic is objectionable for some acids, particularly those used in the chemical industries, but is not objectionable where the acid is purified or is used without purification, as in the manufacture of fertilizers. All Spanish pyrites contains more or less arsenic, but this has not restricted its use except as noted. Arsenic much in excess of 1 per cent would, however, be objectionable, although there does not appear to be a clearly defined upper limit recognized. Pyrites contaminated with a large percentage of impurities is practically unsalable.

Physical Requirements of Pyrites

Two kinds of pyrites are recognized upon the market, "furnace ore," or lump, and fines. Lump ore ranges in size from 2 to 10 in., and the proportion of fines must not exceed 10 per cent past a ½- or ⅜-in. screen. All material past a ½- or ⅜-in. screen is sold as "fines," the price differential being usually 2c. per sulphur unit less than for lump ore. Sometimes the "ore" is sold as run-of-mine, but this kind is objectionable, as it usually carries a large proportion of fines. Should the furnace or lump ore contain a greater percentage of fines than the 10 per cent maximum, the allowances to be made would be subject to negotiation. The same would apply to the fines if there were any pieces that failed to pass the limit screen size.

Pyrites is usually shipped in cargo lots of 3,000 to 6,000 tons, and is bought and sold in lots of 500 to 1,000 tons, up to a cargo. Domestic pyrites is handled in carload lots and on a contract basis in which the quantities may vary between wide limits. The allowable tolerance in weight on shipments is 10 per cent over or under the specified weight.

No well-defined premiums or penalties are recognized, but where transactions involve uncertainty, special clauses are inserted in the sales contract covering them. An increase in the price is usually allowed where sulphur exceeds the guarantee basis and a penalty where the sulphur content is less. No allowance is made for moisture except where it is in excess of 1 per cent.

Sampling is usually done by a disinterested chemist who acts for both buyer and seller, sampling the cargo as it is discharged from the steamer and analyzing the sample. His results are generally final and binding on both parties. The expense for sampling and analysis is divided between buyer and seller. In some transactions both buyer and seller have their agents present, and the sample is divided and sent to separate chemists, the price of the ore being figured on the mean of the separate returns.

Shipment and Delivery Conditions

Pyrites is always shipped in bulk and frequently foreign pyrites is shipped as ballast. Shipments are usually c.i.f. (cost, insurance, and freight) and delivery is made from the "ship's tackle." Occasionally, contracts are made on an f. a. s. (free alongside ship) basis, and under this designation the consignee takes the ore out of the steamer after the ship has been placed alongside the pier. Cargoes are often distributed among several different consumers, each taking from 500 to 1,000 tons. This makes it easier for the seller to finance the sale and avoids a loss due to the interest on his purchase. Although buyers do not especially care to take large quantities of pyrites during the early spring or fall, no cut in price on deliveries is made at these times.

The value is computed on the percentage of sulphur in the ore at the contract price per unit on the basis of the long ton, 2,240 lb. Thus the unit is 22.4 lb. sulphur. The usual terms of settlement are ocean freight, cash, on arrival of vessel, and the balance of the invoice due on the 10th of the succeeding month.

Price Range Limited

The price of pyrites ranges from 12 to 14c. per unit, the differential between furnace ore and fines being usually 2c. per unit. This price is for high-grade Spanish pyrites, and the quality must be good. The price is equivalent to $0.00535 per lb. of contained sulphur, or $12 per 2,240 lb. of contained sulphur, up to $0.00625 per lb. of contained sulphur, or $14 per 2,240 lb. of contained sulphur. Before the war, prices were approximately 13c. per unit for furnace-size ore and less for fines and run-of-mine. During the war prices reached 30c. per unit, taking into account the excess ocean freight which had to be paid on account of scarcity of tonnage.

Spanish pyrites dominates in the domestic market except in certain localities, principally because the domestic ores are lower in grade, running between 35 and 40 per cent sulphur; the imported ore runs to 50 and 51 per cent.

As a rule, the buyers retain the cinder, but this custom will probably be discontinued and the cinder resulting from the burning of the pyrites will be returned to the sellers. The cinder is desulphurized and sintered and sold as iron ore at a rate of 12c. per unit (long ton) of contained iron. In some instances where the percentage of copper is high enough, the cinder is leached first and then disposed of as an exceptionally pure iron ore after being desulphurized and sintered.

SUGGESTED FORM OF CONTRACT

An example of a form of sales contract is as follows:

Quantity and Description—Concluded this . . . . . day of . . . . . between the . . . . . seller . . . . . . , who agrees to sell and . . . . . . buyer . . . . . . , who agrees to purchase the sulphur contents in about . . . . . tons, 10 per cent, more or less, seller's option, of . . . .

. . . .

. . . .

on the following terms, viz.:

Shipment—Shipment to be made from abroad . . .

. . . .

. . . .

Seller to have the right to anticipate deliveries, but the buyer, by reason of such anticipation of deliveries, shall not be required to have on hand at any time more than . . . . . tons.

Delivery—Delivery to be made ex-ship . . . . . .

. . . .

buyer guaranteeing sufficient water at mean low tide at safe wharf where vessel discharges, vessel always afloat.

Buyer agrees to take delivery of ore as fast as discharged from vessel per day of twenty-four hours as required by seller, and to provide lighters, railroad cars, or other means of transportation so that discharging will not be impeded.

Price—The price to be . . . . . per unit of sulphur, per ton of ore of 2,240 lb., on dry basis, no allowance to be made for moisture unless in excess of 1 per cent. Certificates of weight and analysis to accompany each invoice.

Terms—Payment to be made in gold or its equivalent, in New York funds, on the 10th of the month for all ores delivered the previous calendar month.

All ocean freights to be paid by buyer and deducted from invoice, with the exception that gross ocean freights in excess of . . . . . shall be borne by buyer. Should the buyer fail to pay his invoices at maturity, seller to have the right to cancel the unfulfilled portion of this contract by giving buyer written notice.

Analysis—The ore shall be sampled ex-ship at port of discharge and tested for sulphur by . . . . such determination to be final and binding upon both buyer and seller. The cost of sampling and analysis to be borne half each by buyer and seller.

Weight—The weight to be ex-ship at port of discharge according to the certificate of sworn public weigher, whose certificate shall be accepted as final by both buyer and seller.

Place of Consumption—The above ore is for consumption only at the buyer's works at . . . .

. . . .

Cinder—The cinder from said ore, after burning, shall be the property of buyer (or otherwise as especially agreed).

General—In the event of fire, strikes, lockouts, combinations of working people, scarcity of miners or other workmen, stoppage of mines, floods, or damage or accident to machinery, mines workings, ports, railroad or warehouse, illegal or excessive charges by those operating the mines, wars, civil commotion, epidemics, intervention by constituted authorities, whether civil, military, custom or sanitary; stress of weather, lack of berth room, inability to charter vessel, or any other cause or causes whatsoever occurring at the mines, port of loading, or of discharge or elsewhere, beyond the control of the seller or buyer, by reason of which shipments or deliveries of ore are retarded, delayed, interrupted, or rendered impossible, the seller shall not be liable for failure to make shipments and deliveries, and the time allowed for any stated shipment or delivery under this contract shall be proportionately extended for the period of two months beyond the stipulated time therefor; but, however, if by reason of any cause or causes arising under this clause, deliveries of ore shall be interrupted for more than two months beyond the stipulated time therefor, then the seller shall have the right to cancel this contract.

It shall be optional with the seller as to whether or not he shall replace shipments lost at sea, but he shall not be liable for any damage on account of non-arrival of such shipments lost at sea.

In no event shall shipments under this contract be extended beyond . . . .

. . . .

Buyer shall pay all customs duties and imposts, if any, charged upon said ore by the United States or Spain.

Should any dispute arise as to any of the conditions of this contract, the matter is to be referred to the arbitration of two disinterested persons, one each to be chosen by buyer and seller respectively, and if they should fail to come to an agreement, they shall appoint a referee, whose decision shall be final.

If either party shall fail to appoint an arbitrator within twenty-one days after notice in writing requiring him so to do, the arbitrator named by the other party may act as sole arbitrator.

Acknowledgment is made of the material assistance of C. B. Stranahan in the preparation of this article.

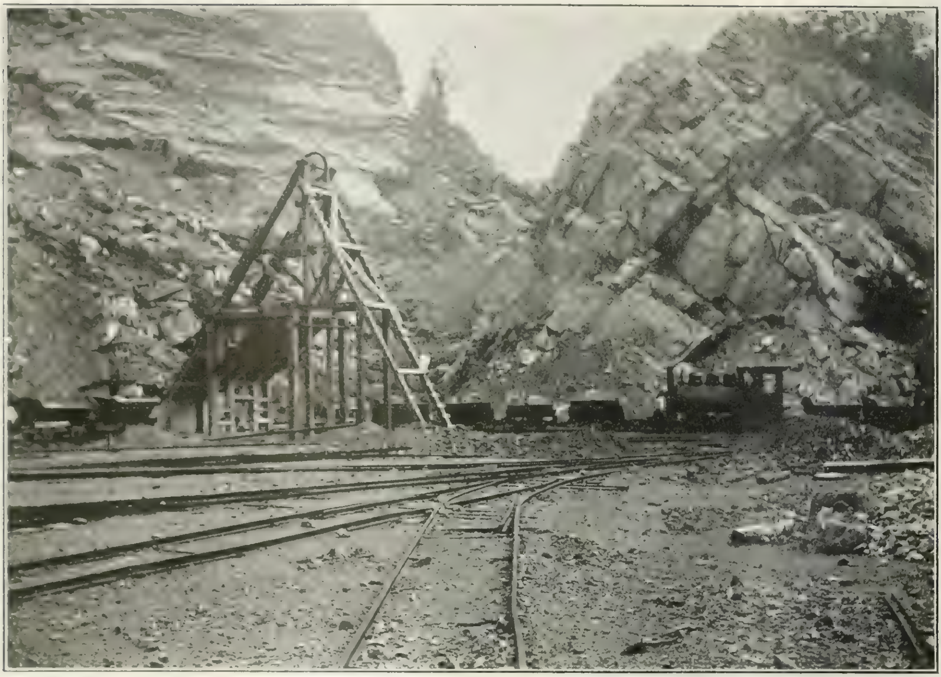
Canadian Feldspar in Demand

The production of feldspar in Canada in 1921, though somewhat below that of recent years, was still creditable, the tonnage mined amounting to 33,597, according to the Canadian Department of Mines. During the period slightly more than 2,0[illegible] tons was milled. Shipments, all from Ontario and Quebec, totaled 30,540 tons, valued at $223,000, an average of $7.31 a ton. Of this quantity all but 200 tons was sold in the crude form. Two-thirds of the crude feldspar sold came from Ontario deposits.

Complete returns were received from the six operators in Quebec and from fifteen producers in Ontario in 1921.

Imports of feldspar during 1921 were valued at $25,120, and exports in the same period totaled $169,864 in value. The quantity of feldspar exported reached a total of 27,292 tons. Imports amounted to only 1,050 tons.

Canadian feldspar has been in considerable demand in the United States in recent years, and the erection of further grinding plants in Canada will permit of the export of Canadian feldspar at a much higher price than is now obtainable for the crude product. One new grinding plant has been opened during the last year, and Canadian producers are apparently fully alive to the desirability of preparing the Canadian product in its most valuable marketable form.



Sinking headframe at No. 3 quarry of American Lime & Stone Co.

Shaft Sinking in a Limestone Quarry

Underground Mining Methods Are Being Used To Procure High-Grade Limestone Instead of the Customary Quarrying—A Four-Compartment Inclined Shaft Sunk and Other Work Done on Contract, Preparatory to Installation of Mining Machinery

BY J. H. STOVEL

THE RECENTLY COMPLETED SHAFT at the No. 3 quarry of the American Lime & Stone Co., of Tyrone, Pa., presents an interesting development in the mining of limestone. The company has for many years operated quarries and lime kilns in the vicinity of Bellefonte and Tyrone, and about two years ago started work on the erection of a large lime-burning and hydrating plant. This plant involved a considerable outlay of capital, and to secure the product which would give the fullest returns on the investment it was necessary to have a constant source of supply of high-grade limestone.

The company has, in its quarries around Bellefonte, a 75-ft. ledge of limestone, known locally as the "good stone," which met fully its requirements as to quality. Unfortunately, the limestone measures at this point dip into the hills at a 52-deg. inclination, which fact makes it difficult at times to quarry this special ledge without getting a large amount of the lower-grade surrounding limestones mixed in with the "good stone." For this reason the company decided to make use of underground methods as the only economical means of assuring a constant output of limestone of the required quality. The development work, involving a shaft, pocket, raise, and crosscuts, was done, under contract, by the E. J. Longyear Co., of Minneapolis, Minn., according to specifications prepared by A. Neustaedter, mining engineer for the American Lime & Stone Co.

NO NEED TO SUPPORT HANGING WALL IN SHAFT

The accompanying diagram shows the underground work. The shaft was sunk in limestone in the floor of the quarry about eighty feet from the foot wall of the "good stone" ledge. It is 8 x 24 ft., has four compartments, provision being made for two skipways, one cageway, and one ladder, and is 391 ft. deep on the inclination. The shaft was sunk in a stratum of limestone 8 ft. thick, so that advantage could be taken of the slips in drilling and blasting. This provided an unbroken slip for the shaft hanging wall and, judging from present appearances, the shaft will never need any timbers for the support of the hanging wall. The inclination of the measures changed gradually from 52 deg. at the surface to 63 deg. at the bottom of the shaft, but, as the stratum of limestone maintained its thickness, the shaft was allowed to follow the measures.

The shaft is concreted at the collar for about twenty feet and has some special timbering at the pocket.

Between these points the only timbering consists of a row of 8-in. posts carrying a 2-in. plank partition between the inner skipway and the cageway. A 250-ton storage pocket connects the lower crosscut with the shaft, and this pocket is connected with the upper crosscuts by a raise with bypasses to the crosscut, so that all the stone is handled from the one pocket. The stone in the pocket will be fed, by compressed-air-actuated revolving drums, into measuring pockets, which will in turn discharge into five-ton skips. The first crosscut was driven 70 ft. vertically below the quarry floor, and the other crosscuts at vertical intervals of 60 ft. The crosscuts are 7½ x 24 ft. and extend from the shaft to a slip, in the "good stone" ledge, which is to form the hanging wall of the stopes.

UNDERHAND STOPING TO BE PRACTICED

The section through the stopes, shown in the diagram, indicates the proposed method of mining. The ground above the crosscuts will be left as a pillar, and a stope, which will be 30 ft. high vertically, will be opened up on each side of the crosscut. After the preliminary opening has been excavated it is planned to carry a pilot drift at the top of each stope. The upper cut will be slashed across the stope from this pilot drift and the two remaining cuts will be taken out as underhand benches. Mechanical shovels will be used to load the stone from the stopes into the mine cars. As the stopes will have plenty of head-room, and as the material to be handled will be fairly coarse, a heavy type of underground shovel will be used. The crosscuts will be cut higher at the hanging-wall end, so that one shovel may serve either stope on the same level.

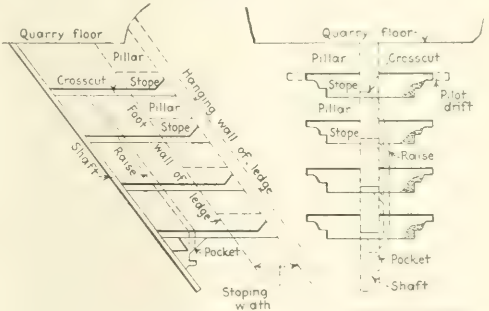
Electric motors will take the cars from the shovel to the raise or pocket. The ground between the floor of one stope and the roof of the stope next below will be left as a temporary pillar, and permanent pillars, extending across the width of the ledge, will be left at regular intervals. When the stopes have been mined to the desired distance from the crosscuts, the greater part of the temporary pillars, referred to above, will be mined by a retreating method. The hanging wall of the stopes will be formed by a well-defined slip in the ledge which is about 15 ft. from the real hanging wall. This will give a stoping width of about 60 ft. The company expects to produce from 1,000 to 2,000 tons per day from the shaft.

CRUSHING AND GRINDING

The sinking headframe, shown on the opposite page, will be replaced by a steel headframe and bins. The "good stone" ledge shows in this photograph just back of the headframe sheave wheel, and the dip of the measures is also shown clearly. The stone will be drawn from the headframe bins into cars, which will be hauled a short distance and dumped into the crusher. An elevating conveyor belt will take the crushed stone to storage bins. From these bins it will pass to a large rotary kiln and thence to the hydrating plant. A tube mill is provided for use when fine grinding of the stone is desired. The process used in the hydrating plant, which is already in operation, differs considerably from the usual method of manufacture, and the system, together with the adoption of underground mining, has been the source of considerable interest to other limestone producers and lime manufacturers.

Stations were cut at each crosscut as the shaft was sunk, and, on the completion of the shaft, a raise was driven, through the section of the pocket, from the shaft to the lower crosscut. A timber chute was built at the bottom of this raise, and all the stone was loaded from this chute directly into the one-ton skip which had previously been used in mucking during the sinking of the shaft. The crew was then divided, one gang driving the raise to connect the pocket with the upper crosscuts while the other gang drove the crosscuts forward to the point where the raise intersected them. When the raise was finished, muckers were hired and the shaftmen who remained were employed on drilling only, each crew having two crosscut faces to work to. All the stone from the raise and from the greater part of the crosscuts was handled through the chute in the pocket raise. On the completion of the crosscuts, the pocket was stripped to the full section required, and a pump station cut in the end of the shaft at the level of the bottom of the pocket. The laying of the permanent track ties completed the agreement undertaken by the contracting company.

No. 55 Clipper drills were used in the shaft, and these were mounted and equipped with water heads for the work in the crosscuts. A shift boss and five miners were employed on each eight-hour shift in the shaft and a progress of 5.4 ft. per day was made. Though the progress made, as expressed in feet per day, was not extraordinary, a consideration of the size of the shaft and of the number of men employed will indicate that the headway made was decidedly good, as 1.01 tons was mucked per man-hour and 6.6 ft. was drilled per machine-hour. The time record of the shaft work was as follows: Drilling, 16 per cent; blasting, 8 per cent; blowing smoke, 7 per cent; mucking, 56 per cent; miscellaneous (such as track, pipe, and timbering brow at crosscuts), 12 per cent, and delays, attributable to various causes, 1 per cent.



Section through Shaft and Crosscuts

Section through Stopes

General underground arrangement, shaft of American Lime & Stone Co., Bellefonte, Pa.

The costs, per cubic yard, of the shaft and station work, exclusive of the contractor's profit, were as follows: Labor and bonus, $4.81; power (electric), $0.54; explosives, $0.61; materials, $0.30; buildings and equipment, $0.69; a total of $6.95. Shift bosses were paid $5.50 per shift; miners, $5; blacksmith, $5; hoistmen, $3.50, and surface labor, $3. The bonus paid was on a sliding scale, depending on the progress made. The costs given above do not include amounts paid for timbering materials nor the labor that was charged to the operation of the compressor.

Canada as a Gold Producer

Prophecies Injudicious—Porcupine Mines Preparing for Greater Production—Better Conditions Will Result in Growth in Number Of Smaller Operators—Elbow Lake and Other Districts Promising

By Alexander Gray

WITHOUT WISHING to be disputatious I must take friendly exception to the view expressed in the Annual Progress Number of the *Engineering and Mining Journal* that a decrease in the Canadian production of gold is "inevitable," because "the producing mines are reaching increasing depth, and no new large ones are being opened."

Twelve years ago, almost every mining engineer of more or less eminence—Canadians included—dogmatically declined to believe Canada would or could present a gold field or fields of first magnitude. The highest authorities, off-hand, or after inspection, flouted the geology, mineralogy, and fissuring. "Bull" quartz in schist, lenticular features, were accentuated to the point of rejection. American mine owners operating at Cobalt were given to understand that Porcupine did not possess the essential attributes; the opinion was registered that the Dome property "never will make a mine"; that the combined Hollinger areas would not reimburse their owners for purchase moneys, equipment at a nominal price, and development capital.

Time and again the McIntyre property was unceremoniously condemned. And I myself, after having had access to the Dome assay plans, and discounting the average owing to the method of sampling adopted, was classified as a falsifier. Hollinger principals were accused of high-grading their initial test shipment, and it was urged that the orebodies at the outcrop lacked lateral and, presumably, vertical continuity. Repeated efforts to interest mining capitalists in the McIntyre were unsuccessful.

Increased Capacity Planned at Porcupine

As the Hollinger, Dome and McIntyre companies are to be credited with most of the increased and total production of gold in Canada, it is admitted that they are mining at depths where the "inevitable" is nearer. That admission, however, conveys no element of apprehension, any more than is it a reasonable deduction that "no new large" mines will be "opened," either in northern Ontario, or throughout the west and northwest, where recent discoveries provide preliminary evidence of extensive gold occurrences.

No one familiar with the Ontario districts in particular will hazard projections as to depths and values beyond the known and positively indicated. By diamond drill and workings the lives of at least the three mines specified are assured for a period during which further explorations will be undertaken. Increased milling capacity, planned without trepidation, bespeaks the confidence of the respective managements; consequently, deeper development is to be expedited.

It follows that for the time being the gold output will increase and that for some years the three companies named will contribute annually as much gold as the whole of Canada has been doing of late. To doubt this is to confess ignorance of the mining position and substantiated outlook. Provided there are no interruptions, the current year will give the Hollinger mines the world's milling record, if labor and power are adequate, without encroaching upon the estimated ore reserves.

A comprehensive mining program for the upper sections, and the inducements disclosed in the lower levels, cast no shadows. In reality, the Hollinger's milling capacity must be enlarged—and doubtless the grade will be lowered—owing to large stoping widths, where glory-holing is now being considered. How to deal with intimately related orebodies and great lower-grade sections which dictate milling expansion has given the management more concern than the likelihood of disappointments at immediate depth.

For the sake of argument, were argument intended, it will be conceded that the Hollinger is pre-eminent. Its capitalization exacts rapid production and redemption of capital. Dome Mines is second in importance. Whereas Hollinger workings at 1,200 and 1,550 ft. denote no change of formation, development below the 800 level has been more incidental than progressive, centralization being necessary until labor was more plentiful and efficient. It might be a slight error of underestimation to place Hollinger ore reserves above the 1,000 level somewhat in excess of the total tonnage extracted to date, or about 5,000,000.

For the Dome Mines, no recent estimates of ore reserves were incorporated in the annual reports. It is known, however, that the values are more consistent at the 1,000 level and that there is better definition. This is reflected in the milling grade and in the decision of the directorate to proceed with the redemption of capital at the rate of $1 a year, besides the customary quarterly distributions. Hence the expectation that the output will be maintained if not increased. And what applies to the Dome properties is not to be denied to the McIntyre mines, where mining is being done at the 1,800 level.

Number of Producing Properties Will Increase

According to Witwatersrand standards, the three mines named may be regarded as the only large or nearly large ones. Here is where relativity of the smaller mines to the aggregate output now and hereafter enters into this discussion. Without recourse to probabilities contained in areas adjacent to the Hollinger, McIntyre, and Dome, where drilling and development have induced Nipissing and other companies to bestir themselves, it is possible that no "new large" mines within the meaning of the writer in the Annual Progress Number may be in the developing stage elsewhere at Porcupine; but there will be more producing properties a year from now than there have been since the war intervened. Working capital was unobtainable by some of those equipped for crushing. While producing companies were crippled, it was impossible for others to do development, because of lack of capital. It is unnecessary to file a detailed bill of particulars, for those fully informed are confident of progressive outputting, irrespective of the factor of "inevitability" in mining.

Unmindful of what happened in the American West, where it was the multiplicity of smaller mines that gave impetus to all mineral industries, the tendency among outstanding engineers is to discard others than the "new large"; just as Canadian bases of capitalization take those of Cobalt for example. Notwithstanding Cobalt precedents and Rand gages of what a mine should be to interest combinations of capital, the conviction prevails that the widespread distribution of gold throughout northern Ontario will afford enough meritorious properties to broaden the movement throughout the district.

Corroboration of the conclusion above set forth has been forthcoming from the so-called Kirkland Lake district, where values at depth are greater. The accumulative effect of six producers at Kirkland Lake by no means is a deterrent. Lake Shore and Wright-Hargreaves would be large mines in other districts of North America. The former is developing 5-oz. rock—much above the milling average—in its deepest workings, and the latter has the greatest milling capacity in the locality.

Adjoining on the east, the Tough-Oakes, Burnside, and Sylvanite, in co-operation, have solved problems of faulting and are to augment the provincial gold output. To the west, the Teck-Hughes and Kirkland have been joined by the Ontario-Kirkland, situated to the south—and all three are in the outputting sheet—without inviting invidious comparison with their neighbors or the Hollinger, Dome, and McIntyre.

Kirkland Lake has been slower to reach maturity. Its half dozen productive companies exceed in number those of the larger Porcupines, and there will be other Kirklands when venders offer more attractive terms to those capable of providing capital. They are not going to be Homestakes or Hollingers. Withal, as an experienced engineer, formerly chief of staff to one of the Witwatersrand groups, remarked: "Kirkland Lake and the generality of the northern Ontario country, where the prerequisite geology is favorable, is the most inviting gold field I know of."

In so expressing his opinion, this engineer is a stickler for terms upon properties which have to be proved. Not every area has the "come-back" of the Tough-Oakes, where the human factor accentuated faultings, now being circumnavigated. And the London geologist who brought this about, after inspection of the Porcupine mines, with his added intimate knowledge of Kirkland Lake, declared he had no misgivings as to the future of the districts. Perhaps, in this connection, the most pressing need of the districts here discussed is the amalgamation of eligible areas or saner financing for individual properties.

Improved Conditions Will Bring New Products

"Time is the essence" of all estimates of the future gold production of Canada. Cheap hydro-electric power is indispensable to those who would hasten development. Costs have been prohibitive and capital has been shy. Customs smelters to which gold ore could be shipped have not yet been provided in Ontario. Bonding and leasing on a royalty basis is unknown there outside of Cobalt. Preference among prospectors and promoters has been shown for "market deals"—which often have meant the undoing of all concerned.

Unmindful of what it has entailed to give Ontario a gold production at the rate of over $20,000,000 per annum, it has taken ten years for prospectors, however much they are entitled to consideration, to learn the lesson that Cobalt alone was enabled to provide ample working capital from first shipments of bonanza ore. The idea of raising capital by the lithographed route has been more of a hindrance than helpful—too much to repent of being left on the hands of the public. All of which does not preclude the constructive development of what are excellent prospects. Kirkland Lake and environs especially require thorough exploration, the experience being that values improved with depth—the depth thus far reached.

Elbow Lake and Other Districts Offer Hope

With the information derived from the Porcupine and Kirkland districts, it is not improbable that abandoned properties in the Rainy River and Lake of the Woods sections of Ontario will be reopened. It was the disappointments due to those properties, several of which are equipped with milling plants, and the premature over-booming of Rossland, that deterred Canadian men of affairs from entertaining the newer Ontario gold fields, as well as the Cobalt and Montreal River silver districts. Makeshift metallurgy—chlorination and what not—together with inefficient management in most instances—gave "the dog a bad name." Of late, in the vicinity of Goudreau, outcropping conditions of interest have been noted. But it is at Elbow Lake that results from the Hollinger, Dome, and McIntyre mills are reechoing, and there optimism is rampant.

The influence of one mine like the Hollinger is far-reaching. With its shares of the par value of $5 representing a split-up of four for one, selling on a basis of almost $34, after paying $16,500,000 on the $3,000,000 initial capital of the Hollinger company prior to the merger, with ore reserves valued in the gross at 50 per cent more than the issued capital of the Consolidated, it is not surprising that "every prospect pleases." By taking an exploratory interest in the northern Manitoba Elbow Lake country, individual Hollinger directors set the pace, blazed the trail for those who have blanketed acreage, and may not have more than snow.

As the *Engineering and Mining Journal* stated, Elbow Lake is now in the limelight. Its surface showings make inconsequential their distance from transportation. What may be defined as the Hollinger interest—although the Hollinger company has simply loaned its technical co-operation—is cutting a sixty-mile road from rail, has established camps, provided preliminary equipment and purposes applying acid tests to the wide mineralized zone in which free gold wherever there is quartz may make a "new large" low-grade mine.

Specimens from the property would grace cabinets. Whether the enrichments will carry the larger body of lean rock is what the holders of the option will try to ascertain by early spring or summer. Meanwhile, other discoveries in narrower orebodies are reported.

Anyhow, the countryside is staked, and it is injudicious to prophesy for or against Canada as a source of increasing or decreasing gold supply. Enough finds have been made to please pioneer adventurers, in which respect northern Manitoba has had quicker action than did the Portland Canal district of British Columbia, where the Guggenheims have an interest in a "new large" mine, mostly silver, the gold values not being despicable, however. The Premier mine, as it is known, has increased the precious-metal output of British Columbia and contributed largely toward greater confidence in the district, doubted for ten years and discarded by influential New York mining capitalists.

Lead Losses in Smelting Low-Grade Material

Smelters in Continental Europe Forced To Treat Undesirable Slags and Byproducts During the Great War—Losses Were Higher Than Expected, Being 24 Per Cent for a Serbian Slag Containing 8.5 Per Cent Lead

By Dr. C. Offerhaus
Consulting Engineer, Beer, Sondheimer & Co.,
Frankfort-on-Main, Germany

IN SMELTING lead-bearing material, there are losses in the slag, through the stack, and by dust blown away and lead sticking to shoes and cloth. In smelting Australian concentrates and similar European concentrates, as did most of the European lead-smelting works before the war, with rich charges and with only a fairly good equipment for condensation (no baghouse or wet condensation), a total lead loss of about 5 per cent was considered good practice. This figure is based on the dry analysis, according to which the ore was generally purchased.

During the war, the Continental lead-smelting works were obliged to smelt poor materials like muffle residues, rich slags, mattes, and impure, low-grade concentrates. Though one can figure theoretically how much lead goes into the slag with such poor charges, the managements of several lead smelters were not fully aware of the total losses which occurred under these new conditions. Some works undertook to smelt rich Serbian lead slag, with, on the average, 8.5 per cent lead (wet estimation), on which they estimated that a loss of 10 per cent would occur. This allowance had to be augmented first to 15 per cent, and later to 24 per cent. Higher losses than were expected, had, of course, to be covered by lead out of their own concentrates, so that these smelters had to pay dearly for smelting this rich slag.

Old Roman slag dump in Babai, Serbia

Tests Conducted to Determine Losses

To get an exact idea about the total losses which occur in smelting poor lead-containing materials, the management of a lead smelter in Germany kept an accurate account of the total lead charged and recovered when smelting low-grade material. This was continued over several weeks, in periods of one week, not only to find out how large the lead losses really were, but also how they were divided and how they agreed with those calculated.

The estimations which follow, and deductions therefrom, may be of interest to lead smelters which treat mainly low-grade lead materials containing the precious metals, such as silver-containing muffle residues; and to those which treat mainly dry gold and silver ores, and generally experience a lack of lead ores. It should, however, be pointed out, that only lead losses will be discussed, and not losses in gold and silver.

The blast-furnace plant of the smelter which provided the data, and its mode of operation, will be briefly described, so that the reader may better understand the results obtained.

Description of Smelter Equipment

The lead plant has two open-top blast furnaces; the one which was in operation when the tests were made measures 1.07 x 3.5 m. (42 x 138 in.) at the tuyères, and has eight tuyères, with a diameter of 100 mm. (4 in.), on each side. The distance from the tuyères to the charging floor is 6.71 m. (22 ft.), and to the lower rim of the downtake, 5.173 m. (17 ft.). The furnace has one tier of cast-steel water jackets; at both long sides an Arents tap and at both short sides a slag tap hole. The gases are taken off below the charging floor at one of the short sides of the furnace by an unlined square flue, 1,400 x 1,820 mm. (55 x 72 in.) made of 12-mm. (½-in.) sheet iron. This flue passes horizontally over the bedding floor into a brick channel, 1,500 x 2,300 mm. (59 x 90 in.), which delivers the gas to the dust chamber, 23,000 x 12,000 x 5,000 mm. high (75 x 39 x 16 ft.) and then to the stack, 80 m. (262 ft.) high, and 2.9 m. (9½ ft.) diameter at the top. There are two dust chambers of the same dimensions. During the test one served the roasters and refinery and the other was connected to the blast furnace alone. Only the stack served all plants.

The gases from the tap hole were removed by an exhaustor[1] which was too big for the purpose. One of the proper size was not obtainable at the time. This blower exhausted into the flue between the furnace and the dust chamber. The exhaustor in this way worked also as an injector; however, too much air was passing the dust chamber and made it inefficient.

The blast-furnace blower is a KKK Rateau turbo-blower with a capacity of 160 cu.m. (5,650 cu.ft.) per minute at 1,500 mm. (34 oz.) water pressure, 2,935 r.p.m. The furnace runs generally with 65 to 70 cm. (15 oz.) water pressure, and smelts on the average 190 metric tons of total charge in twenty-four hours. Slag is tapped alternately on both short sides of the furnace; the slag flows from the spout through a covered cast-iron launder about 1 m. long, through a hole in the charging floor into slag cars, which pass underneath the furnace in the direction of the long side. During the time the slag flows, the passage is closed on both sides of the slag car by iron doors, and the gases rise through the launder, combine with the gases from the tap hole, and are removed by the exhaustor. The full slag cars, which have a capacity of about two metric tons, are pulled under the crane, which takes them up and sets them on a track mounted about one meter above the floor, at both sides of which slag and matte pots are placed. The contents of a slag car (slag and matte) are tapped through a hole a little above the bottom of the vessel, first over a matte pot, and then, when slag comes, over a slag pot. Bottoms and skulls go back to the charge. While the slag in the pot is still liquid, hooks are introduced, and after solidifying, the slag cones are placed, with the aid of a crane, in a dumping car and taken to the dump, where the hooks are recovered.

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[1] KKK Rateau blower, capacity 200 to 250 cu.m. air per minute at 100 to 150 deg. C.; suction, 500 mm. water; 52 hp.

SLAG FROM OLD ROMAN DUMPS IN SERBIA

During the test most of the material smelted was rich Serbian slag averaging 8.5 per cent lead. This material came from old slag dumps in Babai, Serbia, which date from the times the Romans worked there, and shows included charcoal. The following is an average analysis of this slag, in per cent:

Pb (wet)	FeO	SiO_2	CaO	Al_2O_3	ZnO	S	Mn
8.5	32.9	31	2.9	13.2	6.4	2.3	1.5

Ag, 40 gr. per m.t. (1.16 oz. per ton)

The following materials were also smelted: Sinter, with 27 to 31 per cent lead from pre-roasted concentrates and matte, flue dust and muffle residues; then a poor, disseminated lead ore with 7 per cent lead and 7 per cent sulphur, and intermediate refinery products, as dross, skimmings, low-grade zinc oxide, and litharge. The losses in blast-furnace smelting were estimated by determining the lead in the materials charged and that in the furnace products, such as work lead, waste lead, lead matte, speiss, furnace incrustations, and flue dust. The materials of the charge were weighed accurately and continuously sampled. In the average twenty-four-hour sample the lead was determined by the wet assay; in the Serbian slag a moisture determination was also made, as the material was stored in the open.

WEIGHTS OF SOME PRODUCTS ESTIMATED

The different products of the furnace for each shift were separately stored, weighed, and sampled. Flue dust and furnace crusts were weighed at the end of the campaign and aliquot weights taken for the time of the test. It was not possible to weigh the slag; however, the lead losses from the stack were determined daily by sampling the waste gases in the flue not far from the stack. Tests for carbon dioxide, carbon monoxide, and temperature were made at the same place.

The results of the tests during three weeks are given in tables 1, 2, and 3. All lead determinations were made by the wet assay. Charges with 11.41 per cent lead, 12.46 per cent lead, and 15.05 per cent lead (on dry total charge plus coke ash, less the carbon-dioxide content of the limestone) gave lead losses of 17.39, 14.64, and 10.90 per cent respectively. These losses are made up of losses by the slag and through the stack only.

The waste gases contained on the average 0.732 grams of lead per cubic meter at 35 deg. C., and from the coke consumption of the furnace, taking in consideration the coke ash formed, it was calculated that 6 cu.m. of waste gases escaped per second, at a temperature of 35 deg. C. The stack losses were therefore 2.656 metric tons of lead during one week.

TABLE 1 FIRST WEEK OF TEST PERIOD

Materials Charged	Weight Metric Tons	Weight of Lead Contents, Kilograms
Roast sinter	145.27	39,881
Zinc oxide	29.83	26,756
Serbian slag (dry)	796.635	67,714
Old cupels	2.04	832
Varés ore	37.6	3,042
Litharge	0.85	751
Total.		138,976
Furnace products (except slag)		
Work lead	110.955	109,102
Matte	38.772	4,149
Speiss	0.877	26
Flue dust.	0.767	767
Furnace incrustations	0.763	763
Total		114,807

138,976—114,807 = 24,169 kg. or 17.39 per cent loss
Total dry charge, plus coke ash, minus CO_2 from limestone, 1,218,169 kg.
Per cent of lead on total dry charge, 11.41
Total weight of products except slag, 152,134 kg.
Weight of slag, by difference, 1,066,035 kg., containing 1.374 per cent lead or 14,647 kg., or 10.54 per cent of lead charged
Stack loss = 86,400 x 6 x 0.732 x 7 = 2,656 kg.

TABLE 2 SECOND WEEK OF TEST PERIOD

Materials Charged	Weight Metric Tons,	Weight of Lead Contents, Kilograms
Roast sinter	127.580	34,357
Zinc oxide	5.1	4,652
Serbian slag (dry	739.264	64,760
Varés ore ..	33.683	2,950
Litharge . .	33.667	31,843
Furnace incrustations.	7.759	1,986
Cupel furnace ashes...		21
Waste lead.		893
Total................		141,462
Furnace products (except slag		
Work lead	116.69	114,741
Matte	40.539	4,520
Speiss	0.373	11
Flue dust.....	0.767	767
Furnace incrustations	0.763	763
Total		120,802

141,462—120,802 = 20,660 kg. or 14.64 per cent loss
Total dry charge, plus coke ash, minus CO_2 from limestone, 1,135,052 kg.
Per cent of lead on total dry charge, 12.46
Total weight of products, except slag, 159,132 kg.
Weight of slag, by difference, 975,920 kg., containing 1.43 per cent lead or 13,956 kg., or 9.87 per cent of lead charged
Stack loss = 86,400 x 6 x 0.732 x 7=2,656 kg.

TABLE 3 THIRD WEEK OF TEST PERIOD

Materials Charged	Weight Metric Tons	Weight of Lead Contents, Kilograms
Roast sinter	108.82	33,952
Zinc oxide.	60.797	51,483
Serbian slag (dry	723.218	61,474
Varés ore	35.56	3,272
Litharge	12.133	10,[illegible]2
Skimmings	9.675	7,231
Furnace incrustations	10.273	2,[illegible]74
Slag bottoms	14.8	65[illegible]
Total		171,265
Furnace products (except slag)		
Work lead	148.46	145,981
Matte	38.38[illegible]	5,079
Speiss	0.[illegible]	4
Flue dust	0.767	767
Furnace incrustations	0.763	763
Total..................		152,594

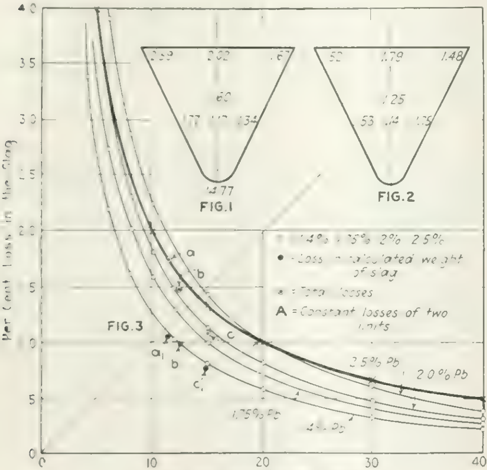
171,265—152,594 = 18,671 kg. or 10.90 per cent loss
Total dry charge, plus coke ash, minus CO_2 from limestone, 1,138,283 kg.
Per cent of lead on total dry charge, 15.05.
Total weight of products except slag, 188,558 kg.
Weight of slag, by difference, 949,725 kg., containing 1.404 per cent lead or 13,334 kg., or 7.79 per cent of lead charged
Stack loss = 86,400 x 6 x 0.732 x 7= 2,656 kg.

Of the total losses of 63.5 metric tons during three weeks, 7.968, or 12.5 per cent, went through the stack, and 55.532, or 87.5 per cent, was lost with the slag.

Considering the matter in another way, the lead lost from the calculated amount of slag formed (dry total charge plus coke ash, less the carbon-dioxide content of the limestone, and less furnace products), multiplied by the average lead contents of the slag, and adding to this figure the lead lost through the stack, will amount to considerably less than the total loss found. (See tables 1, 2, and 3.) This is explained by the fact that it is unavoidable that a considerable amount of matte should go with the slag to the dump; furthermore, the lead found in the slag samples is not the average of the actual lead content, as is shown below.

Correct Sampling of Slag in Pot Difficult

The slag sample was taken from the middle of a pot of liquid slag with an iron rod, at a distance from the surface of about one-third of the height of the pot. The three-hour samples were mixed and a "dry" analysis was made; in the average twelve-hour sample, a "wet" determination was made. It was observed that a slag sample from the dump always gave more lead than the daily samples. Several slag cones were therefore broken up and samples from different parts analyzed. Figs. 1 and 2 are cross-sections of two different slag cones, and show the lead contents at different places. The average lead content of several slag cones (matte at the bottom not included) was about 25 per cent higher than the rod sample from the liquid pot; instead of 1.4 per cent, the lead content will therefore be about 1.75 per cent.



Figs. 1, 2, and 3. Results of analyses shown graphically.

It may be of interest to record that the difference between dry and wet assay, which is usually 0.3, increased to 1 per cent during the war, as a consequence of the use of poor fluxing material.

Slag Loss More Important Than All Others

Comparing the lead lost through the stack with that caught as flue dust, it was found that more than three times as much escaped through the stack as was caught. The main reason for this was, as mentioned before, that the exhaustor which removed the tap-hole gases discharged in the flue between furnace and dust chamber, and it was, moreover, too big. If this exhaustor had discharged into the open air, the amount of lead which escaped during one week through the stack would then have been reduced from 2.656 metric tons to 1.428. Under this condition, 93.25 per cent of the total lead loss would have been with the slag, and 6.75 per cent through the stack.

From the figures above recorded it is clearly evident that in smelting materials poor in lead the loss is mainly in the slag, and that in such an operation, given a good separation of matte and slag, the most important thing is to make a slag low in lead; however, the unavoidable slag losses will always be considerable.

The following indicates the degree in which the figures obtained agree with the theoretical ones, and how the unavoidable losses in the slag change with the lead content of the materials to be smelted.

Suppose a charge with 10 per cent lead, which produces 90 per cent slag with 1.4 per cent lead; a simple calculation shows that in such an operation 12.6 per cent of the lead goes into the slag. Charges containing from 5 to 40 per cent lead give the following figures:

Pb in the Charge, Per Cent	Pb in the Slag, Per Cent	Units of Slag on 100 Units of Charge	Units of Lead in the Slag	Lead Loss, Per Cent
5	1 4	95	1 33	26.6
10	1 4	90	1 26	12.6
15	1 4	85	1 19	8.0
20	1 4	80	1 12	5.6
25	1 4	75	1.05	4.2
30	1.4	70	0 98	3.27
35	1 4	65	0 91	2 60
40	1 4	60	0 84	2 10

Making this calculation for slags containing 1.75, 2.0, and 2.5 per cent of lead, and plotting the relation between lead on the charge and lead loss in the slag, gives the curves of Fig. 3.

Plotting the results of the actual test on the same system of co-ordinates, *a*, *b*, and *c* represent the total losses of the first, second, and third week, and a_1, b_1, and c_1 are lying, it is seen, pretty well in the theoretical curve for the losses in the slag with 1.4 per cent lead; and the curve which touches *a*, *b*, and *c* is a similar one, which proves that the results of the test are reliable.

It should be remarked that the losses in the slag are even greater than indicated, for the matte produced must be treated again, and in refining the work lead about one-fifth of it comes back as intermediate products which have to be re-treated. The losses in the slag by the intermediate products, as dross, skimmings, zinc oxide, and litharge, are not of importance, as these materials are rich and, in consequence, do not make much slag. However, the losses in re-treating the matte must be considered. To take a concrete example: During the test, in the first week 3.6 per cent of the lead appeared in the matte, which assayed 10.7 per cent lead. Now, considering a slag with 1.75 per cent lead, the losses in the slag by re-treating the matte are 0.6 per cent, so that the losses in the slag during the first week rise from 13.58 to 14.2 per cent; this also does not include losses in roasting the matte.

From the above results and considerations, and from the curves, it is seen that in smelting rich Serbian slags with 8.5 per cent lead, and taking the slag product as containing, on the average, 1.75 per cent lead, as seems to be right, the slag losses alone are 19 per cent, to which must be added the loss by the stack and the loss in matte which goes to the dump in consequence of the method of handling the slag, as was the practice in this particular instance. The actual total losses in smelting this Serbian slag in the plant under discussion were 24 per cent.

USEFUL OPERATING IDEAS

Loosening Frozen Casing or Drill Pipe With Oil

An Old Idea With a New Application—Circulation Must Be First Established—Little Equipment Required

THE practice of using oil instead of water as a mixing fluid in cable tool drilling is one of long standing, according to W. W. Copp in a bulletin of the California State Mining Bureau. One advantage of its use is that the casing remains free in the hole, even when there is considerable friction. Several oil operators have recognized the possibilities of this condition and have applied the principle involved in loosening casing frozen in holes drilled with either cable or rotary tools. The application of the idea is simple, provided circulation can be established either through the casing or the drill pipe, as may be most practicable. The only equipment required is a circulating pump, flexible hose, and a pressure connection at the top of the casing.

The procedure is as follows: Oil is pumped into the casing or drill pipe through a tight head until it has replaced the fluid in the well. This necessitates its passing up around the shoe joint or drill collar along the walls of the hole to the surface. When the oil appears at the surface it is returned to the pump and again circulated. After circulation is obtained, a strain is put on the pipe to be loosened. Circulation is then maintained until the pipe comes loose. It will do this of its own accord. The length of time required for circulation varies from a few hours to three days, depending on the amount and character of the material binding the pipe.

The probable action of the oil is to work through and permeate the formation holding the casing. This causes the formation to creep and become more elastic, thereby releasing its hold. In its effect on sand, the oil has a tendency to hold it in suspension and prevent the settling or packing which occurs in water or mud fluid.

It often happens that the string of casing intended to be the water string freezes in the hole, perhaps several hundred feet above the proper depth to shut off water. This necessitates the use of an additional and smaller string of casing, which not only adds to the cost of the well but reduces the size of the hole. It is obvious that if the original string of casing can be loosened by the method described and landed at the desired depth, a long step has been taken toward the successful completion of the well.

The Union Oil Co. of California has successfully used this method of loosening frozen casing or drill pipe in a number of jobs in the Richfield oil field. In drilling one well rotary tools were used and a 15-in. hole was drilled to 1,725 ft. A "feeler," consisting of four joints of 12½-in. casing on 6-in. drill pipe, was run to bottom and could not be pulled out. Customary pulling methods were used in an attempt to loosen the casing, with the result that the derrick was pulled in. After the derrick had been rebuilt, the method described above was tried and the string successfully removed from the well. Circulation with oil was maintained for three days, when the casing began to move. It literally jumped out of the hole a few inches at a time, finally coming entirely free.

In another operation, the well was drilled with rotary tools to a depth of 3,057 ft., when the drill pipe was lost in the hole and could not be recovered. After landing 12½-in. casing at 2,009 ft., the well was redrilled from 2,200 ft. with cable tools carrying 10-in. casing and underreaming to 12¼ in. Oil was used as the drilling fluid. The 10-in. casing was successfully carried to 3,062 ft. (1,053 ft. of friction at contact with formation), where it was cemented and a water shut-off obtained. While drilling from 2,200 ft. to 3,062 ft. the 10-in. casing stuck several times. When this occurred, an additional joint was screwed on, oil was circulated until the casing was loosened, and the casing worked until it became perfectly free in the hole.

The examples cited indicate that casing or drill pipe can be loosened with this process, even under severe conditions such as described in the first instance cited. Its use has been proved to be successful, and neither special equipment nor great expense is involved in the operation.

Where circulation cannot be obtained through the frozen pipe and up along the walls of the hole, the situation is not hopeless, as has been demonstrated by the Standard Oil Co. in its well No. "M/C" 78, in the Coyote Hills field. In this well a water shut-off was obtained with the 8¼-in. casing at a depth of 3,384 ft. Drilling was continued to a depth of 3,542 ft., using rotary tools. Six and one-quarter-inch casing was run in and stuck at 3,500 ft. Circulation could not be established. However, oil was introduced between the 8¼-in. and 6¼-in. casings, and a strain put on the 6¼-in. casing. The mud fluid was bailed to 3,000 ft. and its level maintained at this depth. The oil gradually worked down outside of the 6¼-in. casing and finally appeared on the inside. When this occurred, the pipe came loose and was completely removed from the well.

Home-Made Gasoline Locomotive

By ALLEN P. CHILD

A Texas company built a gasoline locomotive for use in its rock quarry from a truck which had been mired in a bad hole near by and which could not be removed without more or less wrecking. The motor and chassis of the truck were placed on a regular quarry car stripped of its body. Timbers running along its length and cross beams at either end served in raising the car frame. On this superstructure the motor and chassis were placed. An extension was made on the motor jackshaft, and on either side sprocket wheels were attached. To one of the timber supports along the side of the car another jackshaft with similar sprockets was attached. These sprockets measured 12 in. Attached to the inner side of the bearing of the jackshafts of the two shafts were two 6-in. sprockets. To the journals of the quarry-car wheels two 14-in. sprocket wheels were placed in line with the small sprockets on the jackshafts. The 12-in. sprockets on each side were linked up with a chain, as were the 6-in. to the 14-in. wheels. Power goes from the transmission to the first jackshaft driving the rear wheels of the car and also to the second jackshaft driving the front wheels of the car. Running on a 36-in. gage track this locomotive can easily haul a twenty-ton train.

Safety Factors and Ways of Attaching Hoisting Ropes

It is customary to compute the factor of safety of hoisting ropes by dividing the breaking load by the maximum load or by the aggregate weight of rope, useful load, cage, and cars. The factor of safety determined in this manner is called the static factor of safety. This does not give the real factor of safety, which is difficult to determine. The approximate estimate of the minimum value of the factor of safety can be obtained by dividing the breaking load by the sum of the maximum attached weight, the weight of the rope, the accelerating force in pounds, and the bending stress caused by the rope passing around the sheave. Bending stresses are uncertain, and no generally accepted formula is available for computation. Formulæ are given in various handbooks.

In mining practice the factors of safety range from 10 to 6, figured on the basis of breaking load divided by the weight of the rope plus the suspended load. Lower factors of safety are used with greater depths, as the longer rope can better overcome the uncertain loads due to shock, vibration, and high acceleration forces than short ropes. In manufacturers' catalogs a factor of safety of 5 is usually taken. Williams gives the static factor of safety for the hoisting ropes used at the De Beers mine as ranging from 7.89 to 6 and with the bending and accelerating forces included, the factors of safety range from 3.73 to 2.7. Certain rules given in Bulletin 75 of the U. S. Bureau of Mines provide that new ropes in shafts of less than 3,000 ft. in depth shall have a static factor of safety of not less than 6. Where the factor of safety, due to wear, falls below 4.5, such ropes shall not be used for hoisting or lowering men. In 6 x 19 ropes the limit of use for handling men is reached when the number of broken wires in one lay of a rope exceeds six. When the crown of the strands is worn down to less than 65 per cent of their original diameter, or when the broken wires are reduced by wear more than 30 per cent in cross-section, the number of breaks in any lay of the rope shall not exceed three.

Where long service is expected of a rope, a high initial factor of safety should be chosen. For deep hoisting just as small a factor of safety should be selected as safe operating conditions will permit. For flat ropes a somewhat higher factor, 20 per cent greater than for round ropes, is required. This is due to the difficulty of obtaining uniform strength over the full section.

Both sheaves and drums should be of sufficient diameter to prevent undue bending stress in the rope. Sheaves are proportioned from 800 to 1,000 times the diameter of the wire in the rope. The product of 100 and the diameter of the rope can be more conveniently taken.

In attaching hoisting ropes to drums the free end of the rope is passed through a hole in the drum close to the flange, looped around the drum shaft, and secured by two or more drop-forged rope-clips. The opening in the drum should have a rope-bearing of comparatively long radius, and under the drum shell there should preferably be a casting giving a long-radius bearing to the rope seat. A sharp bend produces a serious weakening of the rope. The excess length of the rope is coiled upon the drum, and sufficient should be used to prevent the complete unwinding of the rope. The extra coils serve to prevent a direct pull coming upon the rope clamps.

Three types of rope fastenings are used at the cage end—wire rope clamps or clips, rope sockets or capels, and wedge clamps. In using rope clamps the rope is fastened by from four to six clamps. This type of fastening is common in many Western mines. Comparatively few published tests of the holding power of rope clips are available, but opinion is in their favor. A test made with a ⅝-in. plough-steel rope gave the following results: One clip, tightened with 12-in. wrench, slipped at 8,360 lb.; one clip, tightened with 24-in. wrench, slipped at 10,020 lb.; and two clips, tightened under load, broke the rope at 21,710 lb. (*Engineering and Mining Journal*, Vol. 95, p. 472.) Probably the most serious objection that can be presented to the use of the clip is the crimping of the rope beneath the U-bolt.

Socket fastenings when carefully prepared will develop the full strength of the rope. One method of preparing is to wrap the rope tightly below the position of the socket, open the rope and straighten and clean the wires first with kerosene, wiping this dry and then dip into a one-to-one hydrochloric-acid solution, holding long enough to clean the wires. Wash off the acid and wipe the wires dry with a clean rag. Bind them together and slip the socket over and then evenly distribute the wires; cover the bottom of the socket with fire clay, and pour in molten zinc. The method as described is given in the catalog of John A. Roebling's Sons Co.

The rope thimble or socket is bolted to the draw head of the cage or skip in the simplest arrangement. In other methods it is bolted to a forging, to which are attached four chains. With this arrangement the chains and connecting forging must be annealed at regular periods. Some engineers advocate the use of a rope-detaching device between the rope fastening and the cage. The purpose of the device is to detach the rope automatically and prevent the cage from falling if overwinding should occur. The plates are held in place by a copper rivet which is sheared when the hook comes in contact with the bell which is attached to the headframe. The detaching hook has been known for a long time, but its use is not widespread. It is of doubtful utility, and safety engineers rely more upon automatic overwinding devices which stop the hoist at a given position in the headframe.

Device for Igniting Safety Fuse

A device called a "lead spitter," intended for igniting safety fuse, has recently been introduced. It consists of a small lead tube, half as thick as a pencil, which incloses a train of free-burning black powder, which, when ignited, spits a continuous stream of red-hot sparks. The lead melts away as the powder burns, thus permitting a steady emission of sparks.

THE PETROLEUM INDUSTRY

Deepest Well Drilled in California Proves Dry

The deepest well ever put down in the State of California in search of oil proved to be a "dry hole," and was drilled by the Standard Oil Co. of California twenty miles north of Main Camp, Lost Hills-McKittrick Division, Kern County. After boring 6,202 ft., the company abandoned the well and has given up hope of finding oil.

The history of the "well," as narrated by E. M. Delaney, superintendent of the Lost Hills Division of the company, is as follows:

Before we could start drilling (the well was spudded in during May, 1919), it was necessary to establish a camp large enough to accommodate about twenty men. The next problem was the water supply and fuel oil. We drilled a water well 550 ft. deep near the camp site which furnished an ample supply of water for the boilers and drilling, but before the water could be used in the boilers it had to be treated. Water for domestic purposes was hauled by truck from Lost Hills throughout the entire period of drilling operations. To secure fuel oil for the boilers we laid four and a half miles of 4-in. pipe line. An average of 40 bbl. of 18 deg. gravity crude oil was used daily.

On account of hard rock overlying this territory, cable-tools were used to drill an 18-in. hole to a depth of 210 ft., 75 ft. of which was solid rock. At this depth a rotary was installed and drilled an 18-in. hole to a depth of 1,691 ft., where the 12½-in. casing was landed and cemented. We used 11¼ tons of oil-well cement and 1,500 lb. of hydraulic lime. After standing cemented fourteen days, tested 12½-in. casing for water shut-off. This tested O. K. Drilled ahead with rotary, using 6-in. drill pipe and 12-in. fishtail bit to 1,875 ft. At this depth the 8¼-in. casing, with 100 ft. of perforated casing, was set in hole to test formations below 12½-in. casing. In tests made found only a very small showing 15.5 gravity oil.

After satisfactory tests were made at this depth and formation proved non-productive, pulled 8¼-in. casing out, drilled ahead, using 6-in. drill-pipe and 12-in. fishtail bit, to a depth of 3,500 ft., where the 10-in. casing was landed without being cemented. At this depth cable tools were used again. Put in 3,500 ft. of 8¼-in. casing and carried to a depth of 3,695 ft., where 8¼-in. casing was cemented, using four tons of oil-well cement. After standing cemented fourteen days, cleaned out cement below 8¼-in. casing and tested for water shut-off. Water was not shut off. Shot 8¼-in. casing off and pulled it out. Put 8¼-in. casing back in and sidetracked casing let in hole, and carried 8¼-in. casing this time to 3,694 ft. and cemented, using four tons of oil-well cement.

After standing cemented fourteen days to allow the cement to harden, tested 8¼-in. casing for water shut-off. Water was shut off. Put 3,694 ft. of 6¼-in. casing in hole and carried it to a depth of 4,031 ft. While making a test of formations at this depth for oil, after [illegible] perforating and bailing hole, froze 6¼-in. casing. [illegible] After bailing water down 3,000 ft. hole showed very little oil. Cut off 6¼-in. casing at 3,650 ft. and pulled it out. Ripped 8¼-in. casing off at 3,535 ft. and [illegible] it out.

After sidetracking top of 8¼-in. casing [illegible] cable tools, installed rotary using 6-in. drill pipe [illegible] 10-in. fishtail bit. Drilled ahead to a depth of 4,0[illegible] and set in an 8¼-in. liner at 4,080 ft. to hold [illegible] back. Drilled ahead through 8¼-in. liner, using 4-[illegible] drill-pipe and 8-in. fishtail bit to a depth of 5,327 ft., where the 6¼-in. casing was landed with a Texas boot on [illegible] top and 5 ft. of perforations at 4,180 ft., where 3½ tons of oil-well cement was pumped through and back of [illegible] 6¼-in. casing. After this was done drilled ahead, using [illegible] rotary with 3-in. drill-pipe and 5⅝-in. fishtail bit, drilling through 6¼-in. casing to a depth of 6,602 ft. The formation of this well was blue shale with a great number of hard shells to a depth of 5,327 ft.; from this depth to 6,602 ft. was hard brown shale, except hard shells at different intervals.

This is the drilling history of this well, except the many long and expensive fishing jobs which usually occur while drilling in hard formation. After drilling to this great depth and not encountering any oil showings below where the 6¼-in. casing was landed at 5,327 ft., it was decided to abandon the lower portion of [illegible] hole and test out formation back of 6¼-in. casing, which was done by pumping fifteen tons of oil-well cement through 3-in. drill-pipe and filling hole up to 4,773 ft. After this was done the 6¼-in. casing was perforated and the brown shale showings were tested out, which again proved to be non-productive.

Oil Prospecting in Australasia

Reuters' Trade Service

The Commonwealth government of Australia has decided to extend the period of oil prospecting licenses in the Northern Territory from one to five years. One hundred licenses have so far been granted.

The Commonwealth Oil Refineries, Ltd., which was formed in pursuance of an agreement between the Anglo-Persian Oil Co., Ltd., and the federal government, has decided to establish refineries in Melbourne and Sydney. Four hundred acres of land have been purchased near Williamstown (Victoria), and arrangements are being made for wharf and railway accommodation, water service, electric power, and the laying of pipe lines. Tenders are to be called for the supply of oil tanks with a capacity of from 2,000 to 10,000 tons. The Sydney refineries will be established at a later date.

Boring for oil is proceeding assiduously in the several states, and the most promising indications recently have been reported from Kilmore, Victoria, and the Barcoo district, in Queensland. Operations are being continued in Victoria, despite the fact that the Ministry of Mines characterized the ventures as "hopeless propositions."

According to advices from Wellington, New Zealand, a fresh attempt has been started to exploit the Taranaki oil wells. A start is being made with the Blenheim bore, where deposits at the 2,000 level will be tested.

Shale-oil operations at Newnes, New South Wales, are being curtailed, as the oil cannot be supplied as cheaply as it can be imported into the country. Those interested declare that there are many millions of gallons of oil in the deposits at Wolgan, but the problem is to discover an economic method of extracting it.

The Locke Oil Development Syndicate, Ltd., has been formed in Sydney, with an authorized capital of £12,000 in £50 shares, to acquire an option over a Western Australian oil concession.

Risks Great in Oil Fields of North-Central Texas

The wildcatter says, "Oil is where you find it," and he points to the oil fields in Stephens and Eastland counties, Tex., to prove that he is right. Certainly many wells whose locations were chosen at random in those counties, either without or against geologic advice, have struck oil, and many whose locations were carefully selected by enthusiastic geologists were so dry that they sizzled when the drilling water was put in. Geology of the common garden variety, planted in the region between Ranger and Breckenridge, Tex., has not produced a flourishing crop of dividends. On the other hand, there can be no doubt that geology properly applied by able men can greatly reduce the prospect of stupendous losses, such as have crippled or killed many of the companies that have essayed to develop oil in this rich field.

Unlike the Healdton, Cushing, Garber, Burbank, and other famous oil pools in Oklahoma, to the north, most of the pools in these counties in Texas are not indicated by well-marked domes or arches (anticlines) in the beds of rocks at the surface above them. To be sure, the beds that contain the oil which lies deep beneath the surface are sharply arched into anticlines and domes, and the oil, following the general rule, tends to gather at the crests of these deeply buried arches, but at some places the surface beds extend smoothly over the oil bonanzas, not suggesting by even the slightest bump or buckle the fortunes that lie far beneath them. More commonly the surface rocks are gently folded, but the folds are not of the same shape as the anticlines that hold the oil, nor do they lie vertically above them.

The task of the geologist, and through him that of the oil operator, is to discover the relation between the folds at the surface and those that his drill must strike at a depth of 3,000 ft. or more in his search for oil. He may find that the anticlines in the oil sands generally lie north of gentle anticlines on the surface, or that they lie east, south, or west of them. He may find that some of the anticlines in the oil sands lie below places where the surface beds are flat, or that steeply dipping beds on the surface are so commonly associated with anticlines in the oil sands that it is advisable to drill near them. Perhaps he may find that the surface anticlines which trend in a certain direction are reliable guides and that others are false guides, luring the operator to disaster. Any one of a great number of relations may be found, but the essential thing to keep in mind is that there is a relation and that it can be found.

Many forlorn investors in the oil fields in Stephens and Eastland counties, Tex., will testify to the desirability and the magnitude of the possible saving, for although these fields have been remarkable for their rapid development and for their many productive wells, they are no less remarkable for the high cost of drilling and operating, for the short lives of a large number of the wells, and for a multitude of dry holes. A few companies have been conspicuously successful, but many more have either barely paid expenses or have failed miserably—failed even to recover their original investment. Some of these failures are due to poor methods of operation and to the bull-like, blind policy of many of the large companies that shouldered into the field, sublimely indifferent to the repeated sickening jolts dealt them by extortionate leaseholders, by the supply companies, and by outrageously high operating expenses. Many companies that held productive leases and put hundreds of thousands of barrels of oil on the market failed to earn enough to balance their original outlay. A large percentage of the absolute failures, however, particularly those of small companies, are due to the fact that the operators did not strike oil in the single well that they had sufficient funds to drill.

HOW TO PREVENT FAILURE

The remedy for this waste and failure is to study painstakingly the geologic structure in the oil-bearing beds as revealed by well records, to determine the shape, outline, and position of the anticlines, and then to determine the relation between the structure far below the surface and that at the surface. Some of the strong companies have undoubtedly made such studies, but most of them guard jealously such information as they have obtained. The U. S. Geological Survey, Department of the Interior, is furnishing some assistance in the exploitation of the oil and gas resources of the country by publishing reports describing in detail the surface rocks in promising areas and containing maps showing the structure of the beds. These reports are sent from the Geological Survey at Washington to anyone requesting them. A report recently issued as Bulletin 726-G, by Clarence S. Ross, entitled "The Lacasa Area, Ranger District, North-Central Texas," describes a block six miles square in the southeastern part of Stephens County, Tex. It is not a monographic report on the geology and oil prospects of that area, but serves well as a foundation for further geologic investigation.

California Crude Oil Prices

The following are the current prices offered by the Standard Oil Co. for crude oil at the well, as reported by *Oil Field News*, San Francisco, Cal., March 15, 1922:

CRUDE OIL PRICES—SAN JOAQUIN VALLEY
AND WHITTIER-FULLERTON FIELDS
(Per Barrel.)

14 to and including 17.9° gravity	$1.10
18° to and including 18.9° gravity	1.11
19° to and including 19.9° gravity	1.13
20 to and including 20.9° gravity	1.16
21 to and including 21.9° gravity	1.20
22° to and including 22.9° gravity	1.25
23° to and including 23.9° gravity	1.31
24° to and including 24.9° gravity	1.38
25 to and including 25.9° gravity	1.46
26° to and including 26.9° gravity	1.55
And for each increase in gravity of one (1) full degree above 26.0° gravity, up to and inclusive of 34.9° gravity, ten (10) cents per barrel additional; 35° gravity and above	2.45

CONSULTATION

Commercial Grades of Magnesite

"I am interested in the various grades of magnesite that are used in the United States—that is, the common salable grades. For what purposes is magnesite mainly used? Kindly tell me the difference between dead-burned and caustic magnesite. I would like to have a few analyses of the typical domestic and foreign product."

The magnesite marketed in the United States is sold in two general classes—as crude magnesite and as the calcined product. The crude mineral is the run-of-mine product which may have received some simple treatment such as crushing, sorting, or screening before being shipped. It is essentially the raw mined mineral. Calcined magnesite refers to crude magnesite which has been roasted to remove all or part of its combined carbon dioxide.

When the magnesite is roasted at moderate temperatures, so that all of the contained carbon dioxide has not been driven off, the product is termed "caustic magnesia." Usually from 3 to 8 per cent of carbon dioxide is intentionally retained in the calcine so that in its subsequent use the caustic magnesia will readily react with water and carbon dioxide in the air in cement manufacture or with various acids in the manufacture of magnesium salts. The action is comparable with that of quicklime when mixed with water. About two tons of crude furnish one ton of calcined magnesite.

Dead-burned magnesia, as its name implies, is magnesite that has been roasted until but one-half of 1 per cent or less of combined carbon dioxide remains. Dead-burned magnesia, unlike the caustic variety, will not combine with water and slake or combine with chemicals. It is put on the market in granular form and as brick. More magnesite is consumed in the manufacture of dead-burned magnesia than in other forms.

Magnesite is used mainly in the manufacture of refractory brick for use in the basic open-hearth process of steel production and in copper metallurgy. It is used as a lining in converters, kilns for sulphuric-acid manufacture from pyrites burning, and in electric furnaces. The magnesite industry is almost entirely dependent for its prosperity upon conditions in the steel trade, which requires more than 80 per cent of the domestic consumption. No substitute has been found that will wholly take the place of magnesite refractories. High magnesian dolomites have been tried and found fairly satisfactory, but they do not make a product as highly refractory.

Caustic magnesia is used largely in the plastic trade for manufacture into cements and flooring. When mixed with magnesium chloride, a byproduct of salt manufacture, caustic magnesia is converted into Sorel or oxychloride cement, which makes an excellent flooring and may be mixed with various fillers, cork, talc, marble dust, sand, clay, asbestos, silica and other materials to be sold under a trade name. It is claimed for the use of magnesite flooring that greater resiliency is obtainable than with ordinary cements, a physical characteristic permitting lighter building construction. From 10 to 15 per cent of the domestic consumption of magnesite goes into the plastic trade, a use for the mineral which seems to be gaining in importance.

American magnesite is purer than the Austrian product, which contains a small but desirable percentage of iron. The absence of this element in the American magnesite is overcome by adding iron synthetically in the form of from 2 to 5 per cent of magnetic iron ore during the roasting of the magnesite. The product is termed a ferromagnesite or ferromagnesia.

Typical analyses of American and foreign grades of magnesite were given in articles that appeared in the Jan. 14, 1922, Feb. 4, 1922, and March 11, 1922, issues of *Engineering and Mining Journal*. Additional information is supplied by the publications of the U. S. Geological Survey in its separates on "Magnesium."

Marketing Manganese Ore

"What would you suggest as my best method to find a market for manganese pigments and other manganese concentrates?"

Before finding a market for any mineral a producer should carefully ascertain the grade or grades he is capable of producing and the amount that can be regularly delivered under a contract. Uniformity of product and constancy in mineral shipments are requirements which many mineral producers neglect to meet, frequently making the consumer resort to importations.

We have not heard of manganese being used as a pigment (coloring agent), although it is being used as a drier in paints. As a drier it is added only in minute amounts, less than 0.5 per cent, so that a small quantity of manganese produced for that purpose will go a long way toward satisfying a consuming demand. The function of a drier is to make linseed or other drying oils capable of absorbing oxygen from the air or of drying by its action. The natural manganese mineral pyrolusite, when used for that purpose, is ground to a powder in water and then dried. Pyrolusite is essentially a peroxide containing oxygen loosely combined and readily combining with other oxidizable bodies. This characteristic of manganese compounds is used to advantage in manganese driers, for when added to boiling oil the excess oxygen combines with the oil, oxidizing it, some of the manganese dissolving and forming a compound with linoleic acid in the oil.

If the prospective manganese producer is desirous of supplying the relatively small amounts of manganese used for this purpose, a good plan is to get in touch with the nearest paint manufacturers.

Other uses for manganese ore exclusive of steel making are in dry-cell manufacture, as decolorizing agents in glass manufacture, and in chemical manufacture. The specifications of manganese battery ore were outlined in *Engineering and Mining Journal* of Dec. 24, 1921. Anyone having under consideration supplying consumers of these grades of manganese ore should first investigate the local field for his product.

BY THE WAY

Chiclet Contest Over

There are two sides to a statue, just as there are to a controversy. As seen from one side last fall, at the exhibit of the National Association of Women Painters and Sculptors, Mrs. Whitney's now famous statue was known as "The Engineer," and no one quite understood. One had a chance recently, however, to see it from an opposite point at the exhibition of the Society of Independent Artists on the Waldorf Astoria roof. To one's surprise and enlightenment it was called "In the Trenches." The light breaks. All is forgiven. But what sticky muck the lad is shoveling! And, incidentally, Mrs. Whitney gets the Chiclets.

"In the Trenches," by Mrs. H. P. Whitney. The other side is known as "The Engineer"

In California

Shame and humiliation has humbled the native sons. California's wonderful climate has not lived up to its name. Easterners have returned with tales of rain, snow, cold and the "flu." Westerners make similar complaints. Our Lordsburg correspondent went to Los Angeles for the holidays and is only now recovering. Likewise Duncan MacGregor, a valued contributor, was almost lost to us by reason of a well-nigh fatal assault by uncalifornian weather, this in spite of a rugged Scotch constitution. MacGregor has a passion for mountain climbing, which he frequently indulges. But California was too much for him. We have decided hereafter to go to Florida or Bermuda on our annual winter vacation. Thus California loses.

Many theories have been advanced to explain this situation. One scientist holds that the north pole is moving south. This is a chestnut. What good would it do if it got there? Is not the south pole as cold as the north? The theory should therefore be discarded. Then, too, there is quite a bit of talk about earthquakes, as if they were a regular thing in California and were only ignored by the Chambers of Commerce lest they drive visitors away. All in all, California has had a bad time of it lately. The boosters, that is, the tellers of the plain unvarnished truth, almost forgot to boost. But better times are coming. The sun is getting warmer even here in raw New York. Cheer up, California.

Geology in the Filbert Islands

Although we do not intentionally wish to detract attention from our book-review page, we feel compelled to call attention to that deliciously humorous little volume, "The Cruise of the Kawa." The comments relating to the geology of the Filbert Islands, as expressed by one of the members of the exploring party, are as follows:

> "It is plain," he said, "that the basalt monadnock on which we stand is a carboniferous upthrust of metamorphosed schists, shales, and conglomerate, probably Mesozoic or at least early Silurian."
>
> "You doubtless noticed on the shore that the deep-lying metamorphic crystals have been exposed by erosion, leaving on the upper levels faulted strata of tilted lava-sheets interstratified with pudding stone."
>
> "Evidently then," continued the professor, "the atoll is simply an annular terminal moraine of detritus shed alluvially into the sea, thus leaving a geosyncline of volcanic ash embedded with an occasional trilobite and the fragments of scoria, upon which we now stand."

Certainly this is the work of no amateur and is well worthy of such scientific humorists as Lewis Carrol and Stephen Leacock. It is quite obvious that certain promoters of mining and oil stocks, whose sole object is the exchange of beautifully engraved certificates for the cold, hard coin of the realm, have overlooked an opportunity. The Cagliostros of fake oil and mining properties would indeed have hard work presenting such a convincing display of geological phenomena.

Keen Cutters

"Seems to me, m'son," said Cap'n Dick, "I 'ave told thee stories baout mos' o' tha minin' districts in tha country, 'cept per'aps tha lead an' zinc mines daown an' raoun' about Joplin, Missouri. So 'ere gaws, jus' so thee won't think I'm partial: Seems as 'ow Jimmy Trenow 'ad been daown there some little time, w'en long comes Jan Polglaze, 'oo 'e'd nawn h'up to that Sibley mine, in tha h'iron country. Firs' thing h'off Jimmy 'ad to show Jan h'all baout tha place, so 'ee takes un h'out for a walk. If thee's h'ever been daown in that part of the country, m'son, thee naws a chap can't gaw very far 'less 'ee runs h'into some o' these 'ere razor-back 'ogs. So, sure nuff, Jimmy an' Jan runs h'into a passel o' they h'out sunnin' in a field, an' tha 'ugest 'og wuz a-rubbin' 'isself again a tree, firs' h'on one side then h'on tha h'other. 'Dam-me,' sez Jan, 'w'ot's call they?' 'Razor-back 'ogs,' sez Jimmy. 'W'ot's for that gert chap rubbin' 'isself 'gainst tha tree, you?' 'W'y, dam-me,' sez Jimmy, 'mus' be 'ee's stropping' 'isself.' "

A Suggestion

Somebody might write something on the relation of rebellious ores to the Permian revolution. We have been trying to but can't. Inspiration seems lacking. A paper on the subject would fill in a gap on the program at the next A. I. M. E. meeting—that is, one of those gaps that one would frequently like to see on the program.

SOCIETIES, ADDRESSES, AND REPORTS

Hoover Outlines Engineer's Functions at Colorado River Commission Meeting

Herbert Hoover was the guest of honor at a dinner given by the Engineering Council of Utah on March 27. With Secretary Hoover were other members of the Colorado River Commission, A. P. Davis, director of the Reclamation Service, and others. The speakers were: Mayor C. Clarence Neslen of Salt Lake City, Governor Charles R. Mabey, W. S. Norviel, of Arizona, W. F. McClure, of California, D. E. Carpenter, of Colorado, Colonel James S. Scrugham, of Nevada, Governor Mecham of New Mexico, F. C. Emerson, of Wyoming, and Governor Emmet D. Boyle of Nevada.

Director Davis was the only speaker except Secretary Hoover who held the floor for more than two minutes. He spoke of the Colorado River and its possibilities, saying that the problem of the Colorado had been under investigation by the Department of Reclamation for more than twenty years. Mr. Davis was followed by Captain F. M. Bishop, a member of the second Powell expedition, which made the first survey of the Colorado River from Green River, Wyoming, to the mouth.

Mr. Hoover in his speech dealt chiefly with the engineer's relation to the life of the community and his function in government. Most problems to-day, said Mr. Hoover, are economic and physical, and for the solution of the latter type the engineer is necessary. The engineer's life is in the open, and the results of his work are easily discernible. The engineer has nothing for sale except his own services, and he meets problems in a disinterested spirit. In matters of legislation he belongs neither to the group for or against any particular measure, as he has nothing to gain either way.

Speaking of the work of the Colorado commission—the cause of his coming to Salt Lake City—Mr. Hoover pointed out that this was the first great national problem to be presented to the engineering profession for its recommendation. The solution of the problem of the Colorado River was an interstate problem in engineering, and its solution lay on the basis of engineering facts.

Among the questions for which the engineering profession can find a solution is that of great waste in production and distribution. A super-power project planned for the North Atlantic seaboard would save a billion dollars a year by supplying central power. The development of the Colorado River possibilities would add four million hp. to the national supply. Even a moderate standardization of railroad freight cars would greatly reduce the cost of transportation.

One of the most difficult engineering problems is that of the bituminous coal industry, in which a double wage is paid for half-time employment, and 40 per cent more men are employed than are needed to get the coal for domestic requirements. It is an engineering problem to bring the industry out of its present condition of alternating profiteering and bankruptcy, and to get it back on a full time basis of employment.

Mr. Hoover's speech received enthusiastic applause. The meeting was one of the largest gatherings of engineers ever held in Salt Lake. About 600 were present.

Safety Association To Co-ordinate Work of Local Safety Chapters

The Joseph A. Holmes Safety Association, which is composed of various national societies interested in mining and metallurgy, held its annual meeting at Washington, D. C., on March 6. The following abstract of a report indicates an important additional activity of the association.

The association will now take charge of local safety societies which the Bureau of Mines has formed, in the following way: Each important mining district is visited soner or later by one of the first-aid cars of the Bureau, which remains in the locality for a sufficient time to educate the miners in first-aid work and give to those who have established proficiency a certificate or diploma. It is common practice before the instructors leave the neighborhood to organize those who have become proficient in first-aid work into a local chapter, which is organized for the purpose of promulgating first-aid work and social betterment of the miners. Frequently the local chapters lose interest in their work, through lack of stimulus from a national center. Therefore, the Joseph A. Holmes Safety Association has undertaken to organize all of these local chapters and to see that their interest is continued, so far as is possible. It is expected that many new similar chapters will be organized, both by the Bureau of Mines and by direct application to the association itself, under specified rules and regulations.

The main work of the association has thus far been to bestow medals for heroism in risking life in saving others in mining accidents.

A. A. E. Seeks Amendment of Model Licensing Law

Among the developments at the quarterly meeting of the board of directors of the American Association of Engineers, held on March 24 and 25, was the draft of a proposed amendment to the Model Engineers' License Law. This grants an engineer or surveyor registered in a state permission to practice in another state for not more than ninety days without being registered there, and without paying any fees, provided he files with the board of the state in which he is not registered a certified copy of his certificate of registration and also informs the board of his intention to practice, his address while in the state, the date of his work, and the approximate time required. Another change provides that engineers employed by partnerships or corporations may sign and seal the plans prepared by the partnership or corporation.

Prospectors Organize in British Columbia

Much interest was shown last winter in the lectures delivered by British Columbia government mining engineers to mining men. They were largely attended on the coast, and reports from the interior indicate similar appreciation. One of the results has been the organization of a Vancouver Island Prospectors' Association, Thomas Golby being selected as chairman and G. E. Winkler secretary. It is the purpose of the organization to call prospectors and others interested in mining together frequently for the discussion of matters of common interest.

SOCIETY MEETINGS ANNOUNCED

The eighth annual convention of the **American Association of Engineers** will be held in Salt Lake City, Utah, on June 5, 6 and 7, 1922.

Preliminary preparations for the **International Mining Convention,** to be held at Nelson, B. C., during the summer, are being perfected.

The Southwestern district of the **American Association of Engineers** will hold its third annual convention at Las Cruces, N. M., on April 13, 14 and 15. This district has jurisdiction over West Texas, Arizona, New Mexico, and Mexico.

MEN YOU SHOULD KNOW ABOUT

Carl Beal, of San Francisco, is visiting Washington, D. C.

R. E. Miller is making examinations in the Lordsburg, N. M., district.

W. E. Thorne recently left San Francisco on his way to New York and London.

C. A. Pierce, mining operator of Patagonia, Ariz., is in Kansas City on mining business.

O. E. Meinzer has received the doctorate degree in geology from the University of Chicago.

Walter A. Funk, mining engineer, formerly of Idaho Springs, Col., has moved to Paso Robles, Cal.

James P. Porteus, superintendent of the Bonney mine, at Lordsburg, N. M., has returned from the Coast.

H. McLeod Cobb, mining operator of Guanacevi, Durango, Mexico, is in El Paso, Tex., purchasing supplies.

George Parent, M. P., of Montreal, has been appointed a member of the board of directors of the La Rose mines.

E. A. Julian, of San Francisco, general manager of the Goldfield Consolidated, was in Reno, Nev., on March 23.

A. C. McLaughlin, of San Francisco, is in Washington conferring with Government officials on petroleum matters.

C. L. Nelson and **Roscoe Reeves** have returned to the New York office of the Sinclair Exploration Co. after extensive work abroad.

R. Frizzell, of Prince Rupert, B. C., has returned from an extended trip in the Mackenzie River and Copper Mine River districts.

H. W. Hardinge returned to New York on March 29 from a business trip abroad. He spent a month in England, France, and Belgium.

C. M. Weld, of Weld and Liddell, left New York on April 4 for Alabama, where he will be engaged on professional work for about one month.

Walter L. Reid, of the United Comstock Mines Co., is in San Francisco completing details for the milling plant now under construction at Gold Hill, Nev.

Stanly A. Easton, general manager of Bunker Hill & Sullivan Mining & Concentrating Co., returned to Kellogg, Idaho, from San Francisco the latter part of March.

E. A. Holbrook, assistant director of the U. S. Bureau of Mines, is at the Massachusetts Institute of Technology, where he is delivering a series of lectures on mining subjects.

W. R. Wilson, president of the Crow's Nest Pass Coal Co., Fernie, B. C., was recently elected president of the Canadian Institute of Mining and Metallurgy to serve for the coming year.

C. P. Ross, of the U. S. Geological Survey, is en route to Tucson to study the economic geology of the Christmas quadrangle. Later he will make a survey in the neighborhood of Arivaipa.

F. Cushing Moore, **J. C. Haas**, and **L. K. Armstrong** were appointed a committee recently by Columbia Section, A. I. M. E., for the further investigation of oil possibilities in and around Spokane.

J. M. Boutwell, formerly geologist with the U. S. Geological Survey, who recently finished an examination of the deposits of copper-silver ore at Morococha, Peru, visited Salt Lake City last week.

Oscar Hershey, geologist for the Bunker Hill Mining & Concentrating Co., returned the latter part of March to San Francisco, after a visit to the Bunker Hill operations at Kellogg, Idaho.

C. W. Hall, formerly assistant mine superintendent for the Tigre Mining Co. at El Tigre, Sonora, Mexico, is now superintendent of the Yoquivo Development Co., San Juanito, Chihuahua, Mexico.

J. J. Forbes, mining engineer, with the Southern station of the U. S. Bureau of Mines, left Birmingham, Ala., recently for an inspection tour of the mines in North Carolina, Tennessee, and Florida.

John S. Lutes, general manager of the Tod Stambaugh Co., accompanied by **Charles H. Claypool**, general superintendent, has completed a tour of inspection of the company's properties on the Mesabi iron range.

Dr. H. M. Payne was in San Francisco on March 27, en route to Bakersfield and Taft, where he will visit California oil fields. Mr. Payne will then return to New York, stopping at Golden, Col., and Cleveland, Ohio.

Stewart S. Bruce, formerly professor of metallurgy and ore dressing at the Michigan College of Mines, is temporarily filling the chair of metallurgy at the University of Idaho, **Prof. R. B. Elder** having a leave of absence on account of illness.

John M. Sully, general manager of the Chino Copper Co., and **E. M. Sawyer**, manager of the Burro Mountain Branch, Phelps Dodge Corporation, who have been attending hearings before the State Tax Commission at Santa Fe, have completed their work and returned home.

Robert Linton, chairman of the New York Section of the A. I. M. E., was a guest on March 28 of the Pittsburgh Section at a dinner at the William Penn Hotel. Later in the evening Mr. Linton addressed the mining and metallurgical section of the Engineers' Society of Western Pennsylvania.

H. Kenyon Burch has completed a concentrating plant at Bisbee, Ariz., for the treatment of Sacramento Hill ore for the Copper Queen Branch of Phelps Dodge Corporation, and is leaving for his home in Los Angeles, where, in all probability, he will take up general consulting work. The Moctezuma Copper Co.'s plant is nearing completion, and Mr. Burch will remain in charge until the plants have been started.

Mining and metallurgical engineers visiting New York City last week included: **Walter M. Small**, Monterey, Mexico; **Walter Graham**, Washington, D. C.; **J. P. Furbeck**, Cleveland, Ohio; **H. M. La Follette**, La Follette, Tenn.; **Walter J. Browning**, Spain, and **Oscar Lachmund**, Spokane, Wash.

OBITUARY

John Ballot, president of the Minerals Separation North American Corporation, died in New York on April 2. He was born in South Africa and came to New York in 1915 after twenty years in London as a mineral expert.

Edwin S. Shanklin died in San Francisco, Cal., on March 18. Mr. Shanklin was a graduate of the University of California, class of 1891, and was one of the first engineers in the development of the Goldfield and Bullfrog districts in Nevada.

George R. Davis, topographic engineer in charge of the Pacific division of the topographic branch of the U. S. Geological Survey, died at Sacramento on March 31. His service with the Geological Survey dates from 1898. He was forty-five years old.

Charles McKintsrey Van Cleve died at San Diego, Cal., on March 10, aged sixty-nine years. Mr. Van Cleve retired from actual metallurgical work some years ago. He was in Leadville, Col., in the early 80's and later was superintendent of the El Paso smelting plant, the Compania Metalurgica Mexicana smelter at San Luis Potosi, the Penoles smelter of the Mapimi Co., and of the Guggenheim's Monterey smelter.

John R. Tregloan died at Alameda, Cal., on March 21, of pneumonia. He was born at Hazel Green, Wis., in 1846. He came to California with his parents in 1855 and was educated in the public schools of that state, the University of the Pacific, and Oakland College. His first experience in mining was at White Pine, Nev., in 1869. From there he went to Amador County, Cal., where he was employed in the Gover and Potosi mines. Later he and his father opened and developed the South Spring Hill mine, of which he became superintendent, holding that position until he retired from active business in 1895. In 1906 he moved to Alameda, where he remained till his death.

Technical Papers

Economic Geology of Quebec—Memoir 127 of the Canadian Geological Survey, Ottawa, is a brochure of 105 pages on the "Beauceville Map-area, Quebec." The report is confined largely to the placer deposits of the Chaudière River basin, which were worked for gold from 1847 until a few years ago. Other deposits occurring within the district include ores of copper, molybdenum, and iron; and platinum, asbestos, steatite, marble, and clay. The report may be obtained on request.

Waste in the Wisconsin Zinc District—A ninety-nine page mimeographed bulletin prepared by Coghill and Anderson and published in co-operation with the Missouri School of Mines and Metallurgy and the Wisconsin Mining School discusses the experimental determination of a method for reducing mineral waste in the Wisconsin zinc district. Important losses in the practice as at present conducted can be obviated, it is indicated, by tabling and flotation. Progress toward electrolytic methods of recovering the zinc, rather than smelting, is also mentioned.

Timber Preservation—Reports of Investigations, U. S. Bureau of Mines, Serial No. 2,321, contains a paper on "Mine Timber Preservation," by R. R. Horner and George M. Hunt, which was presented at the New York meeting of the A. I. M. E., Feb. 20-23, 1922. The purpose of this paper is to point out some of the benefits and economies to be derived by the better selection, preparation, storage, preservation, and utilization of mine timber, and to give some specific information on certain wood preservatives and processes suitable for mine-timber preservation.

Mineral Resources—Recent publications in the "Mineral Resources" series, published by the U. S. Bureau of Mines, Washington, D. C., obtainable on request, include: "Cobalt, Molybdenum, Nickel, Tantalum, Titanium, Tungsten, Radium, Uranium, and Vanadium in 1920," thirteen pages; "Iron Ore, Pig Iron, and Steel in 1920," thirty-four pages; "Stone in 1920," thirty-seven pages; "Cement in 1920," twenty pages; "Tin in 1919," four pages; and "Salt, Bromine, and Calcium Chloride in 1920," nine pages.

Sulphur and Pyrites—The Imperial Mineral Resources Bureau has issued a bulletin on the sulphur and iron pyrites industry of the British Empire and foreign countries. Following the style of other bulletins in the series, statistics of production and consumption are given for the years 1913 to 1919, and the state of the industry in the most important producing countries is outlined. A selected bibliography is appended. The bulletin may be obtained from H. M. Stationery Office, Imperial House, Kingsway, London, W. C. 2, for 1s. 7½d.

Canadian Mineral Production—The preliminary report of the Mineral Production of Canada for 1921 is now available from the Dominion Bureau of Statistics, Ottawa. Total value of mineral products decreased from $237,422,857 in 1920 to $172,327,580 in 1921, but the quantity of gold, lead, zinc, corundum, and tripolite produced was greater than in the preceding year.

Bureau of Mines—The U. S. Bureau of Mines, Washington, D. C., has prepared a 185 page mimeographed report summarizing the principal investigations being conducted by the Bureau for the fiscal year beginning July 1, 1921. The bulletin may be obtained on request. Summaries of the more important work are included, but the report contains little scientific data, and consists largely of a description of what work is being done at the various stations, together with the personnel of the different staffs.

Square Set Stoping—*Compressed Air Magazine* for April (11 Broadway, New York, price 35c.) continues a series of articles on mining methods in the Butte district of Montana by publishing a five-page article giving details of timbering for the support of badly faulted ground and the procedure for the recovery of caved stopes. The description is well illustrated with diagrams and photographs.

Mine Management—Pope Yeatman delivered a most valuable paper at the recent meeting of the A. I. M. E. in New York, "Factors in Mine Management That Lead to Loss and Waste." It is published in the March issue of *Mining and Metallurgy* (29 West 39 St., New York; price $1). Institute members who are accustomed to take the contents of that magazine lightly should not overlook this paper by Mr. Yeatman.

Tunnel Ventilation—Ground has already been turned for the construction of two vehicular tunnels under the Hudson River to connect New York and Jersey City and to obviate the delays now caused by ferry transportation. Two cast-iron tubes will be used, of a maximum diameter of 29 ft., lying 60 ft. below the surface of the water, and having a span from portal to portal of 8,500 ft. The exhaust from automobiles will make proper ventilation difficult. An article in *Compressed Air Magazine* for April (11 Broadway, New York; price 35c.) describes the laboratory research work which has been done at Yale, Pittsburgh, and Urbana, chiefly under the direction of the U. S. Bureau of Mines, and shows how the problem has been solved.

Open-stope Mining—The open-stope system of mining carried out at the Spies mine, near the village of Iron River, Mich., is described in a two-page illustrated paper in *Mining and Metallurgy* for March (29 West 39th St., New York; price $1). The disadvantages of the shrinkage-stope system and the merits of the method described are outlined.

Lead Milling and Smelting — *The Canadian Mining Journal* of Feb. 24, 1922 (Gardenvale, Quebec; price, 15c.), contains a three-page article describing the Kingdon lead mill and smelter at Galetta, Ont., near Ottawa. The milling is simple, the principal apparatus being Mitchell screens, rolls, James automatic jigs, Hardinge mill, Richards classifiers, James tables, and a Callow cone thickener. The smelter consists essentially of a Newnam ore hearth. More than 3,000,000 lb. of lead was produced in 1921.

Canadian Mineral Production—The preliminary report of the mineral production of Ontario in 1921 is now available in Bulletin 43, eleven pages, obtainable on request from the Minister of Mines, Toronto. A preliminary statement of the mineral production in the province of Quebec during 1921 is available in an eight-page pamphlet obtainable from the Bureau of Mines, Quebec.

Economic Geology — *Economic Geology* for March-April (Lancaster, Pa.; price, 65c.) contains a twenty-five page article "The Geology of the Braden Mine, Rancagua, Chile," and a nineteen-page article "On the Metasomatic Processes in Silicate Rocks."

New Vanadium Mineral — In the *American Journal of Science* for March is a nine-page article describing what has been termed melanovanadite, a new mineral from Mina Ragra, Pasco, Peru. It is a calcium-vanadium-oxide. Separates of the paper may be secured from W. Spencer Hutchinson, 201 Devonshire St., Boston, Mass.

Canadian Mining Engineers—In the *Bulletin* of the Canadian Institute of Mining and Metallurgy for February (503 Drummond Building, Montreal; price, 50c.) appears the annual list of members. The arrangement is alphabetically by provinces, a method which we do not like. The membership list of the A. I. M. E., by the way, is not to be issued at all this spring, as usual, but may be published at the end of the year.

Perpetual Inventory System — The perpetual inventory is recommended to those firms "who are not satisfied that their material investment is at an efficient minimum; who suffer periodically from shortages of material; who are unable to make monthly profit-and-loss statements, who fret at the prospect of the annual physical inventory; and who are not adequately conserving their material investment by giving it the best physical care." The U. S. Chamber of Commerce has published a practical treatise on the subject, of twenty-eight pages, which may be obtained free by writing to the Chamber of Commerce of the United States, Mills Building, Washington, D. C.

Precious Metals—"The Recovery of Precious Metals From Sudbury Ores," seven pages, appears in the February *Bulletin* of the Canadian Institute of Mining and Metallurgy (503 Drummond Building, Montreal); the price of the separate being 25c.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

THE "porphyry" copper companies resumed on April 1, production to be on a limited scale at the start and gradually increased.

United Comstock, at Virginia City, Nev., has completed its 11,000-ft. haulage tunnel, which at times was driven from nine headings.

J. Parke Channing has resigned as president of the Seneca Copper Corporation and Walter Lewisohn has retired as a director.

Coal stocks are said to be equal in the aggregate to two months' requirements, but are not evenly distributed.

Hearings on the mine law revision bill are to start in Washington on April 27.

The Montreal iron mine, on the Gogebic Range, Michigan, has received orders to resume on full time as soon as possible.

A way has been provided for meeting the power needs in central and southern Arizona through laws recently enacted at Phoenix. It involves increasing the height of the Roosevelt Dam and the construction of power dams at other points.

The Premier Mining Co., in British Columbia, has declared a 10 per cent dividend, amounting to $500,000, for the first quarter in 1922. That for the preceding quarter was $400,000.

A Federal excess profits tax lien for $647,000 has been filed against the Consolidated Arizona Smelting Co.

Porphyry Copper Group Resumed April 1

Production To Be on Moderate Scale at Start — Utah Experimenting with New Flotation Cell

Announcement that the Jackling group of porphyry copper companies, including the Utah, Ray Consolidated, Chino, and Nevada Consolidated companies, would resume on April 1 was made on March 31 by Charles Hayden. Mr. Hayden stated that copper stocks on hand have been disposed of for delivery within the next ninety days. Production, he said, would be on a small scale at the start, but would be gradually increased to a rate of about 50 per cent of capacity.

The Utah Copper Co. has been experimenting at its Arthur plant with a new flotation cell used at the Ray Consolidated mill at Hayden, Ariz. About 1,000 tons per day has been handed intermittently since Jan. 1, yielding 8 to 10 cars of concentrates per week. About sixty Japanese were recently put on the track gang at Bingham. In all about 250 men are working on track repairs. The Garfield smelter has been getting another reverberatory ready.

Preparations in a small way have recently been under way at the Ray, Chino, and Nevada Consolidated plants.

Ray Hiring Old Employees

By Telegraph to Engineering and Mining Journal-Press."

Ray, Ariz., April 3—Ray Consolidated is hiring all old employees who can be reached. It is reported that the mill and smelter will be started soon.

Federal Tax Lien Blocks Sale of Consolidated Arizona

By Telegraph to Engineering and Mining Journal Press."

Prescott, Ariz., April 3—Sale of the holdings of the Consolidated Arizona Smelting Co. to the Southwest Metals Co., which was to have taken place April 7, has possibly been held up by the filing, in Prescott, of a notice of a Government excess profits tax lien for over $647,000. The Southwest Metals Co. had prepared to bid $1,000,000 and had taken over gross claims of $2,300,000. The receiver for the Consolidated Arizona company, G. M. Colvocoresses, went to Globe on April 3 to appear before the Federal judge there, asking assistance.

An effort will also be made in Washington to secure relief from what is called a technical levy on profits not realized.

Ray Hercules Plan Operative

The plan to reorganize the Ray Hercules Copper Co. as the Ray Hercules Mines, Inc., was recently declared operative by the reorganization managers, effective April 5.

New Mexican Coal Mines Run Despite Strike

By Telegraph to Engineering and Mining Journal-Press."

Dawson, N. M., April 3—The coal mines in northern New Mexico, controlled by the St. Louis, Rocky Mountain & Pacific R.R. and the Phelps Dodge Corporation, are not likely to be affected by the strike, it is thought.

Trail Smelter Lowers Penalty for Zinc in Ores

Makes Further Concessions to Shippers in Matters of New York Exchange and Lead Quotations

Prospects for independent silver-lead shippers of southeastern British Columbia have been improved somewhat by the announcement of the Consolidated Mining & Smelting Co. of Canada, Limited, that a larger proportion of the New York exchange on gold and silver is to be allowed the shipper, especially when the exchange is at a low rate. The deduction of 1½c. per lb. on the London lead quotation is to be changed to 1¼c. The penalty for zinc is to be lowered from 50c. to 30c. per unit. These concessions will give the shipper of the ordinary grade silver-lead ore or concentrate an increase of around $4 per ton on his output.

Some weeks ago J. J. Warren, president of the Consolidated company, was quoted as stating that arrangements had been made for the installation at Trail of a custom zinc plant and with its completion the minerals of the Kootenay carrying this element would not be subject to penalty as heretofore. Wide publicity was given this declaration in the province. It is understood, however, that too broad a construction has been placed upon Mr. Warren's words. It is true that a custom zinc plant is to be constructed, that zinc concentrates will finally market at Trail, and that the latest metallurgical methods will be applied to the treatment of the complex ores of the Kootenay. There is no doubt that this is an important advance, but that the problem of economically handling these ores has yet been completely solved has not been demonstrated.

Preparing To Meet Power Needs in Central Arizona

Under the guise of an act to promote agricultural development and to extend the scope of the Salt River Valley reclamation project, the recent special session of the Arizona Legislature has enacted laws to facilitate the generation of hydro-electric power in large quantity for the mines of central and southern Arizona. The Salt River Valley Water Users' Association now has authority to proceed with work promised in raising the height of the Roosevelt Dam and in construction of power dams at Mormon Flat and at the mouth of Fish Creek, on Salt River. The statement was made before a legislative committee that much of the money for these improvements will be forthcoming from large mining interests, that would be repaid in electric current over a term of years. Within sixty miles of the new works lie the mines and plants of the Inspiration, Old Dominion, Miami, Magma, and Ray Consolidated companies, besides scores of properties of lesser magnitude. The association's lines also may be extended soon to Tucson, where electric power could be supplied to the mines of that locality, as well as to the municipalities of Tucson, Casa Grande, and Florence.

Freeport Sulphur Co. Takes Hoskins Mound Lease

The lease of the Texas Company on the Hoskins Mound sulphur deposit, near Freeport, Texas, has been taken over by the Freeport Sulphur Co. A plant will be installed and will be in operation by April of next year. A royalty of $1 per ton, payable to the Mound Company, owner of the deposit, has been assumed by the Freeport Company. In addition there is a contingent royalty, payable to the Texas Company, which will equal 50 per cent of the net profits until the Freeport Sulphur Company has realized out of the remaining profits an amount equal to its plant investment with 6 per cent interest. After that the contingent royalty will be 70 per cent of the net profits.

Hoskins Mound is a salt dome, situated about fourteen miles northeast of the Freeport Company's present mine at Bryan Mound. For a number of years it has been intensively developed by the Texas Company, which controlled it entirely, and several million tons of sulphur have been proved.

The Freeport Sulphur Company has an extra sulphur-mining plant stored at Bryan Mound, which probably will be used at Hoskins Mound, and it is stated that a railroad may be built from Hoskins Mound to Freeport. The mine at Bryan Mound may also be reopened in the near future.

Rio Tinto Dividend Passed

By Cable From Reuters to
"Engineering and Mining Journal-Press."

London, April 3—The Rio Tinto dividend on the ordinary shares has again been passed.

United Comstock Haulage Tunnel Completed

Connection was made on March 27 between the Knickerbocker and Belcher shafts, completing the United Comstock's 10,000-ft. haulage tunnel in the Gold Hill section of the Comstock lode, Virginia City, Nev. The tunnel was begun in August, 1920. At times work was done from nine headings. The completion was three months later than anticipated on account of encountering difficult ground in the portal section.

Miami Smelter Running Three Furnaces

By Telegraph to
"Engineering and Mining Journal-Press."

Miami, Ariz., April 3—Three furnaces are running at the International smelter at Miami, with production of copper at a rate that is the largest that the plant has known.

Tariff Against America's Copper Threatened in Japan

The Japanese government is reported to have introduced a bill in the Diet to increase the import duty on copper, brass, and bronze. Imported American copper is said to be considered in Japan as threatening the life of the industry there. No copper was imported from the United States by Japan before the war, but during and since the conflict large quantities have been received. Many smaller mines in Japan have closed and the larger ones have suspended or curtailed production.

Spanish Lead Mines Close

By Cable From Reuters to
"Engineering and Mining Journal-Press."

Madrid, March 25—The uninterrupted fall in the price of lead has caused a further closing down of mines in the Cartagena basin. Interested producers are demanding measures of protection.

Channing Resigns as President of Seneca Copper

The resignations of J. Parke Channing as president of the Seneca Copper Corporation and of Walter Lewisohn as a director of that company were offered and accepted at a meeting of the Seneca directors on March 29 in New York. Their successors have not been appointed. Robert Linton, the first vice-president, will act as president until Mr. Channing's successor is chosen.

As recently announced, the Seneca board now consists of Thomas F. Cole, Robert Linton, R. M. Atwater, Jr., W. F. Bartholomew, James Deering, W. B. Anderson, George H. Tomlinson and J. Parke Channing. W. J. Uren will continue as general manager of the property at Calumet, Mich.

Company Liable for Accidents From "Horse Play"

Michigan Labor Department Holds Practical Jokers as Dangerous as Intoxicated Employees

The Michigan Department of Labor and industry has handed down a decision holding employers liable for injuries caused by the "practical jokes" of employees. They declared the employing company, by hiring a man known to indulge in horse play and permitting him to go about its plant where he could play dangerous tricks on other employees, "knowingly added an additional hazard to the employment of other men for which they are responsible." Such a man, they declare, is "a fool who is no less dangerous than a man who naturally is vicious or intoxicated," and "accidents might reasonably be expected, following the employment of such a man, and the company is liable."

The ruling is of considerable interest to mining companies, as "horse play" is prevalent among the miners, especially when going to and from their working places. Although the men are not actually at work at such times, the employer is no less liable for their safety. One of their favorite "tricks" has been for a man with rubbers on to give another man a shock from the trolley wire, the perpetrator seldom feeling any effect, but the victim sometimes being knocked down by the shock.

Montreal Mine on Gogebic Range To Be Reopened on Full Time

By Telegraph to
"Engineering and Mining Journal-Press."

E. W. Hopkins, manager for the Oglebay Norton Co. on the Gogebic Range, in Michigan, has returned from Chicago with orders to open the Montreal iron mine at Ironwood on full time as soon as possible. Five hundred men will be employed, with wages a little lower than the scale of the U. S. Steel Corporation.

Gold Discovered in Bohemia

By Cable From Reuters to
"Engineering and Mining Journal-Press."

London, April 1—Dispatches from Prague report that excavations now being made in the Commune of Belapod Bezdezem, in northern Bohemia, have led to the discovery of a body of gold-bearing pyrites, 12 m. thick, at a depth of 50 m. Drilling will be done to ascertain the extent of the deposits.

A. H. Brooks Now Chief Alaskan Geologist

A new major subdivision has been created in the United States Geological Survey by raising the Division of Alaskan Mineral Resources to the status of a branch. Heretofore the Alaskan work has been a subdivision under the Geologic Branch. The work will continue under the immediate direction of Colonel A. H. Brooks, whose title under the rearrangement is Chief Alaskan Geologist.

News from Washington

By PAUL WOOTON
Special Correspondent

Coal Sufficient for Two Months, But Not Evenly Distributed

Buying Power of Half Million Men Seriously Affected—Operators Feel Misrepresented.

Though the country has coal stocks sufficient to run it for nearly two months, even if no coal were mined, it is known definitely that these stocks are not evenly distributed. It is feared that once shipments from mines in union territory are suspended, because of the coal strike, it will develop that a large number of consumers have inadequate storage facilities.

Applications for priorities in transportation began reaching Washington before the strike began. One large consumer wrote to Washington on the eve of the strike to the effect that his contracts were with union mines and that his plant is so situated that his current coal supply must be taken from aboard cars. It is not known just how typical these cases are, but it is believed that an avalanche of complaints will be reaching Washington before the strike is two weeks old. Though the operators express great confidence as to their ability to maintain distribution, there is no evidence of the machinery which will be essential to its handling.

Officials at the Department of Commerce say that the coal strike comes at a particularly unfortunate time. The chief concern at the time of a coal strike revolves around the possible inability to secure sufficient supplies of fuel. No great amount of public concern is now apparent as to the supply, and as a result the average person is not worrying. That the buying power of no less than 550,000 men and their dependents is suddenly reduced materially has apparently not been considered, nor have its probable effects been weighed. The men now on strike represent 2 per cent of the able-bodied men of the country. This abrupt loss of buying power gives business, already sick, a jolt it is in no position to withstand. In addition, operators make few purchases of equipment or anything else during the time that their mines are closed by a strike.

Coal operators, generally, feel that their side of the labor controversy is not being presented by the daily press in a sufficiently comprehensive way to give the public a correct picture of their position. They realize that there is no intention on the part of reputable newspapers to misrepresent the situation, but it happens that the developments which appeal to the newspapers are those which, standing alone, put the operators in a bad light. Moreover, the public does not differentiate between anthracite and bituminous. As a result, the fact that the anthracite operators did meet their men in conference has been largely ignored, and the relatively high price of anthracite causes the great majority of the people to overlook the fact that bituminous prices have declined greatly. These instances are typical of a number of misconceptions. When these outstanding conceptions are mingled, they are like the components of an explosive. Incidentally, the operators are the ones most likely to suffer if the compound is touched off.

Bids Asked for Construction of Nenana Bridge

Alaska Railroad Now Officially Named—Will Be Complete to Fairbanks Next Year

The Alaskan Engineering Commission has called for bids for the construction of the Nenana bridge, on the Alaska railroad. The bridge will be ready for service March 1, 1923, and will practically mark the completion of the line to Fairbanks. The railroad beyond the Nenana River is now being operated as a narrow-gage, but standard-gage ties already have been placed. Once the bridge is completed, it will require a short time to set the rail over so as to accommodate broad-gage equipment. The new road has recently been officially designated the "Alaska Railroad."

The bridge to be built will be of particular interest, as it will have a 700-ft. single-truss span. To meet the requirements considerable quantities of special nickel and silicon steels will be used.

I. C. C. Rate Decision Deferred Until April 15

The decision of the Interstate Commerce Commission in the matter of a general reduction in rates, it now appears, will not be forthcoming before April 15. At present the case is being studied by the commissioners individually. If they should find themselves in substantial accord, the decision probably could be handed down as early as April 15, but important differences between them obviously would considerably extend the time.

Weight of Gasoline Per Gallon To Be Considered

The Interstate Commerce Commission has suspended until July 29 the proposal of railroads to cancel the estimated weight of 7.4 pounds per gallon and to substitute actual weight per gallon on crude or fuel oil from Kansas, Missouri, Oklahoma, and Texas to Arizona and New Mexico and to Cananea, Mexico. The case will be heard before an examiner of the commission on April 10 at Chicago.

Hearings on Mine Law Revision To Start April 27

W. R. Ingalls Asked To Be First Witness—Planned To Get Views of All Concerned.

Public hearings on the bill proposing an extensive revision of the United States mining law will be begun on April 27 before the Committee on Mines and Mining of the House of Representatives. Representative Rhodes, the chairman of the committee, says that every effort will be made at this hearing to build up a comprehensive record which will contain the views of all concerned in this much-controverted matter. He declares there will be no effort to rush legislation through, but after full opportunity has been given to all concerned to present their views, the committee expects to take definite action based on the conclusions which it will draw after having heard all of the testimony. An effort will be made to give wide circulation to printed copies of the testimony as the hearing progresses.

Mr. Rhodes has asked W. R. Ingalls, chairman of the committee which drafted the bill introduced by Representative Arentz, to be the first witness. He also hopes to have other members of the Ingalls committee testify at the opening of the hearing, so that other witnesses may have clearly in mind the painstaking efforts which were made by this committee to secure the most practical suggestions on which the changes proposed are based.

District West of Mount McKinley Promising, Commission Says

The Alaskan Engineering Commission in its report for 1920, which has just been transmitted to Congress, states that there is a mining district in Alaska to the west of the McKinley National Park which is showing promising mineralization. In the past, owing to its isolation it has not been worked extensively, but the commission regards it as a probable source of a large mineral tonnage. The Alaska Road Commission recently has focused attention on this zone and has had surveys made with a view of improving roads leading to it. Generally, there has been a slowing down of efforts of the small gold prospectors in Alaska and the commission does not anticipate the working of low-grade ores at a profit for several years.

Government's Silver Purchases

Purchases of silver by the Bureau of the Mint during the week ended April 1 amounted to 193,000 fine ounces. This brings the total purchases under the Pittman Act to 101,485,608 fine ounces.

News by Mining Districts

London Letter

Colombian Mining and Exploration Co. Without Reserves—Buena Tierra Mine a Failure Thus Far

By W. A. Doman

London, March 21—Shareholders in the Colombian Mining & Exploration Co., upon which E. C. Heinemann, one of the directors, has just reported, have received something of a shock. Who is responsible for the high hopes held out in 1920 concerning the Marmato Hill properties is not clear, but certain it is that documents exist stating that the company's gold fields are several miles in extent, and that, at that time, well over 500,000 tons of about 10-dwt. ore had been developed. In fact, "the workings so far have only been scratched." This was good enough for the market, and brought the shares up to a high price—something like £3 in fact. Now it appears there are no ore reserves. Frank B. Powell, general manager, has informed Mr. Heinemann that the main oreshoots opened up by previous managers have had the cream of the ore taken from them, and in no instance was the mine blocked out ready for stoping.

It may, perhaps, be remembered that some stir was made two years or so ago by reports of a deposit of *anchadura* of fully 300,000 tons, valued at £1 per ton net profit. Mr. Heinemann makes no reference to this *anchadura*. The position, in fact, at Marmato, for keeping a 10,000-ton plant employed—and this is the size of the plant under consideration—does not appear to be exceptionally favorable. Mr. Heinemann evidently entertained some such view, for during his visit to the property he acquired on behalf of the Colombian Mining & Exploration Co. the Echendia mine from Norman Jenks and his brother. Some capital assays are mentioned in connection with orebodies on this property, and if the veins should continue to develop in the same manner, the purchase price of £125,000 may be warranted. Mr. Heinemann describes himself as only a layman, and it is therefore somewhat unfortunate that, in reference to the Echendia, he says: "The potentialities are so obvious that I will not insult your intelligence by calling attention to them." The Echendia ore, he says, is amenable to cyanide treatment, and it is anticipated that an extraction of from 80 to 90 per cent can be made.

It is seldom that the chairman of a mining company has to confess himself in the wrong, but R. T. Bayliss, of the Exploration Company, did so at the meeting of shareholders last week. He admitted that he was responsible for the investment of the company's funds in the Buena Tierra mine, and up to the present the property has proved to be a failure. The reason of the failure is, that Mr. Bayliss was over-sanguine with regard to the quantity, not the value, of the ore exposed in the mine at the date of his visit. At the ruling price for lead, the mine cannot be operated at a profit, though this is not the sole reason for its closing down. There was not sufficient ore exposed, either in grade or quantity, to defray the cost of extraction and treatment. Development work during the past two years has been disappointing. Mr. Bayliss, nevertheless, is not altogether despondent, and thinks that when costs are lower the mine will experience the same change of fortune that others in the country have had.

A general sigh of relief went up when it was announced that the revolution on the Rand had been quelled. For revolution it proved to be, and not merely organized protest against the proposed reduction of white miners' wages. The prospect now for mining on the field is much brighter than for many years, and calculations are already being made on the basis of reduced expenses, and the possibility of raising much needed capital in connection with various companies.

TASMANIA

Electrolytic Zinc Co. of Australasia Increases Output

The Electrolytic Zinc Co., at Risdon, Tasmania, during the four weeks ended Feb. 8 produced 1,400 tons of zinc, as compared with 1,238 tons during the preceding four weeks, and 382 tons for the four weeks following the start of operations. The product for the four weeks ended Feb. 8 contained 222 tons of lead and 36,277 oz. of silver. This is sent to Port Pirie for realization.

Rail Tonnage in Last Quarter of 1921 Over Half From Mines

Products of mines contributed 131,224,680 tons to the 246,488,989 tons of freight handled by the railroads during the last quarter of 1921. The freight furnished by mines shows the falling off of more than 62,000,000 tons, as compared with the fourth quarter of 1920.

The principal losses in tonnage were in bituminous coal and in iron ore, although each mineral commodity, with the exception of asphalt and salt, contributed to the decrease. The detailed figures, which are those of the Interstate Commerce Commission, are as follows:

	Fourth Quarter, 1920 Tons	Fourth Quarter, 1921 Tons
Anthracite coal	21,224,244	18,820,581
Bituminous coal	110,522,086	77,443,806
Coke	6,871,501	3,029,036
Iron ore	20,605,039	4,370,568
Other ores and concentrates	3,843,791	904,801
Base bullion and matte	120,918	68,064
Clay, gravel, sand and stone	26,232,054	23,199,670
Crude petroleum	1,590,738	1,493,371
Asphaltum	309,590	416,640
Salt	642,172	771,941
Other products of mines	1,451,284	706,202
Totals	193,413,417	131,224,680

Melbourne Letter

Mount Lyell Restricts Operations Further—Conditions of British Contract for Zinc Concentrates

By Peter G. Tait

Melbourne, March 6—Further restrictions of operations are announced by the Mount Lyell M. & R. Co. (Tasmania) as a result of the failure of the arbitration court to grant them relief in rates of wages and labor conditions. The directors, after returning from a visit to the mine, recently announced that the Mount Lyell mine would be shut down, experiments having proved that concentrates from the North Lyell ores can be smelted without the addition of the low-grade pyritic ore. To make up the required tonnage of ore, the concentrator is to be immediately extended to enable it to treat 10,000 to 12,000 tons of North Lyell ore per month. The directors state that despite all the economies introduced and increased efficiency obtaining during the last twelve months, operations on the basis now outlined cannot be maintained without a loss, and unless the courts grant relief or the price of copper improves, the situation will have to be reviewed in six months.

As to other Australian copper producers, Wallaroo has closed down, and Mount Morgan is preparing to reopen, but to what extent is not apparent. The Cloncurry field is dead, but British and French capital is forthcoming to develop the Elliott group. The Chillagoe state mines and smelters in Queensland are controlled by an optimistic politician who has been holding the copper produced during the last six or twelve months waiting for the rise in price. Doubtless if he holds it long enough a better price will be realized, but whether it will show a better financial return after allowing for interest, storage and other charges remains to be seen. In any event, few companies can allow their money to be tied up indefinitely. He maintains that Chillagoe, with its small output, can produce copper at as low rates as the large American properies. He talks of reducing the cost of production, but wages are not to be touched. The only item he can point to is coke. When locally produced coke is available from the Mount Mulligan property, coke will cost about £3 per ton, as against about £5 at present. Chillagoe does not possess natural advantages, the mines are small, and their situation entails heavy cost for transport on incoming supplies and outgoing shipments of bullion.

According to recent press cables received in Australia there has been some discussion in the British House of Commons regarding the contract entered into between the British Board of Trade and the Zinc Producers' Association. In that discussion it was stated that the Board would take the earliest opportunity of terminating the contracts, but although several members desired explicit information as to the rates to be paid for concentrates, the government refused to divulge the information.

It may therefore be of interest to set forth the conditions attached to the contract, as published in *Chemical Engineering & Mining Review*:

"The contract was for the period of the war and ten years after, including the stocks on hand at the end of 1917, which were purchased at the flat price of 60s. per ton on the stacks at Broken Hill. The scale of future output was made over three periods: First, during the war and one year after; second, four years after that; third, five years after that.

"1. During the war and one year after: 250,000 tons annually at the following prices: 100,000 tons at 90s. per ton, f.o.b. Port Pirie; 100,000 tons at 80s. per ton, f.o.b. Port Pirie, and half of any profit on resale; 50,000 tons at 80s. per ton, f.o.b. Port Pirie.

"2. Four years after that: 300,000 tons annually at 90s. per ton, Port Pirie, and half the profit on resale, less 100,000 tons to be allotted to British smelters.

"3. Five years after that as No. 2 period.

"The assay basis for the whole period is: Zinc 47 per cent, lead 7 per cent, silver 10 oz. per ton; any variation at the rate of 4s. per unit zinc, 1s. 3d. per unit lead, and 1s. 3d. per oz. silver. No payment for silver if under 5 oz. per ton. Excess freight over 60s. to be halved, but the price to be not less than 80s. per ton in any case."

The journal above mentioned, in commenting on the position, states:

"As a rough estimate of the value at these prices, it may be mentioned that on the basis of pre-war freights and smelting rates spelter would have to be about £28 per ton to warrant the price being given. With freights about 10s. per ton higher than pre-war and smelting rates on a higher basis, and spelter ranging about £25 per ton, it can be seen that the contract cannot be a favorable one to the British government, and also that there is no likelihood of any surplus being divided with the producing companies."

Granby Consolidated Building New Reservoir

Prince Rupert—Exceedingly cold weather during February and the early part of March has greatly reduced the output of a number of chemical and metallurgical plants in the northern part of British Columbia, by holding the snow in the mountains and freezing the streams and creeks. Thus those plants that were dependent on water power either had to close entirely or considerably curtail their output. The Granby Consolidated Mining, Smelting & Power Co., for example, had to shut down three of its four large blast-furnaces. Milder weather recently has released the water, and the plants are resuming operations. The Granby company, to avoid the possibility of the recurrence of such a delay, has begun the construction of a 25,000 acre-foot reservoir, one and a half miles higher up Falls Creek than its present reservoir. The company is constructing a temporary railway to haul material for the construction of the dam.

CANADA

British Columbia

Premier Declares Half Million Dividend for First Quarter—Portland Canal District Showing Activity

Sandon—Edward T. Davey, of Tacoma, Wash., president of the West Hunter Mining Co., examined the American Boy property, on Reco Mountain, last month. This mine shipped considerable crude ore in the early days of the Slocan. The property is owned by the American Boy Mining Co., but has been inactive for about fifteen years. It is believed that the West Hunter Co. has an option on the group, as Mr. Davey made an announcement to the effect that operations are to be resumed this spring, with W. J. Smith, superintendent of the Tamarack & Custer, in charge.

Nelson—The raise being put up from No. 3 to No. 2 levels of the California mine, near here, is nearing completion, with 190 ft. finished by the end of March and 15 ft. unfinished at that time. This work will connect all levels of the mine, which will then be in condition for steady production. Milling operations will be started early in May, it is believed.

Grand Forks—Six mineral claims, formerly held in the name of Herbert W. Young, of this city, managing director of the Maple Leaf Mines, Ltd., have been handed over to that company, following the starting of litigation over the property.

Trail—Ore shipments received at the Consolidated smelter from March 15 to 21 totaled 11,062 tons, all from the company's mines.

Alice Arm—The Portland Canal mining district is beginning to stir, although the open season must be considered some distance away. A new bridge is being thrown across Bear River by the provincial government. This will make easy of access the Marmot and Bitter Creek section, where there will be much prospecting this summer. The Premier Gold Mining Co. has been at work all winter, and with the opening of its new aërial tramway has begun making regular shipments. The country adjacent to this company's property has been widely staked, and substantial investments will be made in the prospecting and exploring of this area.

It is interesting to note that the Premier Mining Co. on March 30 declared a dividend of $500,000 for the quarter ended March 31, on its capitalization of 5,000,000 shares of a par value of $1 each. Following as this does the payment of a dividend of $400,000 for the quarter ended Dec. 31 last, the Premier appears to be realizing rapidly the anticipations of the most sanguine.

The Independent group on Goose Creek is being extensively developed by the Fitzgerald Brothers. Supplies have been taken in over the snow, and work will continue all summer. There are reported to be three large parallel mineralized zones on the property. On Bitter Creek the L. L. & H. group is said to be showing good results. A large tonnage of milling ore has been proven.

The Drum Lummon mine, at Hartley Bay, in northern British Columbia, is likely to be developed, it having been announced that $275,000 has been secured in New York for that purpose. The building of a new camp, a dock, and a railroad and the installation of a new compressor plant are planned. There are three large veins, and it is intended to open them up at depth. Some high-grade copper-gold ore has been taken out so far.

Ontario

"Blue-Sky" Legislation Dropped—Removal of Discovery Clause From Mining Act Sought— Boom in Gold Stocks

Cobalt—It is understood that the Ontario government has decided not to proceed with the "blue-sky" legislation as drafted by A. H. O'Brien, after a long investigation. The policy that will in all probability be followed is an amendment to the Ontario Companies' Act which will necessitate promoters giving more definite information of their organizations than is now demanded. Machinery will be provided to check up the information and provisions made for speedy prosecutions for illegal actions.

The Minister of Mines is sponsoring a bill in the Ontario Legislature to amend the Mining Act, the proposed measure embodying some radical changes. If the amendments are made law it will not be necessary to make a discovery of "valuable mineral in place" to secure the rights to a mining claim. As now constituted, the act requires that the prospector make a sworn affidavit that he has discovered valuable mineral, and although under the present act most prospectors commit a mild form of perjury, it is felt that this clause has something to commend it. Many persons interested in mining feel that altogether too many changes are being made in the Mining Act, and, as a matter of fact, few engineers are now able to recognize it. It is also felt that the mineral rights which constitute one of the region's greatest natural resources are rapidly being taken up, and that in a few years it will be necessary to take back parts of these areas upon which no attempt has been made to prospect or develop. If the discovery clause is removed one of the easiest methods by which undeveloped and unprospected claims could be made to revert to the Crown will be eliminated. The proposed bill also makes a large number of other changes in the act, but the elimination of the discovery clause is the most important.

Provision is made in the bill for the operation of the Temiskaming Testing Laboratories by the Department of Mines and the purchase of small shipments of ore from prospectors. Extra powers are conveyed to the Mining Commissioner, the most important giving him the right, formerly held by the Minister, to transfer to active partners the rights of those who do not perform work or pay lease rentals or who have allowed their mining licenses to expire.

Northern Ontario is experiencing, what it has not enjoyed for many years, a real boom in the gold stocks. Practically every stock in the list has had a big advance, and in some instances this has amounted to as much as 400 per cent. Though brokers, and particularly mining brokers, have been looking forward to this for some time, when it did come it took them rather by surprise, as they did not expect a real bull market in mining stocks until next fall. In a great many properties mine developments and general conditions justified enhanced prices for the shares, but with a number of them the bull movement has been much overdone. The public, however, is taking an active interest in the gold stocks, and, as is usual in a rising market, have lost all sense of values.

Ex-Speaker Rhodes of the Dominion government, now president of the British American Nickel Corporation, has closed a satisfactory contract with the British Metals Corporation as exclusive agent for the company in Britain and Europe. The various nickel companies are exceedingly active in trying to find new markets for their products and in developing new metals for its use. Monel metal, which is produced by the International Nickel Co., is now being used in a large number of industries, and recent developments indicate that a considerable quantity may be used in the pulp and paper mills, where its non-corrosive qualities make it extremely valuable. It is also extensively used in the coal-washing plants, where the water contains a large amount of acid. The Mond Nickel Co. has purchased a small rolling mill in Pennsylvania with which to roll sheets and bars. A great deal of attention is also being paid to the development of new alloys, and it is understood that satisfactory results have been obtained by the addition of about 25 per cent of aluminum to monel metal. The disarmament proposals will cut off a large part of the market which nickel companies have previously supplied, and to survive it is essential for the companies to find new uses for their product.

Negotiations are practically concluded between the Dominion Reduction and the Peterson Lake for the retreatment of the large tonnage of old tailings.

During February Nipissing produced ore of an estimated net value of $161,000 and shipped bullion from Nipissing and customs ores of an estimated net value of $131,695. The low-grade mill treated 7,081 tons and the high-grade plant 170 tons. The refinery shipped 200,745 fine ounces of bullion during the month.

ARIZONA

Magma's Smelter To Be at Mine—Greenway Announces Plan for Power Dam at Peach Springs—Verde Central on Three Shifts

By James H. McClintock

Phoenix — From Superior has come word that the Magma Copper Co.'s new smelter is to be built at the mine, and not at old Pinal or Magma station. General Manager Browning returned from New York with full approval of his plans, which are now awaiting only the funds already provided for by the directorate. Though Magma is showing better with depth, it is believed that it has a good future also in the Lake Superior and Arizona ground acquired several years ago on both sides of the Queen Creek gorge, just above the Superior townsite.

Jerome—Verde Central is operating three shifts, drifting on the 650 level and sinking the shaft, which is now more than 75 ft. below that level. Operation is somewhat handicapped by limited hoisting ability.

Two steam-shovel shifts are working at the United Verde and are contributing to a degree to the stockpiles at the Hopewell tunnel. The Kansas City Structural Steel Co. has been awarded a contract for the steel of the new United Verde crushing plant.

Bisbee—General John C. Greenway, manager of the Calumet & Arizona, states that application has been made for authority to build a power dam north of Peach Springs, across the Colorado River channel, and that favorable response is expected soon. The plan is backed by a number of Arizona mining interests. In no way, it is claimed, does it conflict with the Government's Boulder Canyon project or with the Edison plans at the head of the Grand Canyon, near Lee's Ferry. General Greenway says also that the proposed railroad from Ajo to the Gulf of California can be constructed, according to a recent estimate, for $3,000,000, considered low in view of the resultant lowering of freight expense.

Tombstone—Owing to the burning of a bridge on the Tombstone branch of the El Paso & Southwestern, most of the mines of the district are without fuel and have been forced to close temporarily.

Chloride—The Brunswick has completed unwatering of shaft and main level. One shift of machine men is driving this drift to the south, where it is hoped to strike the oreshoot.

Tuckahoe has resumed shipping high-grade silver ore to the Midvale smelter. Contract has been let for 500 ft. of drifting into new ground on the north.

Dardanelles new electric equipment is arriving at the mine. A 400-ft. compressor and 50 hp. hoist are the main items. Power line, road, and building construction for the new shaft is progressing. It is planned to sink 400 ft., connecting with the present workings at the 200 level. A new level will be driven under the ore at the 400 level.

NEW MEXICO

Colorado Fuel & Iron Co. To Take Silver City Manganese Ores—Aztec To Enlarge Mill

By James P. Porteus

Silver City—The Colorado Fuel & Iron Co. has contracted for manganese ores to be shipped to its Pueblo, Col., plant. These ores will come from the Boston Hill and Chloride Flat properties in the Silver City district. E. A. Perrault is making arrangements to start work at once, having taken a lease on Boston Hill ground. L. P. Goodier, of Denver, has taken leases from the C. Armory Stevens estate on Chloride Flat and on ground on Boston Hill also. It is expected the total daily shipments will be 200 tons.

Steins—McGee Brothers will change their original plans and install steam-power equipment in place of internal-combustion engines recently tried out on their zinc property at Steins. They are in the market for a 170-hp. water-tube boiler, a 150-hp. engine and a complete condensing plant.

Baldy—The Aztec Gold Mining Co. intends to enlarge its mill and is in the market for milling equipment. Its post-office address is Ute Park, N. M.

UTAH

Victoria's Most Productive Orebody Opened at Greater Depth

Eureka — Ore shipments from the Tintic district for the week ended March 24 amounted to 154 cars, compared to 144 cars the week preceding. Shippers were: Tintic Standard 43 cars; Chief Consolidated, 38; Iron Blossom, 19; Victoria, 17; Eagle & Blue Bell, 13; Colorado, 11; Swansea, 5; Gemini, 3; Centennial-Eureka, 3; Bullion Beck, 1; Eureka Mines, 1.

At the Victoria, the orebody from which has come the largest production of the mine in the last year's output has been opened at greater depth on the 1,875 level. In January, 1921, the mine shipped 1,633 tons, and this was about the production until the middle of the year, when the output was cut on account of smelting conditions. In July, owing to the finding of a new orebody, production was increased so that an average output of around 3,500 tons per month was maintained for the rest of the year. Production for 1921 amounted to 27,671 tons, an increase of 15,076 tons over 1920. Net smelter returns for 1921 were $308,620.

At the Grand Central the tramway is undergoing repairs, which operation is necessitating the storage of ore in the mine. Upward of forty railroad cars are awaiting shipment by lessees.

Smith-Hovland Suit Up Soon for Final Argument

The noted Smith-Hovland suit, that took nearly a year of hearing in a special master's court in Tucson, Ariz., and which involves more than $1,000,000 in the settlement of an established partnership that had been denied, is to be submitted soon in the Federal Court at Tucson for final argument.

MONTANA

Butte & Superior's Copper Ore on 2,600 Level Leaner—Barnes King Explains Decrease in February Bullion Output

BY A. B. KEITH

Butte—The copper ore showing in the two faces of the drift on the 2,600 level of the Black Rock mine of the Butte & Superior Mining Co. recently has been considerably leaner as compared with the grade of the ore cut when the crosscut first picked up the vein at this depth. But so little drifting has been done at this point on the copper vein that any definite conclusion as to what might be shown on the 2,600 level cannot be attempted. Assays across the face have been running around 1 per cent copper, as against 5½ and up to 7 per cent in that section of the vein where it was entered by the crosscut. The drift on the vein on the 2,600 level, according to reports from the mine, has been driven only about 50 ft. Raising is in progress from the 2,200 level, with the top above the 2,100, where it is in copper ore running up to 7 per cent.

Butte & Superior is operating now at approximately 90 per cent of normal, which is considered to be 1,000 tons of ore mined and milled. This output, it is estimated, will afford the Anaconda sufficient concentrates to yield about 7,000,000 lb. of zinc monthly.

The Barnes-King Development Company reports bullion production for February at $14,432.51. The lower output as compared with previous months is explained in an official statement as follows: "In the mill a concentrating table was started working between the Chilian mills and tube mills, and about 400 lb. of concentrates per day, carrying high gold values, with some lead and copper, are being taken out of the circuit. These will be leached and finally shipped to the smelter, but the bullion record will be out of proportion until this is under way."

WASHINGTON

Minorca-Homestake Financing Arranged—Bead Lake Company Preparing to Start Mill

Bossburg—Arrangements are being completed for financing on an adequate scale the Minorca-Homestake Mining Co., representing a consolidation of several groups of claims north of this point and which will enable the company to equip and adequately develop the ground. Some silver-copper-gold ore has been opened up, and awaits further development operation.

Newport—The Bead Lake Gold-Copper Mining Co., with holdings on the east side of Pend Oreille River, is securing connection with the transmission line of the Intermountain States Power Co. on the opposite side of the river, and as soon as that is finished, operation of the 100 ton mill, completed last year on the Conquest group ground, can be started.

IDAHO

Coeur d'Alenes District

Bunker Hill & Sullivan Orebody Cut One Mile From Apex—An Example of High Freight

BY ALFRED J. DUNN

Wallace—At a vertical depth of 3,500 ft. beneath the surface and fully a mile from the apex following the dip of the vein, the Bunker Hill & Sullivan orebody has been found without change in size or mineral content. It has just been intersected by a crosscut from the shaft, a distance of about 800 ft., on the new No. 16 level, which is 1,400 ft. below the Kellogg or main working tunnel. The oreshoot, where cut, is only about 10 ft. thick, though it is expected to show up much wider when explored by drifts, conforming to conditions above. In the levels above the oreshoot has been from 1,200 to 1,400 ft. long and in places 80 ft. thick, all of high-grade milling ore.

One of the large operating mining companies in the Cœur d'Alene district recently received a carload of blacksmith coal from the mines at Eccles, W. Va. The shipment was 30½ tons, and its cost was $2.75 per ton at the mine, making the value of the consignment $84.43. The freight rate from Eccles to Wallace, Idaho, was $17.88 per ton, making the freight charge against the coal $548.92, or more than six times the value placed on the shipment.

The Hercules and Tamarack, commonly referred to as the Day mines, show no signs of activity. Everything indicated that the Tamarack was preparing to start between the first and middle of March when the death of Eugene R. Day occurred in February. His will gave everything he possessed to his two brothers and two sisters, and made no reference whatever to his widow. Mrs. Day has announced her legal right to all the community property under the Idaho law. The value of the community property is placed anywhere from a million dollars up, and Mrs. Day says that, though she is entitled to all of it, she is willing to take half in full settlement rather than fight it out in the courts. Harry and Jerome Day are executors of the estate, and it is not regarded likely that they will agree to such a settlement, and the case will therefore probably go to the courts. The popular impression is that the mines will remain idle.

CALIFORNIA

Mountain Copper Co. Shipping 600 Tons of Pyrites Daily.

San Francisco Correspondence

San Francisco—The California State Mining Bureau is gathering information on placer mining in California with the object of stimulating interest in this kind of mining. Apparently there are many neglected opportunities for gold production in placer, drift, and hydraulic mining ground. Carefully compiled and accurate information on this subject will be welcomed by mining men of the Coast, it is thought.

In northern California, the Mountain Copper Co. is shipping 600 tons per day of pyrites to chemical works in the Bay region.

A. Jacquemart, of San Francisco, is making preparations to work the Gallea gravel mine near Sawyer's Bar; a ditch is to be constructed from the Little North Fork.

The American & Italian Mining Co. is hydraulicking at the Paulsen ranch, near Lewiston.

The Valdor dredge is being dismantled preparatory to being moved to new dredging ground.

On the Mother Lode, articles of incorporation of the Gold Cross mine have been filed. The new company will operate the Omega mine near Jamestown.

Elsewhere, the Slate Range Consolidated Mining Co. is milling forty-five tons of ore per day. The property is in Inyo County, eight miles northeast of Trona. At Randsburg, the Pittman group of claims in the northern part of the Rand mining district was reported sold by H. G. Nosser to Bakersfield mining men.

NEVADA

Simon Silver-Lead Again at Capacity—Tonopah Has First Bullion Theft—Eureka Nevada Railroad Neglected

From Our Special Correspondent

Mina—The Simon Silver-Lead Mines Co.'s mine and mill are again operating practically at capacity. Wages were cut at this property on March 1 and a period of reduced production resulted until the necessary crews were obtained. On account of bad roads, due to excessive snow and rain, it is temporarily difficult to transport concentrates to the railroad. The company is now negotiating for the use of the roasting plant of the Goldfield Consolidated, at Goldfield, to roast the zinc concentrates before shipment to the plant at Harbor City, Cal.

The West End Consolidated's operations at the Mabel mine, adjoining the old Garfield mine on the west, are said to be promising. Values are in silver and gold.

Tonopah — Recent bullion shipments from this district are as follows: Tonopah Belmont, $108,352; West End, $56,000; Tonopah Mining Co., $60,000; Tonopah Extension, $66,000, and MacNamara, $10,000. These shipments represent the clean-up of operations for the first fifteen days of March.

A 65-lb. bar of bullion, valued at approximately $1,200, was stolen from the express company's truck at the depot on March 24. This is the first bullion theft on record in Tonopah, and about $150,000,000 has been shipped.

Divide—The New Tonopah Dividend Mining Co. reports that a drift on the 200 level has shown commercial values for over 200 ft. Preparations are being made for building an ore bin and to begin shipments to Tonopah mills.

The Tonopah Divide's January production was 1,598 tons, and net recovery $41,686. February production was 1,476 tons, and net recovery $38,000. Shipments continue at the rate of fifty tons per day. Regular development is being accomplished, with no new discoveries reported. The south crosscut on the 265 level has not yet picked up the Gold vein. This Gold vein was worked years before the Divide silver vein was discovered, but only shallow surface work was done.

Eureka—The Eureka Nevada railroad, owing to the fact that the track has been washed out in several places, has been inoperative since March 17. The railroad company has shown no active inclination to repair the damage and resume service, and the Public Service Commission is interesting itself in conditions.

Operations in Pioche District

By E. C. D. Marriage

Pioche—Shipments from the Pioche district for the week ended March 31 indicate that conditions are approaching normal. Tonnage shipped was: Black Metals, 360 tons; Bristol Silver, 250; Prince Consolidated, 50; Mascot, 45; Combined Metals, 45; Alps, 10; total, 760 tons (compared with 682 tons the week before).

Work has been started at the Silver Dale mine, at Silverhorn, the scene of a spectacular boom just a year ago. Operations are in charge of R. K. Brown, of Tonopah.

The new shaft at the Bristol Silver Mines is almost completed, and shipments will now be increased from the present average of forty tons daily to seventy-five tons daily.

Ely—Satisfactory progress is being made with the development at the Ruth mine of the Nevada Consolidated Copper Co., now employing about eighty men underground. Reduced freight rates on coal were granted the Ely district this week. Road conditions are improving and shipments of ore will soon be resumed from the outside districts of Ward, Cherry Creek, and Hamilton, old producing districts of the White Pine boom period.

Mesabi Iron Co.'s Plant Ready To Start

Babbitt, Minn.—The units of the Mesabi Iron Co.'s concentrator are practically complete and are being tested as a whole. It is anticipated that the plant will be ready to make sinter by the middle of April.

Moving of Hibbing, Minn., Costs Over Million to Date

Hibbing—The cost to date to the Oliver Iron Mining Co. of moving of the village of Hibbing is $1,152,458. This sum covers the acquiring of surface rights, moving of the buildings from the old site, and improvements in the new town site. This expenditure will permit the mining of a large deposit of iron ore beneath the old site.

MICHIGAN

The Copper Country

C. & H. Producing on Limited Scale Air Blasts in Quincy Mine—New Arcadian Lode Identified as Isle Royale Vein

By M. W. Young

Houghton—Calumet & Hecla, Ahmeek, and Isle Royale, which resumed April 1, are producing on a limited scale. Rock taken out during course of shaft repairs in the conglomerate department of Calumet & Hecla is being shipped to the mill. It has not yet been determined at what rate production will be maintained from the conglomerate shafts, as this will depend on the size and efficiency of the force that can be built up, but it is probable that regular rock shipments will be brought up to 3,000 or 3,500 tons daily, equivalent to approximately 2,800,000 to 3,300,000 lb. of refined copper monthly. Ahmeek, it is expected, will produce at the start at the rate of 1,125,000 lb. per month and Isle Royale from 500,000 to 600 000 lb.

Thus far there has been no scarcity of labor, and no difficulty is expected in building up forces to the required number. Care is being exercised in the selection of men.

The Mineral Range railroad has opened its main line between Calumet and the Ahmeek mill preparatory to resumption of rock train service. Coal has been shipped. There has been no traffic over this line since mining operations were suspended a year ago.

An epidemic of grippe has affected employees of the mines as well as residents generally in the district, and at the Copper Range property the number incapacitated has affected production somewhat, there having been a falling off of rock shipments recently.

Several air blasts have occurred of late in old workings of the Quincy mine, no damage resulting to any of the present workings. These blasts are severely felt in Houghton and Hancock. Air blasts, however, have occurred with less frequency in the Quincy since the system of filling abandoned workings with waste rock has been practiced.

It has been definitely established that the lode that the New Arcadian is developing is the Isle Royale vein, it having been so pronounced by geologists who have studied its various characteristics and courses. The rich showing in the new north drift at the 1,100 or bottom level of the New Baltic shaft, now in 150 ft., continues. The rock is heavily shot with copper, and considerable small mass is present in the deposits. This drift will be continued as long as copper values persist. The copper zone appears to swing to the north, all openings in that direction being in uniformly rich ground. Work continues in the south drift from the 942 level. Four drills are now at work in the property.

At Seneca, good progress is being made with construction work at No. 2 shaft, Gratiot.

Gogebic Range

Tax Commission May Ask Law To Limit Expenditures of Local Governments

Ironwood—The Michigan State Tax Commission is considering the question of asking for a state law such as Minnesota has, limiting the per capita expenditures of local governments to reasonable figures. In several villages, towns, and cities the total property valuation is exceedingly high, owing to the presence of mines, and the local governments are inclined to be extravagant in their expenditures, because the mines bear the burden. In the past, Michigan communities have been far more reasonable on this question than those in Minnesota, but some are now turning to extravagance. It is believed by some that taxation in the Michigan mining districts is none too equitable, as mining property is assessed at as near 100 per cent of its cash value as the Tax Commission can determine from examining the mines and their books, whereas other real property is assessed by local assessors at from 20 per cent to 65 per cent of its cash value, and personal property is not assessed at all.

At the Pabst mine the necessary development work has been started at "G" shaft preparatory to starting the removal of "C" shaft pillar.

The North-Western Ry. is preparing to move 4,000,000 tons of ore from the Gogebic range this season, which is as much as the average for the last eight or ten years. The railroad officials have usually made a good forecast of the season's shipments, and local mining men are consequently feeling optimistic over the outlook. So far, the establishment of ore prices for the ensuing season has been delayed, awaiting developments in the freight-rate situation. The reduction in dock to furnace rates has led to the expectation of a similar reduction at the upper end of the Lakes.

MINNESOTA

Mesabi Range

York Mine Pushing Preparations to Mine—Mesabi Iron Co. to Make Sinter Soon

Coleraine—The workings of the Oliver company's Holman mine have been dewatered following the recent fire and consequent flooding.

Marble—The stripping operations at the Mesaba Cliffs Hill Trumbull property are to be resumed soon by A. Guthrie & Co., who have the contract.

The removal from the pit and stockpiling of the rocky cretaceous material at the Interstate Iron Co.'s Hill-Annex pit is progressing well. This material will be rehandled through the new screening plant.

Nashwauk—Preparations for mining at the Coates & Tweed Co.'s York mine are being pushed to the fullest extent. It is anticipated that the property will be among the first shippers of the season.

The Situation at the Mines in March

Important Copper Producers Running or Preparing To Do So, With Few Exceptions—Birmingham Active; Lake Superior District Quiet —Economic Conditions Little Changed

By A. H. Hubbell
News Editor, *Engineering and Mining Journal-Press*

MARCH saw the end of the period of widespread stagnancy that had prevailed in the copper industry since last spring, though conditions were still far from normal. By the end of the month the Jackling group of porphyries and the Calumet & Hecla and two of its subsidiaries were on the point of resuming production, actually starting April 1. Gradually increasing activity was shown by those other companies that had already resumed since the first of the year. United Verde, though active in construction work, gave no indication of resuming production; likewise the Phelps Dodge branches at Tyrone and Clifton-Morenci. With few other exceptions practically all important producers in the country were running, most of them at less than capacity.

In general, economic conditions throughout the country were unchanged from February. Except in isolated instances, wages, freight rates, and costs of supplies were about the same. The labor supply was a little better in some places. In others, unemployment was less evident.

In the Butte district, where operations were first resumed, about 8,600 men were employed during the month, Anaconda having 6,000, Butte & Superior 900, the Clark properties 600, and East Butte 400. These statistics indicate that operations were 60 per cent of normal. At Great Falls and Anaconda about 3,000 more men were working. The number of unemployed that recently flocked to Butte showed a lessening, owing to the approach of spring and resumption by small operators.

Production of refined copper in northern Michigan in March was 8,000,000 lb., a slight decrease from February and about 36 per cent of normal. Eleven furnaces were in operation, seven at Calumet & Hecla, one at Quincy, and three at the Michigan smelter.

Continued improvement was also visible in the ironmaking industry in the Birmingham district, Alabama. At the end of the month, seventeen out of thirty-nine furnaces were active. Iron-ore production can only be approximated until reserve stocks are further reduced. In the Lake Superior iron country, on the other hand, there was little change from the stagnancy of the last few months. A few properties resumed work on a limited scale. Some ran simply to furnish employment. Ore prices for the current year had not been set.

Cold weather in the Pacific Northwest delayed the resumption of work at many of the remote and smaller properties, though affecting the larger operators but little. Granby suffered slightly from water shortage. The Tacoma, Trail, and Bunker Hill smelters continued in operation. Northport remained shut down. The Consolidated announced a decrease in the penalty on zinc in ores.

In the Cœur d'Alenes, the Bunker Hill, Federal, and Hecla companies, the only producers, extracted 6,000, 5,000, and 3,500 tons, respectively, of shipping ore, these being normal tonnages. The Bunker Hill smelter ran only one furnace most of the month. There was no surplus labor, though enough for the demand. Washington and Oregon operations, comparatively of a minor nature, were unchanged.

Placer and lode mining and dredging for gold in California progressed as of late. Grass Valley and various Mother Lode companies were active. The Shasta copper belt was dead. In Plumas County, the Engels company ran as usual. The Randsburg silver district was busy.

Gold miners in the Oatman district, Arizona, after the recent boom, settled down to a period of waiting until results of core drilling now progressing should be known and justify their hopes. Activity increased in the district tributary to Douglas.

In Nevada, conditions were normal. At Tonopah, bullion shipments ran over $600,000. Here the West End company increased its mine tonnage to 300 daily and took over the MacNamara mill on an operating basis. At Virginia City, the United Comstock completed its haulage tunnel and increased its construction crew 30 per cent, employing 750 men. Simon Silver-Lead's operations, near Mina, again were normal after the recent labor strike. At Goldfield, promising ore was cut in the Silver Pick lease. The Round Mountain companies ran as usual. Ely was quiet but Pioche showed some improvement.

Poor hauling conditions and the small shipper being out of the market accounted for decreased custom shipments to the Salt Lake Valley smelters in March. Murray ran three furnaces on lead, crowding through a large tonnage; Midvale ran three on lead and one on matte; and Garfield (normally copper) two reverberatories and one blast furnace, chiefly on siliceous silver ores. The International smelter at Tooele prepared to resume. Utah Apex, at Bingham, resumed work March 27. Utah Copper prepared to start. Bingham's output was about 12,000 tons (15,000 in February), the loss being due to railway trestle repairs. Park City produced 10,723 tons in the first four weeks (9,988 in February). Tintic's production in four weeks was 26,647 tons (27,122 in February).

Likewise in Colorado smelter receipts fell off owing to impassable wagon roads. Cripple Creek operators reduced wages to those paid elsewhere in the state. Enlargement of the Portland mill was begun to permit treatment of 1,200 tons daily of dump ore and stope filling averaging under $5 per ton. At Silver Plume, the East Butte company was pushing construction of a 400-ton plant to treat ore from the Dives Pelican group.

In the Black Hills, the labor situation was better, with fewer idle. The Homestake and Trojan companies remained the only producers, with operations on a par with those in February, both working at capacity. Smaller companies were less active.

In the Joplin-Miami district, conditions showed little change. About seventy-five mills ran, the number increasing to eighty-one at the end of the month. Production was about 7,200 tons weekly (5,800 in 1914). One mill burned.

Operations in the southeast Missouri lead district continued at about two-thirds of normal. One company claimed that owing to increased efficiency its output was normal, although operations were somewhat curtailed. Zinc operations in the Mascot district, in Tennessee, continued at about a third of normal.

Two zinc-ore producers resumed in the Wisconsin zinc district, making six in all—namely, the Dale, Connecting Link, Big Dick, Nightengale, North Unity, and Paquette. One roaster, one acid plant, and one oxide plant were also active. Four companies resumed buying blende. The month's production is estimated at 2,500 tons of crude blende concentrates; 1,000 tons of roasted blende, and 250 tons of lead ore as in recent months. An increase in output in April was predicted. Production in March was about 19 per cent of normal.

In Ontario, Porcupine's output increased largely, owing to richer Dome ore. McIntyre began building a new mill. Hollinger ran at capacity. More men were employed in the district. A new hydro-electric power development was begun. Cobalt's production was normal and Kirkland's slightly increased. The Tough-Oakes mill was almost ready to start. Conditions were unchanged in the Sudbury nickel district, with the Mond company the only producer. Labor, in general, was fairly plentiful.

THE MARKET REPORT

Daily Prices of Metals

Mar.	Copper, N. Y., net refinery* Electrolytic	Tin		Lead		Zinc
		99 Per Cent	Straits	N. Y.	St. L.	St. L.
30	12.375@12.50	28.375	29.00	4.75@4.80	4.50	4.675
31	12.375	28.375	29.00	4.80	4.50	4.675
Apr. 1	12.375	28.375	29.00	4.80@4.85	4.55	4.70
3	12.375	28.75	29.375	4.80@4.90	4.625@4.70	4.70@4.75
4	12.25@12.375	28.75	29.50	4.90	4.625@4.70	4.75
5	12.25@12.375	28.75	29.50	4.90	4.65@4.70	4.80

*These prices correspond to the following quotations for copper delivered: March 30th, 12.625 @ 12.75c., 31st, April 1st and 3d, 12.625c., 4th, 5th, 12.50 @ 12.625c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Mar.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
30	$57\frac{7}{8}$	$58\frac{5}{8}$	64	143	$144\frac{1}{2}$	$21\frac{7}{8}$	$21\frac{3}{8}$	$25\frac{5}{8}$	$25\frac{1}{4}$
31	$57\frac{5}{8}$	$58\frac{3}{8}$	$63\frac{1}{2}$	$142\frac{1}{4}$	$143\frac{3}{4}$	22	$21\frac{1}{2}$	$25\frac{3}{4}$	$25\frac{3}{4}$
Apr. 1	. .			. . .	.				.
3	$57\frac{1}{8}$	$57\frac{7}{8}$	$62\frac{1}{2}$	$143\frac{5}{8}$	$144\frac{7}{8}$	$21\frac{1}{4}$	$21\frac{3}{8}$	$25\frac{5}{8}$	$25\frac{3}{4}$
4	$57\frac{1}{8}$	$57\frac{7}{8}$	$62\frac{1}{2}$	$143\frac{5}{8}$	$145\frac{1}{8}$	$21\frac{3}{4}$	$21\frac{1}{4}$	$25\frac{5}{8}$	$25\frac{3}{4}$
5	$58\frac{1}{8}$	$58\frac{3}{4}$	$62\frac{1}{2}$	$143\frac{7}{8}$	$145\frac{1}{2}$	$21\frac{7}{8}$	$21\frac{3}{8}$	26	26

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Mar.	Sterling Exchange "Checks"	Silver			Apr.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
30	$436\frac{3}{4}$	$99\frac{5}{8}$	$65\frac{3}{4}$	$33\frac{7}{8}$	3	$438\frac{1}{2}$	$99\frac{5}{8}$	$65\frac{1}{2}$	$33\frac{3}{4}$
31	437	$99\frac{5}{8}$	$66\frac{1}{8}$	$34\frac{1}{8}$	4	[illegible]	$99\frac{5}{8}$	$65\frac{1}{8}$	$33\frac{1}{2}$
Apr. 1	437	$99\frac{5}{8}$	$65\frac{5}{8}$	$33\frac{7}{8}$	5	$439\frac{1}{2}$	$99\frac{5}{8}$	$65\frac{7}{8}$	$33\frac{1}{2}$

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Average Metal Prices for March

Copper:	
New York Electrolytic	12.567
London Standard	59.245
London Electrolytic	65.739
Lead:	
New York	4.720
St. Louis	4.421
London	21.266
Silver:	
New York, foreign	64.440
New York, domestic	99.625
London	33.269
Sterling Exchange	436.912
Zinc:	
St. Louis	4.658
London	25.467
Tin:	
99 per cent	28.426
Straits	29.171
London	143.152
Antimony	4.319
Quicksilver	50.204
Platinum	87.500

Metal Markets

New York, April 5, 1922

The week has been marked by a phenomenal demand for lead, with an attendent price increase. Zinc is also stronger, and tin has been firm. Copper is again weaker. Business as a whole continues to improve, and better industrial conditions are being discounted by the stock market, which has advanced steadily for some months.

Copper

Inspired by the highly satisfactory sales for the month of March, the larger producers are not disposed to shade their price of 12.75c. delivered, and feel that the market will react to this level as soon as buying of importance develops. Meanwhile smaller producers are marketing their metal for whatever it will bring. Copper has been freely offered all week at 12⅝c. delivered, and certain interests have gone below this price. It is a mistake to think that the tonnage offered at the lower range of prices is small, for individual orders of up to 2,000 tons have been placed at marked concessions and for delivery as late as August. April delivery is rarely wanted. Without doubt, the resumption of the porphyries on April 1 has had a bad effect on prices, but the reopening was justified, for all of the free copper held by those interests is reported to have been sold.

Export business has been fairly active, but at increased concessions in price, the effort to hold the foreign market above domestic levels evidently having been abandoned.

Lead

The American Smelting & Refining Co., after holding the official contract price of New York at 4.70c. since Sept. 22, increased it to 4.80c. on Thursday, March 30, and to 4.90c. on Monday, April 3. Desilverized lead in St. Louis was quoted at 20 points under these figures.

The increased prices have brought out a flood of inquiries, which have virtually scared some producers off the market. Some large orders have been placed, and much more business could have been done had lead been in freer supply. By this it must not be inferred that there is any scarcity of the metal, for comparatively large stocks of high-cost lead are available, and it is likely that some of these will be marketed at not much above current prices. Chemical lead is about on a level with the desilverized product now, though the 5-point range in our St. Louis price may indicate that difference between the two grades.

Zinc

An improved demand from galvanizers enabled producers to do a better business in zinc than for many weeks. Prices rose steadily, and the general holding level today is 4.80c. in a firm market. A feature of the business has been the predominance of sales for forward delivery, practically all of which were made at a premium of 5 points per month in advance of April shipments. The New York price continues at an advance of 35 points over the St. Louis [illegible] High grade ore has been sold at [illegible] prices of 6[illegible], with freight [illegible].

Tin

Demand has continued satisfactory, though the market was not quite so active as last week. The price is slightly firmer. London has changed little, but sterling has advanced. Statistics compiled by the New York Metal Exchange show domestic consumption during March at 6,030 long tons, compared with 3,215 long tons in February. Stocks in this country on March 31, 3,086 long tons, compared with 1,406 on Feb. 28. It is rumored, however, that some metal has accumulated in unlicensed warehouses which has been included in consumption. Tin for forward delivery has commanded approximately the same prices as for spot.

Arrivals of tin, in long tons: Total for March, 7,710; April 1, Straits, 1,875; Liverpool, 25; China, 50; 3d, London, 25.

Gold

Gold in London: March 30th, 95s. 3d.; 31st, 95s.; April 3d, 95s.; 4th, 94s. 9d.; 5th, 94s. 9d.

Foreign Exchange

The market has been quiet throughout the week, with narrow price changes but with a firm tendency. On Tuesday, April 4, francs were 9.14c.; lire, 5.30c.; marks, 0.3125c.; and Canadian dollars, 97.125c.

Silver

Silver prices reached the peak of the recent rise on March 31. After that date China turned seller, having previously been a heavy buyer, and the Indian bazaars also sold. These sales caused a reaction in both London and New York; prices falling to 33½d. and 65⅜c. respectively. From this figure the New York market improved quickly on account of short supplies of spot silver and because sellers were holding for prices above the London parity.

Mexican Dollars—March 30th, 50¼; 31st, 50⅝; April 1st, 50¼; 3d, 50⅛; 4th, 50; 5th, 50¼.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17.50@18.50c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 4.50c.; market quiet and firm. W.C.C. brand, 5@5¼c. per lb. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—7c. per lb.

Bismuth—$2@$2.10 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Cobalt — Metal, $3@$3.25 per lb., black oxide, $2 per lb. in bbls.

Iridium—Nominal, $150@$170 per oz.

[1]**Molybdenum Metal**—In rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Standard prices reduced April 1. Outside market quiet at 30@33c. per lb.

Monel Metal—Shot, 32c.; blocks, 32c. per lb., f.o.b. Bayonne. Demand improving.

Osmium—$70 per troy oz. Nominal. $70, Los Angeles, Cal.

Palladium—Nominal, $55@$60 per oz.

Platinum—$85@$90 per oz.

Quicksilver—$50 per 75-lb. flask. San Francisco wires $50. Firm.

[1]**Rhodium**—$100@$115 per troy oz.

[1]**Selenium**—Black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $18@$20 per lb.

[1]**Tungsten Metal**—Wire, $35@$60 per kilogram, according to purity and gage.

Metallic Ores

Chrome Ore—Basis 48 per cent Cr_2O_3, 40@45c. per unit, c.i.f. North Atlantic ports. Market quiet.

Iron Ore—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $6.45; Mesabi bessemer, 55 per cent iron, $6.20; Old Range non-bessemer, 51½ per cent iron, $5.70; Mesabi non-bessemer, 51½ per cent iron, $5.55.

Magnetite Ore—F.o.b. Port Henry N. Y.: Old bed 21 furnace, $4.85; old bed concentrates, 63 per cent, $5.75; Harmony, cobbed, 63 per cent, $5.75; new bed low phosphorus, 65 per cent, $8.50.

Manganese Ore—25½@26c. per unit, seaport; chemical ore, $45@$60 per gross ton, lump. Nominal.

Molybdenum Ore—85 per cent MoS_2, 40@45c. per lb. of contained sulphide, New York. Quotation purely nominal.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots. Nominal.

[1]**Titanium Ores**—Ilmenite 52 per cent TiO_2, 1¼@2c. per lb. for ore. Rutile, 95 per cent TiO_2, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore—Bolivian, 60 per cent WO_3 and over, per unit of WO_3, $3, f.o.b. Atlantic ports. Chinese, as low as $1.85@$2. Nominal.

Uranium Ore (Carnotite) —Ore containing 1½ per cent U_3O_8 and 5 per cent V_2O_5 sells for $1.50 per lb. of U_3O_8 and 75c. per lb. of V_2O_5; ore containing 2 per cent U_3O_8 and 5 per cent V_2O_5 sells for $2.25 and 75c. per lb., respectively; higher U_3O_8 and V_2O_5 content commands proportionately higher prices.

Vanadium Ore—$1 per lb. of V_2O_5 (guaranteed minimum of 18 per cent V_2O_5), New York. Nominal.

Zircon — Zirconium silicate, f.o.b. Pablo, Fla., 4½@13c. per lb.

[1]**Zirkite**—According to conditions, $70@$90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

Zinc and Lead Ore Markets

Joplin, Mo., April 1—Zinc blende, per ton, high, $29.70; basis 60 per cent zinc, premium, $28; Prime Western, $27; fines and slimes, $26@$25; average settling price, all grades of blende, $26.76.

Lead, high, $65.75; basis 80 per cent lead, $65; average settling price, all grades of lead, $63.60 per ton.

Shipments for the week: Blende, 6,803; lead, 2,343 tons. Value, all ores the week, $331,020.

The largest single week's purchase of blende for two years was made this week, amounting to 14,640 tons. It is more than double the average weekly purchases of March, or the average for the three months. Early in the week an effort was made among buyers to lower the market, but sellers declined to accept. Buying did not become active until the afternoon of Friday, and was continued all day today, with prospects that another 5,000-ton purchase would be made late today.

Lead continues to climb surprisingly in price, with the demand growing stronger week after week. The Eagle Picher Company is now requiring a large tonnage to supply its factory, operating at full capacity manufacturing lead pipe and other plumbers' lead supplies. Federal Lead is seeking a heavy tonnage in this field since December, the first time it has ever been a factor in the local lead situation.

Platteville, Wis., April 1—Blende, basis 60 per cent zinc, $29. Lead ore, $65 per ton. Shipments for the week: Blende, 656; lead, 40 tons. Shipments for the year: Blende, 3,322; lead, 641 tons. Shipped during the week to separating plants, 569 tons blende.

Non-Metallic Minerals

Asbestos — Crude No. 1, $900@$1,100; No. 2, $500@$750; long spinning fibers, $300@$450; spinning fibers, $200@$250; magnesia and compressed sheet fibers, $100@$175; shingle stock, $70@$110; paper stock, $35@$45; cement stock, $15@$17.50; shorts, $6@$10; all per short ton, f.o.b. Thetford, Broughton, and Black Lake mines. Market quiet.

Barytes—Crude, $8 per ton, f.o.b. mines. Ground white, $23, f.o.b. mills. Off-color grades, $15@$20, f.o.b. Southern mills. Foreign barytes, c.i.f. New York, $7.80@$8.25 per ton crude.

Bauxite — American, crushed and dried, $6@$8 per gross ton; pulverized and dried, $12@$14 per gross ton; calcined, $20@$22 per gross ton, all f.o.b. shipping points. Foreign bauxite offered at $6@$8 per metric ton, c.i.f Atlantic ports, depending upon grade.

Borax—Granulated, crystals or powdered, in bags, carloads, 5¼c. per lb.; in bbls. 5½c.

Chalk—English, extra light, 5c. Domestic light, 4¼@4½c.; heavy, 3½@3¾c. per lb., all f.o.b. New York.

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[1] Furnished by Foote Mineral Co., Philadelphia, Pa

China Clay (Kaolin)—Crude, $6@$8; washed, $8@$9; powdered, $12@$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $13@$20, f.o.b. Virginia points. Imported lump, $14@$20, f.o.b. American ports; powdered, $35@$45, f.o.b., quoted at New York.

Emery—Turkish emery, 6c. per lb. American, 4c. Inferior grades, 3½c., f.o.b. from New England points.

Feldspar—No. 1 pottery grade, $6.50@$6.85 per long ton; No. 2 pottery, $5.75; No. 1 soap grade, $7, f.o.b. cars. No. 1 Canadian, $22@$23, f.o.b. mill. High potash Canadian, $10 per ton, f.o.b. mines.

Fluorspar — Lump, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $20 per ton; gravel, $17.50. No. 1 ground, $50@$55, f.o.b. Illinois and Kentucky mines. Lump, $12.50@$13.50; ground, 95@96 per cent, $25@$26, f.o.b. New Mexico.

Fuller's Earth—16 to 30 mesh, $20 per ton; 30 to 60 mesh, $20; 60 to 100 mesh, $17; 100 mesh and over, $15, f.o.b. Pennsylvania points. English, $23@$25, f.o.b. New York.

Graphite—Ceylon lump, first quality, 5@7c.; chip, 4@5½c.; dust, 2½@4c. per lb.; No. 1 flake, 6@8c.; amorphous crude, $18@$45 per ton. All f.o.b. New York.

Gypsum — Crushed rock, $3@$4.50 per ton, depending upon shipping point. Ground, $4, f.o.b. shipping point.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¾ in. size, $1.25@$1.75 per net ton; 1½ in., $1@$1.25. Prices for other sizes practically the same. Agricultural limestone, $2.50@$3.75 per net ton, f.o.b. eastern shipping points, depending upon analysis.

Magnesite—Crude, $8@$12 per ton. High-grade caustic calcined, lump form, $30@$40 per ton. Plastic calcined, $45@$50 in bbls., carload lots, f.o.b. California points. Atlantic seaboard, $60.

Dead-Burned — $33 per net ton, Chewelah, Wash.; $58@$64, Chester, Pa. Austrian grade, $28 per ton, f.o.b. Baltimore. (Magnesite brick — See Refractories.)

Mica — India block mica, slightly stained, per lb.; No. 6, 35c.; No. 5, $1.25; No. 4, $2.25; No. 3, $2.90; No. 2, $4; No. 1, $5.20. Clear block: No. 6, 50c.; No. 5, $1.75; No. 4, $3; No. 3, $4.75; No. 2, $6; No. 1, $7.50; A1, $9; ground, wallpaper grade, $90@$200 per ton (depending upon quantity); ground roofing mica, $25@$70, all f.o.b. New York. Water-ground mica, 100 and 160 mesh, 6½c. per lb., f.o.b. Virginia points.

Monazite—Minimum of 6 per cent thorium oxide, $30 per unit, duty paid.

Phosphate Rock—Per long ton, Florida ports, pebble grade: 77 per cent tricalcium phosphate, $8.50 (9.50 for land rock), 75 per cent, $7; 75@74 per cent, $6.50; 70 per cent, $4.75, 68 per cent, $4.25; 68@66 per cent, $4.

Pumice Stone—Imported, lump, 3@10c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

Pyrites—Spanish fines, per unit, 12c., c.i.f. Atlantic seaports; furnace size, 13c.; Spanish lump, 13@14c.; domestic fines, f.o.b. mines, Georgia, 11@12c.

Silica—Glass sand, $1.25@$2.25 per ton; sand-blast material, $2.25@$4.50, f.o.b. Indiana and Illinois points. Amorphous or decomposed variety, soft silica, 250 mesh, $16; 350 mesh, $20; 450 mesh, $35 per ton. Ganister, crude, $2.50 per ton, f.o.b. Illinois points. Molding sand, building sand, glass sand, $2@$3, f.o.b. Pennsylvania points.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s. New York.

Talc—20 to 200 mesh, $7@$12 per ton, f.o.b. Vermont; $7.50@$12, f.o.b. points in Georgia; 200 mesh, $16@$26, f.o.b. Los Angeles.

Mineral Products

Copper Sulphate — Large crystals, 5.40c.; small crystals, 5.30c. per lb., f.o.b. New York.

Potassium Sulphate — Powder, domestic, $1 per unit, basis 90 per cent, f.o.b. New York.

Sodium Nitrate—$2.85 per 100 lb., ex vessel, Atlantic ports.

Sodium Sulphate—For 95 per cent material, $12.50 per ton, f.o.b. in bulk, Western mines, spot and six months' contract; $17@$20 per ton, New York.

Ferro-Alloys

Ferrotitanium—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrocerium—Per lb., $12@$15.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 11c. per lb. of chromium contained; 4 to 6 per cent carbon, 12c., f.o.b. works.

Ferromanganese—Domestic, 78 to 82 per cent, $62@$64, f.o.b. furnace; English, $62.50, c.i.f. Atlantic seaport. Spiegeleisen, 16@19 per cent, $29 per gross ton, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, $2 per lb. of contained metal, f.o.b. works. Imported material, $1.70@$2.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, $38@$40; 50 per cent, $54@$55; 75 per cent, $115@$120.

Ferrotungsten—Domestic, 70 to 80 per cent W, 37@45c. per lb. of contained tungsten, f.o.b. works. Foreign, 50c., duty paid, f.o.b. Atlantic ports.

Ferro-uranium—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

Ferrovanadium—$3.50 per lb. of V contained.

Metal Products

Copper Sheets—Current New York net price, 20.25c. per lb.; wire, 14@14.125c.

Lead Sheets—Full lead sheets, 7¾c.; cut lead sheets, 8c. in quantity, mill lots.

Nickel Silver—26.75c. per lb. for 18 per cent nickel Grade "A" sheets.

Yellow Metal — Dimension sheets, 17.25c.; sheathing, 16.75c.; rods, ⅜ to 3 in., 14.25c.

Zinc Sheets—$7.50 per 100 lb. less 8 per cent on carload lots, f.o.b. works.

Refractories

Bauxite Brick—56 per cent alumina, $130 per 1,000; 76 per cent, Supрafrax, $200 per 1,000; f.o.b. works, St. Louis and Pittsburgh.

Chrome Brick—$40 per net ton.

Chrome Cement — 40@45 per cent Cr_2O_3, $30@$32 per net ton, and $31 in sacks, carload lots, f.o.b. eastern shipping points.

Firebrick—First quality, 9-in. shapes, $32@$35 per 1,000, Pennsylvania, Ohio and Kentucky.

Magnesite Brick—9-in., straights, $45 per net ton, f.o.b. works.

Silica Brick—9-in., per 1,000, $30@$35 in carload lots, f.o.b. shipping points.

The Iron Trade

Pittsburgh, April 4, 1922

The coal strike has had no untoward influence upon the iron and steel trade so far. The closing of union mines is complete. Mills are well stocked with steam, gas, and byproduct coal.

Bars and shapes present a general market of 1.50c., an advance of $2 a ton in the last ten days and $3 a ton from the recent low point. In sheets the mills, instead of stiffening quotations, gradually announced that they intended to put prices up $3 a ton on April 1 or thereabouts, and these announcements produced an active buying movement. The American Sheet & Tin Plate Co. at this writing has not advanced its prices, but is expected to do so without previous notice.

Steel-ingot production has undergone a further advance, and is now at 31,000,000 or 32,000,000 tons a year, against a 29,000,000 ton rate at the end of February.

Pig Iron—Producers occupy a much firmer attitude and expect to be able to work prices up a trifle. The market is firm at $19.50 for Bessemer, $18 for basic and $19 for foundry, f.o.b. Valley furnaces, freight to Pittsburgh being $1.96. The Snyder averages for March, at Valley furnaces, were $19.388 for Bessemer and $18 for basic.

Coke

Connellsville—Furnace, $3.25@$3.50; foundry, $4.25@$4.75.

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[1] Foote Mineral Co., Philadelphia, Pa.

COMPANY REPORTS

Hollinger Consolidated Gold Mines, Ltd.

A report of operations of Hollinger Consolidated Gold Mines, Ltd., for 1921 shows a net profit of $5,091,659.62, of which $3,198,000 was appropriated for dividends. Profit-and-loss statement follows:

PROFIT AND LOSS STATEMENT FOR YEAR 1921

Gold and silver produced			$10,031,050.57
Interest on investments and other income			283,464.74
			$10,314,515 31
Disposal of 1921 income			
General charges		$459,827 79	
Mining charges		3,194,844 44	
Milling charges		1,568,183 46	
			5,222,855 69
Operating profit			$5,091,659 62
Deduct			
Taxes, Province of Ontario	$76,042 54		
Municipal taxes	49,102 22		
Dominion of Canada 1921 taxes	205,000 00		
Balance of 1919 and 1920, taxes	99 744 85		
		$429,889 61	
Depreciation			
Plant		627,488.50	
Investment in other companies and properties written down		3,551 82	
Donations		3,802 20	
			1,064,732 13
Net profit			$4,026,927 49
Paid out in dividends			3,198,000 00
Added to surplus			$828,927 49

BALANCE SHEET, DEC. 31, 1921

ASSETS

Capital		
Mining properties		$21,150,244 17
Plant brought forward from 1920	$1,500,000 00	
Additions during 1921	482,790 79	
	$1,982,790 79	
Less depreciation for 1921	672,488 50	
		1,355,302 29
Investments in other companies and properties		
Brought forward from 1920	$40,002 00	
Additions during 1921	8,472 32	
	$48,474 32	
Less written off in 1921	3,551 82	
		44,922 50
		$22,550,468 96
Current assets		6,042,794.46
Bullion in transit		454,225 31
[illegible] and slag on hand		99,040 47
		$29,146,529 20

LIABILITIES

Capital stock			
Authorized		$25,000,000 00	
In treasury		400,000 00	
			$24,600,000 00
Current liabilities			
Wages unpaid		$135,575 72	
Accounts payable		245,173 98	
			380,749 70
Reserve for Dominion of Canada 1921 taxes			205,000 00
Surplus			
Balance of account from 1920		$3,131,852 01	
Profits from Jan. 1 to Dec. 31, 1921		4,761,514 86	
		$7,893,366 87	
Less dividends	$3,198,000 00		
Plant depreciation	627,488 50		
Donations	3,802 20		
Balance 1919 and 1920 taxes paid in 1921	99 744 85		
Investments in other companies and properties written down	3,551.82		
		$3,932,587 37	
			3,960,779 50
Net surplus			$29,146,529.20

Total tonnage milled was 1,072,493 tons; average value per ton, $9.67; net value recovered, $10,031 050.57. General charges were $0.429 per ton; mining, $2.979; milling, $1.462; total, $4.870. Ore reserves are given as 1,571,980 tons at $12.80 per ton; 1,653,969 tons at $9.15 per ton, and 176,661 tons at $7.80, making a total gross value of $36,644,154.

United States Steel Corporation

A combined report of the operations and affairs of the United States Steel Corporation and subsidiary companies for 1921, together with a statement of the condition of the finances and property at the close of that year, follows:

INCOME ACCOUNT

The total earnings were, after deducting all expenses incident to operations, including ordinary repairs and maintenance (approximately $92,000,000) and taxes (including reserves for Federal income taxes), per general profit and loss account		$100,791,279 50
Less, interest on outstanding bonds, mortgages and purchase money obligations of the subsidiary companies		8,065,221.58
Balance of earnings in the year 1921		$92,726,057.92
Less charges and allowance for depletion and depreciation applied as follows, viz.:		
To depreciation and replacement fund and sinking funds on bonds of subsidiary companies	$27,905,045 44	
To sinking funds on bonds of U. S. Steel Corporation	8,863,180.35	
		36,768,225.79
Net income in the year 1921		$55,957,832 13
Deduct		
Interest on U. S. Steel Corporation bonds, outstanding, viz.:		
Fifty-year 5 per cent gold bonds	$11,037,432.49	
Ten to sixty-year 5 per cent gold bonds	8,642,150.00	
	$19,679,582.49	
Premium paid on bonds redeemed	747,461.96	
		20,427,044.45
Balance carried forward		$35,530,787.68
Add: Net balance of sundry charges and credits, including adjustments of various accounts		1,086,229.51
Balance		$36,617,017.19
Dividends for the year 1921 on U. S. Steel Corporation stocks, viz.:		
Preferred, 7 per cent	$25,219,677.00	
Common, 5 per cent	25,415,125.00	
		50,634,802.00
Balance provided from undivided surplus		$14,017,784.81

UNDIVIDED SURPLUS OF UNITED STATES STEEL CORPORATION AND SUBSIDIARY COMPANIES

Since April 1, 1901

Surplus or working capital provided in organization		$25,000,000.00
Balance of surplus accumulated by all companies from April 1, 1901, to Dec. 31, 1920, exclusive of subsidiary companies' inter-company profits in inventories, per annual report for year 1920	$498,454,890.89	
Less, for the following items, viz.:		
Adjustment of previous years' allowances for depreciation and of other accounts, not applicable to 1921 operations	510,148 49	
Provision for undivided surplus for excess of dividends over income for year 1921, as above	14,017,784 81	
		$483,926,957 59
Total undivided surplus, Dec. 31, 1921, exclusive of profits earned by subsidiary companies on inter-company sales of products on hand in inventories at that date (see note below)		$508,926,957 59

Note: Surplus of subsidiary companies amounting to $32,114,777 56 and representing profits accrued on sales of materials and products to other subsidiary companies which are in latters' inventories Dec. 31, 1921, is deducted from the amount of inventories included under Current Assets in Consolidated General Balance Sheet.

Superior Copper Co.

A report of operations of the Superior Copper Co. for 1921 states that no copper was produced during the year. Copper sold amounted to 246,009 lb., at 12.64c. per lb., incurring a loss of $2,497.46. Loss for the year was $1,915.22. Balance of current assets on Dec. 31, 1920, was $390,084.07; and on Dec. 31, 1921, $388,168.85.

Bohemia Mining Co.

A report of operations of the Bohemia Mining Co. for the year ending Feb. 28, 1922, states that cash receipts amounted to $16,186.16 and disbursements to $8,116.91.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York 1921	New York 1922	London 1921	London 1922	Sterling Exchange 1921	Sterling Exchange 1922
January	65 950	65 450	39 985	35 035	372 [illegible]	421 750
February	59 233	65 290	34 745	33 891	[illegible]	435 511
March	56 023	64 440	32 479	33.269	389 806	436 912
April	59 337		34 250		391 784	
May	59 810		34 165		396 580	
June	58 510		34 971		377 236	
July	60 260		37 481		362 565	
August	61 597		38 096		364 505	
September	66 160		40 082		371 725	
October	70 970		41 442		386 315	
November	68 234		38 750		396 315	
December	65 760		35 645		414 880	
Year	62 654		36 841		384 191	

New York quotations cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York Electrolytic 1921	New York Electrolytic 1922	London Standard 1921	London Standard 1922	London Electrolytic 1921	London Electrolytic 1922
January	12.597	13 465	70 964	65 226	79 119	72 321
February	12 556	12 864	70 925	60 250	75 925	66 125
March	11 976	12.567	67 565	59 245	71 190	65 739
April	12 438		69 381		71 786	
May	12 742		73 196		74 298	
June	12 697		71 852		75 682	
July	12 170		71 155		75 286	
August	11 634		68 614		72 705	
September	11 948		67 977		72 295	
October	12 673		67 327		73 476	
November	13 035		66 614		74 386	
December	13.555		66.706		74 525	
Year	12 502		69 356		74 223	

New York quotations, cents per lb. London, pounds sterling per long ton

Lead

	New York 1921	New York 1922	St. Louis 1921	St. Louis 1922	London 1921	London 1922
January	4 821	4 700	4 747	4 388	23 387	23 667
February	4 373	4.700	4 228	4 396	20 650	20 681
March	4 084	4.720	4 000	4 421	18 911	21.266
April	4 356		4 272		20 589	
May	4 952		4 784		23 399	
June	4 485		4 293		22 563	
July	4 410		4 260		23.399	
August	4 382		4 217		23 489	
September	4 600		4 392		23 148	
October	4 690		4 439		23 679	
November	4 683		4 356		24 483	
December	4 700		4 369		25 322	
Year	4 545		4 363		22 752	

New York and St. Louis quotations, cents per lb London, pounds sterling per long ton.

Tin

	New York 99% 1921	New York 99% 1922	New York Straits 1921	New York Straits 1922	London 1921	London 1922
January	31 470	31 480	36 000	32 100	190 464	163.065
February	28 534	29 835	32 142	30 767	166 250	149 850
March	27 296	28 426	28 806	29.171	156 924	143.152
April	28.990		30.404		163 [illegible]	
May	31 431		32 500		177 411	
June	28 514		29 423		167 506	
July	26 755		27 655		164 530	
August	25 662		26 301		155 318	
September	26 280		26 680		156 750	
October	27 278		27 655		156 380	
November	28 592		28 935		158 898	
December	32 106		32 486		169 738	
Year	28 576		29 916		165 265	

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis 1921	St. Louis 1922	London 1921	London 1922
January	5 413	4 691	25 262	26 321
February	4 928	4 485	24 850	24 213
March	4 737	4 658	25 977	25 467
April	4 747		25 530	
May	4.848		26 923	
June	4 421		26 750	
July	4 239		26 262	
August	4 186		25 068	
September	4 235		25 256	
October	4 605		26 315	
November	4 667		25 949	
December	4 835		26 900	
Year	4.655		25 845	

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York 1921	Antimony (a) New York 1922	Quicksilver (b) New York 1921	Quicksilver (b) New York 1922	Platinum (c) New York 1921	Platinum (c) New York 1922
January	5 258	4 463	48 440	49 960	73 400	97 260
February	5 250	4.416	49 545	48 295	70 227	89 545
March	5 282	4 319	46 796	50 204	72 463	87 500
April	5 137		45 423		73 404	
May	5 250		47 000		73 740	
June	5 087		46 846		74 942	
July	4.735		44.950		70 440	
August	4 597		45 028		73 222	
September	4 564		42 660		75 960	
October	5 085		39 840		81 800	
November	4 734		39 804		82 609	
December	4 500		49 212		78 192	
Year	4 957		45 462		75 033	

(a) Antimony quotations in cents per lb for ordinary brands (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce

Pig Iron, Pittsburgh

	Bessemer 1921	Bessemer 1922	Basic 1921	Basic 1922	No. 2 Foundry 1921	No. 2 Foundry 1922
January	33 96	21 55	31 96	20 15	33 88	21 34
February	28 96	21 46	26 96	19 71	30 25	20 88
March	28 16	21.35	26.46	19.96	27 85	20 83
April	26 96		24 46		26 77	
May	26 21		23 84		25 56	
June	24 96		22 66		24 38	
July	22 84		20 76		22.36	
August	21 96		20 29		21 53	
September	21 96		21 21		22 82	
October	21 96		20 96		22 96	
November	21 96		20 96		22 74	
December	21.96		20 65		21.96	
Year	25 15		23 43		5.26	

In dollars per long ton

Monthly Crude Copper Production

	1921 November	1921 December	1922 January	1922 February
Alaska shipments	4,841,506	8,881,013	6 909,383	4,193,357
Anaconda	(a)	(a)	(a)	9,503,000
Arizona Copper	(a)	(a)	(a)	(a)
Calumet & Arizona	(a)	(a)	(a)	2,462,000
Calumet & Hecla	(a)	(a)	(a)	(a)
Other Lake Superior	5,500,000	5,500,000	6,000,000	6,000,000
Chino	(a)	(a)	(a)	(a)
Con. Ariz. Smelting	(a)	(a)	(a)	(a)
East Butte	750,000	(a)	(b) 750,000	(a)
Inspiration	(a)	(a)	(a)	2,485,000
Magma	(a)	(a)	(a)	(a)
Miami	4,514,000	5,030,941	5,348,000	4,918,000
Nevada Cons.	(a)	(a)	(a)	(a)
New Cornelia	1,605,936	1,717,183	1,602,909	1,459,063
Old Dominion	(a)	(a)	(a)	(a)
Phelps Dodge	(a)	(a)	(a)	4,091,000
Ray	(a)	(a)	(a)	(a)
Shattuck Arizona	(a)	(a)	(a)	(a)
United Verde	(a)	(a)	(a)	(a)
United Verde Extension	(a)	(a)	(a)	646,110
Utah Copper	(a)	(a)	(a)	(a)
Others, estimated	11,130,000	8,500,000	11 400,000	10 20[illegible]
Total United States	28,341,442	29,629,137	32,010,292	45,957,530
Imports: Ore and concentrates, matte	7,297,583	14,844,641	7,136,976	5,081,497
Imports of blister, unrefined	10,561,454	14 731 185	5 178 068	18.081 802
Imports of refined	2,139,144	2 447 925	565 439	
Grand total	49,339,623	61,652,888	44.890,775	69,120.829
Backus & Johnston	900,000	822,000	[illegible]	990,000
Boleo	976,815	954,765	1,102,080	954,765
Cananea	(a)			(a)
Cerro de Pasco	5,618,000	5,536,000	4,726,000	4 868 000
Chile	4,000,000	[illegible]	[illegible]	4,000 000
Cons. M. & S. of Canada	200,000	[illegible]	97,985	(a)
Falcon Mines	518,600	550,800	582,000	566 800
Furukawa	2,690,377	[illegible]	2,357,258	
Granby Cons.	2,365,017	[illegible]	1,974,162	955,038
Hampden Cloncurry	(a)			
Katanga	5,984,370	6,570,900	6,772,600	5,785,920
Mount Morgan	(a)		(a)	(a)
Mount Lyell	1,068,000	[illegible]		
Phelps Dodge Mexican	(a)			318 000
Sumitomo	2,910,964	[illegible]	[illegible]	3,089,353
Wallaroo & Moonta	835,760	[illegible]	112 575	

(a) No copper produced during the month. (b) Estimated

Comparative Annual Copper Production

	1919	1920	1921	1922
January	135,733,511	121,903,744	90,596,597	32,010,292
February	111.649.512	117,540,000	86,682,941	47,417,530
March	102,040,460	120,309,316	91 046 345	
April	98,808,998	116,078,871	46,946.523	
May	92,652,975	114 964,207	25,310 511	
June	95,856,570	116,107,856	24,623,693	
July	100,369,247	109,729,610	22,033,739	
August	107 994,040	112 460,254	23,248 398	
September	108,703,075	114,919,562	23,855,316	
October	115,143 143	105 231,571	23,231 572	
November	[illegible]	106 700,178	28,341,442	
December	[illegible]	[illegible]	29,629,137	

MINING STOCKS

Week Ended April 1, 1922

Stock	Exch.	High	Low	Last	Last Div.	
			COPPER			
Ahmeek	Boston	65	61	61½	Sept '20, Q	$0 50
Alaska-Br. Col.	N. Y. Curb	4	3¾	4		
Allouez	Boston	27	27	27	Mar '19	1 00
Anaconda	New York	52	49¾	51¼	Nov '20, Q	1 00
Arcadian Consol	Boston	2⅝	2½	2½		
Ariz. Com'l	Boston	9½	9	9⅛	Oct '18, Q	0 50
Big Ledge	N. Y. Curb	*21	*18	*20		
Bingham Mines	Boston	13½	13½	13½	Sept '19, Q	0 25
Calumet & Arizona	Boston			58	Mar '22, Q	0 50
Calumet & Hecla	Boston	280	275	277	June '20, Q	5 00
Canada Copper	N. Y. Curb	*22	*22	*22		
Centennial	Boston	†12½	†10	12	Dec '18, SA	1 00
Cerro de Pasco	New York	36	34½	35¼	Mar '21, Q	0.50
Chile Copper	New York	17⅜	16¾	17¼		
Chino	New York	28	26½	27¾	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*32½	*31	*32		
Con. Arizona	N. Y. Curb	*2	*2	*2	Dec '18, Q	0.05
Con. Copper Mines	N. Y. Curb	1 3/16	1¼	1 1/16		
Copper Range	Boston	43¾	42	43¼	Mar '22, Q	1.00
Crystal Copper	Boston Curb	1⅜	*90	1⅛		
Davis-Daly	Boston	7½	7	7¼	Mar '20, Q	0.25
East Butte	Boston	11	10	10⅜	Dec '19, A	0.50
First National	Boston Curb	*73	*70	*73	Feb. '19, SA	0.15
Franklin	Boston	1½	1¼	1¼		
Gadsden Copper	Boston Curb	*65	*65	*65		
Granby Consol	New York	28	26½	28	May '19, Q	1 25
Greene-Cananea	New York	27¼	26¼	26¼	Nov '20, Q	0.50
Hancock	Boston	2½	2½	2½		
Howe Sound	N. Y. Curb	3¼	2¾	3	Jan '21, Q	0.05
Inspiration Consol	New York	40⅞	39½	40¼	Oct '20, Q	1 00
Iron Cap	Boston Curb	7½	7	7	Sept '20, K	0.25
Isle Royale	Boston	24	23½	24	Sept '19, SA	0 50
Kennecott	New York	30¼	28¾	29¾	Dec. '20, Q	0.50
Keweenaw	Boston	†1½	†1¼	1¼		
Lake Copper	Boston	2⅝	2½	2½		
La Salle	Boston	1¾	1½	1½		
Magma Copper	N. Y. Curb	29½	28¾	29¼	Jan. '19, Q	0.50
Majestic	Boston Curb	†*12	*†8	*5		
Mason Valley	Boston	†2	†1½	1⅞		
Mass Consolidated	Boston	2½	2½	2½	Nov '17, Q	1 00
Miami Copper	New York	27¾	27⅛	27¾	Feb. '22 Q	0.50
Michigan	Boston	†2½	†1¾	2		
Mohawk	Boston	58⅜	56	58	Feb. '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	8	7½	7⅝		
Nevada Consol.	New York	15¼	14½	15	Sept '20, Q	0 25
New Cornelia	Boston	18	17½	17½	Feb '22, K	0 25
North Butte	Boston	12¾	12	12¾	Oct '18, Q	0 25
North Lake	Boston			*10		
Ohio Copper	N. Y. Curb	*9	*9	*9		
Old Dominion	Boston	24¾	24½	24½	Dec '18, Q	1 00
Osceola	Boston	34	34	34	June '20, Q	0 50
Phelps Dodge	Open Mar.	†170	†160		Jan '22, Q	1.00
Quincy	Boston	44½	43	44	Mar '20, Q	1 00
Ray Consolidated	New York	15¼	14½	14¾	Dec '20, Q	0 25
Ray Hercules	N. Y. Curb	*3	*2	*2		
St. Mary's Min. Ld.	Boston	47½	43¼	44¼	Dec '21, K	1.00
Seneca Copper	Boston			13¼		
Shannon	Boston	*90	*80	*85	Nov '17, Q	0 25
Shattuck Arizona	New York	8¼	8½	8½	Jan '20, Q	0 25
South Lake	Boston	†1 00	†*65	*80		
Superior & Boston	Boston	1	*90	*90		
Tenn. C. & C. cfs.	New York	11¼	10¾	11	May '18, I	1 00
Tuolumne	Boston	*70	*60	*65	May '13,	0 10
United Verde Ex.	Boston Curb	27½	27¼	27½	Feb '22, Q	0 25
Utah Consol.	Boston	2	[illegible]	2	Sept '18,	0 25
Utah Copper	New York	64¾	62¾	[illegible]	Mar '22, Q	0 50
Utah Metal & T	Boston	1¼	1¼	1¼	Dec '17,	0 30
Victoria	Boston	†2	†1½	1½		
Winona	Boston	*30	*30	*30		
Wolverine	Boston	12	12	12		
			NICKEL-COPPER			
Internat. Nickel	New York	16¾	15½	16	Mar '19,	0 50
Internat. Nickel, pfd	New York	75	74	75	Feb '22, Q	1.50
			LEAD			
National Lead	New York	91½	88	90	Mar '22, Q	1 50
National Lead, pfd.	New York	113	110¼	110¼	Mar '22 Q	1 75
St. Joseph Lead	New York	13⅝	13	13¼	Mar '22, Q	0.25
			QUICKSILVER			
New Idria	Boston	2	2	2		
			ZINC			
Am. Z. L. & S.	New York	15½	14⅛	15½	May '20,	1 00
Am. Z. L. & S. pfd.	New York	40⅜	39	39	Nov '20, Q	1 50
Butte C. & Z.	New York	6¼	6	6	June '18,	0 50
Butte & Superior	New York	27⅛	25⅛	25⅞	Sept '20,	1 25
Callahan Zn-Ld	New York	6⅝	6⅛	6¼	Dec '20, Q	0 50
New Jersey Zn.	N. Y. Curb	144	142	142	Feb '22, Q	2 00
Yellow Pine	Los Angeles	*37	*37	*37	Sept '20, Q	0 03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce Board; Colorado Springs, The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div	
			GOLD			
Alaska Gold	New York	⅝	½	⅝		
Alaska Juneau	New York	1⅛	1	1⅛		
Carson Hill	New York	16⅝	15⅞	16¼		
Cresson Consol. G.	N. Y. Curb	2⅜	2¼	2¼	Jan. '22, Q, X	$0 10
Dome Extension	Toronto			*85		
Dome Mines	New York	28⅛	25½	26	Jan. '22, Q	0 25
Florence Goldfield	N. Y. Curb	*25	*20	*24		
Golden Cycle	Colo Springs	*76	*74	*74	June '21, Q	0 02
Goldfield Consol.	N. Y. Curb	*10	*5	*8	Dec. '19,	0 05
Hollinger Consol.	Toronto	9 85	9 35	9 50	Mar. '22,	0 05
Homestake Mining	New York	69½	62	69½	Mar '22, M	0.25
Kirkland Lake	Toronto	*47	*40	*45½		
Lake Shore	Toronto	2 45	2 05	2 35	Nov. '21, K	0.02
McIntyre-Porcupine.	Toronto	20 40	18.75	19.50	Jan. '22, K	0.05
Porcupine Crown	Toronto	*28½	*25	*26½	July '17,	0 03
Porcupine V. N. T.	Toronto	*32	*29	*31½		
Portland	Colo Springs	*35	*32	*33	Oct. '20, Q	0.01
Schumacher	Toronto	*57	*51	*55		
Silver Pick	N. Y. Curb	*23	*8	*18		
Teck Hughes	Toronto	*56	*54	*55½		
Tom Reed	Los Angeles	*66	*61	*61	Dec. '19,	0.02
United Eastern	N. Y. Curb	2	1 13/16	1 13/16	Jan. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*18	*18	*18	Jan. '20, Q	0 01
White Caps Mining	N. Y. Curb	*5	*4	*5		
Yukon Gold	N. Y. Curb	1¼	1	1¼	June '18,	0.02½
			SILVER			
Batopilas Mining	New York	1½	1¼	1¼	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*35	*32½	*33	May '20, K	0 03
Coniagas	Toronto	1 50	1 00	1 00	May '21, Q	0.12½
Crown Reserve	Toronto	*21	*19	*20	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3¼	3¼	3⅜	Jan. '22, Q	0.12½
La Rose	Toronto	*44	*35	*43	Apr. '18,	0 02
McKinley-Dar.-Sav.	Toronto	*22¼	*18½	*22	Oct. '20, Q	0 03
Mining Corp. Can.	Toronto	1 15	1 05	1.10	Sept. '20, Q	0 12½
Nipissing	N. Y. Curb	6⅝	5⅞	5⅞	Jan. '22, Q, X	0 30
Ontario Silver	New York	9	7½	7½	Jan. '19, Q	0 50
Ophir Silver	N. Y. Curb			*12	Jan. '12,	0 10
Temiskaming	Toronto	*40	*34½	*35	Jan. '20, K	0 04
Trethewey	Toronto	*4¾	*3½	*3⅞	Jan. '19,	0.05
			GOLD AND SILVER			
Boston & Montana	N. Y. Curb	*36	*26	*27		
Cash Boy	N. Y. Curb	*5	*5	*5		
Dolores Esperanza	N. Y. Curb	1¾	*1⅛	1½		
El Salvador	N. Y. Curb	*8	*4	*4		
Jim Butler	N. Y. Curb	*9	*8	*9	Aug. '18, SA	0 07
Jumbo Extension	N. Y. Curb	*4	*4	*4	June '16,	0 05
MacNamara M.&M.	N. Y. Curb	*12	*10	*10	May '10,	0 02½
Tonopah Belmont	N. Y. Curb	1⅝	1½	1½	Apr '22, Q	0.05
Tonopah Divide	N. Y. Curb	*67	*60	*67		
Tonopah Extension	N. Y. Curb	1½	1⅜	1⅜	Apr. '22, Q	0 05
Tonopah Mining	N. Y. Curb	1 13/16	1¾	1¾	Oct. '21, SA	0.05
West End Consol.	N. Y. Curb	1¼	1 1/16	1 3/16	Dec. '19, SA	0.05
			SILVER-LEAD			
Caledonia	N. Y. Curb			*6	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*97	*93	*93	Dec. '20,	0 15
Chief Consol	Boston Curb	3¾	3⅝	3⅝	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	20½	19½	20	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†3 00	†1 25		July '20, Q	0.10
Daly-West	Boston	†2	†1¾	2¼	Dec '20, Q	0.25
Eagle & Blue Bell	Boston Curb	2½	2½	2½	Apr. '21, K	0 05
Electric Point	Spokane	*7	5½	*5½	May '20, SA	0.03
Federal M. & S.	New York	10	9¼	9¾	Jan '09,	1.50
Federal M. & S. pfd.	New York	39	38¼	38½	Mar '22, Q	1 00
Florence Silver	Spokane	*24½	*24	*24½	Apr '19,	0 01½
Grand Central	Salt Lake	*54	*53	*54	Jan. '21, K	0 01
Hecla Mining	N. Y. Curb	6	5⅞	5⅞	Mar '22, Q	0 15
Iron Blossom Con.	N. Y. Curb	*21	21	*21	Dec '21, Q	0 02½
Judge M. & S.	Salt Lake	†3.50	†2 75	3 00	Sept. '20, Q	0 12½
Marsh Mines	N. Y. Curb	*9	*6	*9	June '21, I	0 02
Prince Consol	Salt Lake	*8¼	*8	*8	Nov. '17,	0 02½
Rambler-Cariboo	Spokane	*5½	*5	*5	Feb '19,	0.01
Rex Consol	N. Y. Curb	*8	*7	*7		
South Hecla	Salt Lake	†*60	†*35		Sept. '19, K	0 15
Standard Silver-Ld	N. Y. Curb	*16	*16	*16	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*11	*8	*11	Dec. '15,	0 05
Tamarack-Custer	Spokane	2 25	2 25	2 25	Jan. '21, K	0 04
Tintic Standard	Salt Lake	2 02½	1 95	1 97½	Dec. '21, Q	0.05
Utah Apex	Boston	3½	3½	3½	Nov. '20, K	0 25
Wilbert Mining	N. Y. Curb			*2	Nov. '17,	0 01
			VANADIUM			
Vanadium Corp.	New York	39⅜	37½	38¼	Jan. '21, Q	1 00
			ASBESTOS			
Asbestos Corp	Montreal	56½	54½	56½	Jan. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	78	76	78	Jan. '22, Q	1.75
			SULPHUR			
Freeport, Texas.	New York	17½	16¾	17½	Nov. '19, Q	1.00
Texas Gulf	New York	42½	40½	42	Mar. '22, QX	1.00
			MINING, SMELTING AND REFINING			
Amer. Sm. & Ref.	New York	54	50⅝	53¼	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	97½	95	97½	Mar '22 Q	1.75
Am. Sm. Sec. pf. A.	New York	90	90	90	Apr. '22, Q	1.50
U. S. Sm. R. & M.	New York	37	35⅛	36½	Jan. '21, Q	0.50
U.S. Sm. R. & M. pf.	New York	46	45	4[illegible]	Jan. '22, Q	0.87½

NEW MACHINERY AND INVENTIONS

"Guniting" a 225-Ft. Flue

The following is a description of a flue that was constructed by the Calaveras Copper Co. to connect the dust chamber with the stack at the company's 300-ton smelter at Copperopolis, Cal. This flue is 225 ft. long, 8 ft. in diameter, and is shown in photographs 1 and 2, the reinforcing steel being entirely assembled.

The vertical supports, slightly inclined, are made of 4-in. boiler tubes set in concrete piers, and are tied together at the top. The reinforcing for the main flue consists of ½-in. rods, spaced horizontally circular with 2-ft. centers, tied together, and welded at the intersections. On top of these rods, as shown in photograph 2, was secured 7-A triangular mesh screening. The circular ½-in. diameter ribs were bent up and welded to make several rings. As stated above, all this steel reinforcing was entirely assembled and was self-supporting. The next step was to apply heavy tarpaulin, or canvas, to the outside of the steel reinforcing, and "gunite" was then shot on the inside, the lower half of the flue being shot first. The canvas backing was moved along the flue as the work progressed. After the interior of the flue had been shot (see photograph 3) the exterior of the flue was shot, the completed flue being shown in photograph 4. A three-to-one mixture of sand and cement was used. The slope of the flue is about 25 deg. from the horizontal, and the average thickness of the "gunite" is 2 in.

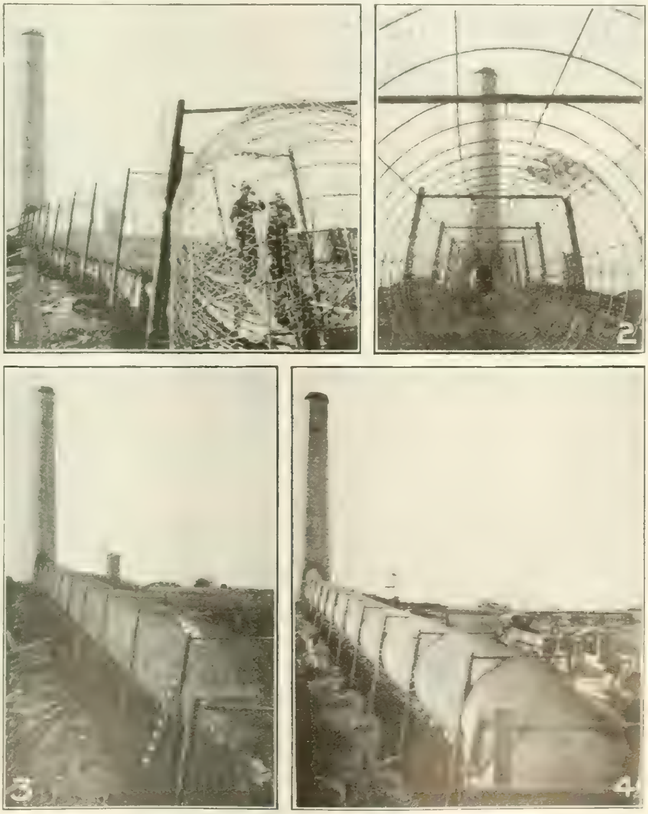
Motors for Mine Pump Service

There has recently been developed a direct-current motor especially built for operating mine pumps. The design and construction of the motor is the result of investigation of conditions under which mine pumps operate.

Six different sizes and ratings are built, but the design and construction is standard for each size. They are compound wound with approximately 15 per cent series winding, having four main field and two commutating field poles. All field poles are laminated and bolted to the frame. The frames are cast steel, octagonal in shape, and provided with a large hole in the bottom for drainage of any water that may accumulate inside the frame. The leads are brought out through heavy insulating bushings to connection plate on the side of the frame. Stamped markings on both the bushings and the connection plate above each lead show the external connections for both directions of rotation.

The motors are not designed to run totally inclosed, but as a protection against water there is a sheet-metal top half cover on the commutation end, the end shield on the pinion end being cast solid on top. A new feature in this motor is the large bearing housings on the end shields, equipped with waste-packed bearings. The end shields complete including brush holders, studs, and bearing housings. The latter are interchangeable on all types except one, the 250-v., which requires larger bearings.

On all sizes except the 550 v., the brush holder studs are assembled directly on the end shield. The large commutator on the 550-v. motors requires a special bracket, which is fastened to the end shield. Brush shifting is done by turning the whole end shield, the bolt holes being drilled large enough to allow all the rotation necessary. When the proper brush position is determined, the end shield is doweled to the frame, and its bolts are tightened. The brush holders are specially designed, and so constructed to prevent chattering or the rocking of the brushes in the holder. The design is a development of the General Electric Co.



Constructing a flue at Copperopolis, Cal.

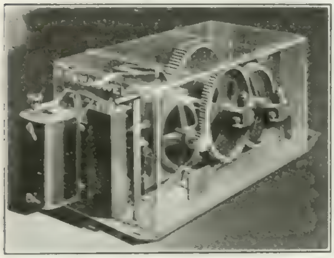
A Convenient Small Hoist

A self-contained, small portable hoist which is suitable for light hoisting and hauling, is mechanically dependable, safe from injury to its mechanism, and protected in such a way as to prevent injury to workmen finds ready application for all sorts of odd jobs, both above and below ground. Its work comprises everything from hauling cars, placing machinery on foundations, skidding timbers, and loading concrete forms, to handling a slusher in underground work.

Such a machine is shown in the illustration on the next page. This hoist is wholly inclosed in a heavy sheet-steel plate casing and mounted on ½-in. steel sole plate. The unit casting forms the support for the drum and gear shaft bearings, the latter being electric steel castings, fitted with renewable bronze bushings and lubricated from a waste-packed oil reservoir. The controller box and resistance panel are, of necessity, mounted on the exterior of the casing. All other mechanism and the motor are entirely inclosed.

The hoist is provided with a clutch manipulated by a lever at the operator's end of the hoist, which lever is automatically locked either "in" or "out." Control of the load is effected by a powerful hand-brake, whose controlling hand-lever is conveniently placed. This brake-lever is normally latched in an "off" position, allowing the hoist drum to run free. A removable door or cover is provided on the top of the casing to give easy access to the mechanism within. All parts except the barrel of the rope drum are made of steel.

The 8 x 12 in. drum has a capacity of 1,500 ft. of [illegible] in. wire rope and a



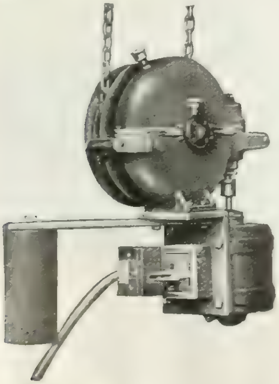
Small inclosed hoist

rated hoisting capacity of 1,500 lb. at a speed of 100 ft. per minute. The standard motor employed is of 5 hp. operating at 1,200 r.p.m. The entire hoist measures 2 x 2 x 4½ ft. over all.

This new product has been developed by the Treadwell Engineering Co., at Easton, Pa.

An Electric-Driven Chain Hoist

Mine, mill, and smelter operators frequently have use for hand-power hoists of five tons' and larger capacity. The following is a description of a patented electric machine that may be suspended in the bight of the operating chain, and has a capacity to overhaul [illegible] ft. of hand chain per minute and a chain pull of 130 lb. This gives a load-lifting speed of approximately four times that obtainable by hand power and requires only one man for operation.



Chain hoist with electric drive

Current may be supplied by a flexible conductor from convenient sockets or suspended from the hoist if more desirable to bring feeders to that point. The machine balances itself, weighs about 160 lb., and is easily handled. The gears are hardened and run in oil, and the machine can be furnished for operation on both alternating and direct current. The New Jersey Foundry & Machine Co., 90 West St., New York City, manufactures the hoist.

An Ingenious Device for Filling Storage-Battery Cells

By means of a cleverly devised tool, the exact amount of water necessary to fill storage-battery cells is permitted to flow into the cells without overflowing or causing the electrolyte to slop over. In addition to saving time, the use of the device will materially aid in keeping the battery tops dry, and will be equally useful where one battery is kept or where a fleet is maintained.

The barrel end of the filler is grasped with the index finger resting upon a trigger on the lower side. The nozzle end is inserted in the filling vent, the trigger is then held down, and the water flows through the hose into the cell. As soon as the level of the liquid reaches the proper height, a contact is made and a small electric bulb signal lights. The trigger is then released, shutting off the water, and the operation is repeated in the next cell.

Battery cell-filling device

The device is known as the Exide Cell Filler and is the invention of and manufactured by the Electric Storage Battery Co., of Philadelphia, Pa.

TRADE CATALOGS

Traylor Machinery—The Traylor Engineering & Manufacturing Co., of Allentown, Pa., and with branch offices at New York, Chicago, Pittsburgh, Los Angeles, and Spokane, has issued Bulletin 1,000, which consists of a pocket edition of the company's general catalog. Condensed information is given concerning crushing and grinding machinery, furnaces, classifiers, jigs, mine skips and cages, pumps, and compressors.

Mine Pumps—Catalog No. 15, issued by the Prescott Co., Menominee, Mich., covers the subject of mine pumps—electric and steam—in an excellent manner. The illustrations are beautifully done and the issue does credit to the company. There is also included a number of tables and engineering data. Prescott pumps need no introduction to mining men, but the descriptions of the various types will prove interesting to those who are not familiar with all of them.

Pump Bearings—The Oliver Sherwood Co., of 505 Market St., San Francisco, Cal., has issued a bulletin bearing the title "Cutless Bearings," which describes the uses and advantages of an "Olivite" rubber bearing for pumps. A number of objections made to the use of rubber bearings are given in the pamphlet and arguments in favor of their use are presented.

Controllers—A simple description of controllers for electric motors and definitions of the terms used in that connection have been compiled by the Electric Power Club and published in a handbook. Words which do not appear in the regular dictionaries are here explained in simple language, and in addition to being a handbook for users of electrical control apparatus, the volume gives the meaning of terms with which all users of electrical apparatus should be familiar. The handbook may be obtained from leading manufacturers of electric power and control apparatus, or from S. N. Clarkson, executive secretary, 1017 Olive St., St. Louis, Mo.

Couplings — The function of the Whitney free-floating coupling is to transmit power from one shaft to another, though the shafts are not in alignment, without causing strains in the shafts or bearings. This is accomplished by the power being transmitted through the free floating center link which fits into sockets in the hubs so that it is free to rock in any direction and float laterally and yet is of such design as to give a positive drive. The action of these couplings is in no way accomplished by the bending or otherwise distorting of any of its members, and therefore limited by the fatigue of material, but is due entirely to the geometric design of the center link. Further particulars are furnished in Circular No. 1922, issued by the Kay Manufacturing Co., Norwalk, Conn.

Compressors—Bulletin No. 407, issued by the Bury Compressor Co., of Erie, Pa., describes the Bury Universal three-cylinder, two-stage compressor. This type includes among its special features the square type, rolling-mill style frame; broad, deep and well reinforced with heavy ribs with ample support under its entire length and breadth; large main bearing surfaces in removable shells, easy of adjustment and removal; thorough and copious automatic lubrication; automatic patented pyramid box plate intake and discharge valves with the largest areas, insuring light work, low velocity of air through valves and low power cost with high efficiency, noiseless in operation, and most simple.

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Consulting Editors

Volume 113 New York, April 15, 1922 *Number* 15

Recognition of Mexico

AMERICANS who are mining or who are desirous of mining in Mexico would like to have all possible done to promote stability. They would like to see the United States use its friendly influence to that end. Many of them would like to see the Government at Washington formally recognize that at Mexico City, believing that President Obregon has shown capacity for maintaining a stable and increasingly orderly government. The reports which come to us from time to time, from mining men, as to conditions in Mexico, are moderately favorable. The country is still industrially almost prostrate, as the result of the long years of internal war and banditry; but it is agreed that the tendency is toward improvement and that the present administration is doing pretty well.

The policy of the Government in Washington is not that of a few years ago: we do have a foreign policy; we recognize that we have part in and are affected by the conditions of other peoples than our own. Our Government will, therefore, do everything that it can toward aiding the prosperity of Mexico and in assisting those Americans who are engaged in mining enterprises there. The State Department, according to trustworthy reports, is willing to recognize the present government in Mexico, provided the usual preliminaries and mutual agreements are made, preferably in the form of a treaty. There is one clause in the new constitution of Mexico—Article 27—which in effect confiscates the property of certain Americans in Mexico by declaring that the oil in the oil lands is the property of the state, although these lands have been obtained by private purchase from individual Mexican owners. No real attempt has been made to enforce this action: nevertheless it stands as a threat. It is admittedly a difficult and perplexing problem for the Mexican government, whose minerals are otherwise held to be the property of the state, and are held by individuals or companies only so long as they pay the stipulated rental in the form of taxes.

Just as Mexico is puzzled and disturbed over the petroleum situation, which must look to President Obregon as if foreign capital were obtaining sovereignty over one of Mexico's greatest sources of wealth, the Government in Washington, whose mining law gives away its minerals in perpetuity, is unable to see any foundation for the Mexican attitude. It is a misunderstanding that could be cleared up and adjusted by frank conversations, not by stilted diplomatic notes. With these matters discussed and boiled down to a common agreement, a treaty would be possible which would bind the friendship of the two nations. Such overtures should come from the Mexican government; and if made frankly and fairly, as we have no doubt they would be, there is no question whatever of a highly satisfactory outcome.

Another Assessment Work Bill

SENATOR STANFIELD, of Oregon, could have done better than introduce, as he did on Feb. 20, a resolution to suspend the requirements of annual assessment work on mining claims during "the years 1920 and up to and including June 30, 1924." There were never more than two reasons for the suspension of the assessment law. These were, briefly, the absence of the claim holder in service during the war, and, second, the difficulty in securing labor to perform the work. Neither of these conditions now exists, nor have the conditions named existed for some time.

The question has been well debated in the past whenever it has come up in Washington. Beginning with the years 1917 and 1918, when the plea that the law be suspended was unanimously granted by Congress, the matter has been brought up for discussion year after year. The law was again suspended in 1919, when at first only five claims held by an individual were exempted, this restriction being removed, however, before the year ended, so that all claims were then exempt. It was promised then that suspension would not be asked again in the future. The matter, nevertheless, was brought up in 1920, and, as a compromise, six months' extension of the time within which the work must be done was granted, so that 1920 assessment work was being performed until July 1, 1921. Then last August a bill was passed making the assessment-work year coincide with the fiscal year instead of the calendar year, which had the effect of extending the period for 1921 work by six months, or until July 1 next at noon. Thus claim holders had eighteen months to do their 1920 work and will have a similar period for that required for 1921.

It is to be noted from the foregoing that the law was completely suspended in 1917, 1918, and 1919 and that no work was necessary during those years to hold claims. But for the year 1920 the stipulated amount of work was required, and likewise for 1921, the time in which the work must be done in both of these periods merely having been extended (in the latter period incidentally) by six months. The significance of Senator Stanfield's bill, then, is seen in that it provides for total suspension of the requirements during the years 1920, 1921, and up to June 30, 1924. It is thus retroactive as far as 1920 is concerned and is a violation of the promises made in 1919 that further suspension would not be asked.

Evidently the bill was drawn in the interest of speculators, who located claims as they desired, without expense to themselves and in the hope of turning them over at a profit. The longer the period of suspension, the longer will birds of this feather flourish, and with no resultant benefit to mining. There is one bit of comfort, however, in all of this, and it is that the bill stands little chance of passing. But the more quickly it is killed the better.

The Premier Mine

PAYMENT OF A DIVIDEND of half a million dollars is announced by the Premier Gold Mining Co. This is on account of the quarter ending March 31 and is paid on a capital of $5,000,000. On Dec. 31 the company distributed $400,000 to its shareholders, but the fact was not made known until recently. The delay in publicity was caused, we understand, by negotiations for the purchase of additional claims. Those handsome dividends have followed upon the completion of the sixteen miles of tramway from the mine, in the Salmon River district, in British Columbia, to tidewater at Hyder, Alaska, at the head of the inlet known as the Portland Canal, whence the ore and concentrate are shipped to the smelters at Anyox and Tacoma.

The original claims, located in June, 1910, were acquired by Mr. O. B. Bush, who organized the Salmon-Bear River Mining Co. The prospecting that was then started proved unsuccessful, and nothing was done until the summer of 1914, when some promising ore was exposed along the outcrop. In the winter of 1915 the property was examined by Mr. Henry Krumb, who placed Mr. R. H. Plate in charge of the exploratory work. These engineers represented Mr. William B. Thompson, of New York. Sundry crosscut tunnels were driven, without, however, striking any rich ore, whereupon the bond was canceled, after about $60,000 had been spent in eighteen months. The mine became idle again.

In the summer of 1918 Mr. R. K. Neill, an experienced operator of Spokane, was induced by Pat Daly, who had been foreman for Messrs. Bush and Plate successively, to examine the mine. The result were so satisfactory that Mr. Neill bonded the mine for $100,000, and began work in the spring of 1919. He ascertained that the No. 1 tunnel, 225 ft. long and 250 ft. below the surface, had been run nearly parallel with the lode. Cuts of only 6 ft. sufficed to disclose a veritable bonanza, the assays running into hundreds of dollars per ton. Shortly afterward, a fifth interest was bought by Mr. Minor C. Keith, of the United Fruit Co., and another fifth by Guggenheim Brothers. Mr. Neill met the option price of $100,000 out of the sales of ore.

To show the richness of the ore it can be stated that 286 tons brought a return of $96,000, of which 40 per cent was in gold and 60 per cent in silver. At one time a face of ore 7 ft. high and 6 ft. wide averaged $1,000 per ton. A crosscut showed a thickness of 82 ft. that averaged $57 per ton. The silver is in the form of argentite, proustite, and stephanite, or, as a miner would say, silver glance, ruby, and brittle silver. The ore is docile; the flow sheet of the new mill includes concentration, cyanidation, and flotation. Most of the silver is recovered in the flotation froth. The grinding is done in cyanide solution. Mr. Dale L. Pitt is manager. He is to be congratulated on the results already achieved, which promise to place the Premier among the great mines of the American continent.

Caving Systems of Mining

IN A RECENT NUMBER of *Mining and Metallurgy*, J. Parke Channing discusses in an interesting manner the subject of caving systems of mining. In his opening paragraph he defines the term "caving system of mining" as "that method of removing the ore from an underground body in which the top is first attacked and mined out and the capping or roof is allowed to fall in or 'cave' and fill the space formerly occupied by the mined ore." It seems to us that this definition is not specific enough, since it would apply broadly to all methods of mining in which open spaces were left, as eventually caving of some kind results. The illustrations which Mr. Channing uses to carry his definition are extreme examples of the same kind. It is desirable to make distinction between "cover caving," meaning by this the breaking and settling down of the overlying rocks upon existing cavities, and "ore caving," in which the ore is first undercut and is then broken (caved) by the weight of the orebody and cap rock above.

As a general mining term "caving" carries with it two fundamental ideas, the incidental collapse of wall rocks and contiguous rocks and a systematic caving of the cover with or without a deliberate attempt to make the weight of the ore play a part in breaking itself from position and reducing large fragments to smaller ones. Incidental caving is consequential upon some method of mining. Caving as used to signify a method implies control and deliberate planning.

In top-slicing, there is the mining out of a block of ore which may or may not involve undercutting. Usually the ore is broken down by drilling and blasting. After a block has been mined out the supporting timbers of the room are blasted down and the cover caves. This is therefore not a caving method, because the weight of the ore is not used in mining. According to our distinction, we would relegate it to "cover caving," but prefer to use the term top-slicing. We admit that top-slicing, to be successful, implies the regular caving of the cover as the slice is retreated.

The long-wall method of coal mining is without much doubt one of the first mining methods in which roof pressures were used to "mine" the coal. Under favorable conditions little undercutting and only light pickwork are required to mine the coal, as the pressure put upon the coal face exceeds the compressive strength of the coal and breaks it down. From this extreme we can find varying degrees up to the point where the coal must be fully undercut and shot down. In all such operations, however, the cover is dropped a short distance back of the face being mined. Here is an example of "ore caving" and "roof caving."

We believe it to be desirable to limit the term "caving method" to those methods which involve more or less undercutting and the action of the weight of material and cover in the further breaking of the ore.

Mr. Channing traces out an interesting sequence in the application of the block-caving method at Miami. It represents experimentation with thin vertical pillars and then with a slab of ore in a horizontal position. A logical consideration of block caving would imply the undercutting horizontally of a relatively thin (in height) block. The height of the block and its fall through a certain distance, together with the weight of the cap rock, would act under the most favorable conditions to break up the ore. It seems to us that mining engineers have not clearly defined the conditions under which block caving is effective. The undercut space should be sufficiently high to cause a definite drop and the volume great enough to take care of the expansion of the broken ore. It need not be the full theoretical amount represented by the difference in volume between broken ore and solid ore, but it should be, let us say for a beginning, 50 per cent of it. Block caving is undoubtedly more or less gradual, and, during the process of drawing, the upper part of the block is undergoing progressive breaking down. Hence our reason for saying that the volume of undercut may be a fraction of the theoretical requirement.

A relatively thin slab is required, as a thick slab would be held too firmly by the sides. In the method as applied years ago in the Pewabic mine, end-cutting of the block was practiced, and this released it to a considerable degree, but in the method described by Mr. Channing the top weight must be sufficient to shear the sides of the block. This factor acts to reduce the vertical thickness of the block. It is of interest to note that there is a close parallel between the practice at the Ruth mine and at Miami and long-wall mining. At the mines mentioned, the thin slab is not dropped as a unit, as in the Ohio and Pewabic practices, but is subjected to the downward thrust of the broken and moving capping and the broken ore. This thrust acts upon the end of the thin block. By sequentially undercutting the end of the block and retreating, the end of the block is progressively crumbled off, and as it subsides, due to drawing off through chutes, the irregular ore blocks are gradually reduced in size. This differs from the type examples of block caving represented by the practice at the Pewabic and Ohio mines and more closely approximates the long-wall mining method. We suggest that it be called "progressive block caving," rather than "block caving."

Selective Dredging

AN INTERESTING outcome of the present struggle to reduce costs in mining operations is taking place in the gold-dredging industry. Engineers are resorting to a close scrutiny of their drill logs and are discriminating in their selection of dredging ground on the basis of its gold content and ease of dredging. In a general way gold dredging has always been conducted with a reasonable distinction between pay and non-pay ground, but the lines are being drawn closer, and dredge engineers are now discussing selective dredging. This involves the drilling of additional drill holes in uncertain parts of given areas and the study of the vertical distribution of the gold, with the object of curtailing the depth of dredging whenever possible.

In one instance coming to our attention the dredge engineer has graphically represented the vertical distribution of gold content upon his working map for each test hole or pit. With this chart he is laying out the course of his dredge and specifying the digging depths in accordance with the principle of making every cubic yard dredged carry its cost and yield some profit. It is precisely by methods such as these that mining can be made to pay.

Continuity of Operation

CONTINUITY in the operation of modern cyanidation machinery is an essential to economy and efficiency. Equipment is arranged usually so that stoppage of the entire mill need not occur in consequence of minor breakdowns or normal repairs. In some operations, however, the supply of power is not dependable, and extraordinary provision must be made against accidents that may occur from this cause.

At the Hollinger cyanide plant a number of slow-speed, mechanical agitators are used to assist dissolution of the gold before subsequent treatment is begun. The need for a reliable supply of power and for adequate provision against accident will be apparent to those whose experience has included the operation of equipment of this character. The problem was solved by the installation of compressors of a novel design, and so arranged that by making minor changes they can be converted into steam engines, the induction motors then serving as generators. These reversible units have been found to constitute an insurance against serious trouble in the mill, in consequence of the complete stoppage of electric power. One unit was in service during 1921 for current-generating purposes for four months. Thus was it possible to continue cyanidation without interruption through a period during which the power company failed to meet requirements.

The design of suitable equipment is not all that is needed in mining work; numerous unfavorable contingencies must be foreseen and provision made for them. Although those who suffer from the effects of broken machinery and unfilled contracts deserve some degree of sympathy, commendation is merited by others who make extraordinary provision against the ill-effects of accident or delay; for uninterrupted operation is the keystone of industrial success.

Industrial Applications of the Flotation Process

MANIFOLD are the uses of flotation, and interesting the details when the process is borrowed, often unconsciously, for application in some phase of industry other than as a sequel to the mining of metals. Much research has been done on the deinking of printed paper, as well as on the development of an ink that would be susceptible to bleaching by an economical chemical treatment. However, the use of the carbon-base ink, which is unsusceptible to bleaching processes, has persisted; and now comes a method by which it may be removed from old papers, and by which many economies may be effected, for newspapers may thus be used almost indefinitely. In this process the old papers are shredded and macerated in water; the pulp is then heated and laundry soap is added, agitation being maintained until the oil in the ink is thoroughly emulsified. Cold water is then added, with the result that, as the heating continues, some of the soap is thrown out of solution and rises, with the oil and the pigment, to the surface as bubbles. These, carrying their load of carbon from the printer's ink, are then removed by an appropriate mechanism, or are allowed to overflow.

This invention forms another example of the separation of a mineral by the flotation process; but a long vista of legal tangles is seen ahead if an attempt be made to determine whether or not the amount of oil used in the ink amounts to more or less than one-half of 1 per cent of the carbon contained therein!

The Technique of Mining

RECENTLY, a mining engineer in conversation with us remarked that in mining considerably more attention to technical matters was needed. How is it, he said, that while adequate attention is given to the metallurgical treatment of the ore, and an organization, the metallurgical staff, is considered essential in important operations, the mine itself is allowed to go on in humdrum fashion without adequate attention to many technical details? He remarked that the mine superintendent and his foremen usually have their time so occupied that they are unable to give adequate attention to improvements in methods, equipment, and operations.

In our opinion this general criticism is worth the attention of mine managers. Not enough technical assistants are directly concerned as fact finders in the production operations of a mine. Neither foremen nor superintendents have sufficient time to investigate thoroughly the detail of the ordinary run-of-mine work. No little attention is given to cost analysis and sampling, and surveying and even geological mapping come in for a fair share of study. These are very important; but of importance also are technical studies of drilling and blasting operations, of mining methods, of mucking, of transportation, of hoisting, of drainage, of ventilation and of wastes both in labor time and supplies.

Price and Service

IN A SMALL GATHERING in one of the engineering clubs, an experienced mining engineer was discussing the power problem at his property. He stated that the present power requirement of the property in question was approximately 1,000,000 kw.-hr. per month. The cost, let us say, was 1c. per kw.-hr., or $1,000 per month. "Usually," our engineer friend went on to say, "first consideration is given to cost, but this, after all, is secondary. It is the service that counts. Continuity of service, reliability, is a far more important consideration than cost."

There is a good point to this engineer's argument. How often do we really consider cost details in the light of the accessory facts? Cost is the most obvious factor, but when we are buying drill hose how many of us have the facts in hand on the durability, weight per foot, and efficiency as a conduit for compressed air? When we complain about power costs we seldom think of the twenty-four hour 365 days per year service that may be attained at the switchboard. A power interruption of an hour in a mine employing 400 men may mean a direct money loss of $200, or one-fifth of the power bill. A day's interruption may mean a relatively large loss in milling capacity.

Similarly, it is not the day's pay that looms as the important limiting factor of most mining operations, but the quality of the service rendered. In the purchase of supplies, power, equipment, or labor we are, if we are logical, under the necessity of having the facts on service.

The Sucker List

DON'T BELIEVE that the promoter who is directing the destinies of fly-by-night and impossible mining ventures in which the innocent or mercenary or the foolish stock buyer puts his money has complete disregard for this trusting buyer. On the contrary, he studies him most carefully, and if we are to believe one of our friends, the more experienced of these "milkers of the public" have introduced modern methods into their business to the extent of classifying prospect lists into distinct strata. In one instance the "milker" has what he terms his Class A list. This list contains the names of "suckers" who come through all the time, in amounts of from $250 up to several thousand, and on any venture. We suppose a new name belonging to this designation might become the object of lively bidding on the part of several "milkers" if it were possible to auction it off. Next to Class A is Class B. In this the owner of the name "comes through" all the time on anything, but only in small amounts. Class C includes a list on which some 20 to 30 per cent of the names will invariably "come through" in greater or less amounts of money. Class D represents a list which yields remittances from only 10 per cent of the total number.

We had suspected it before, but now we know it. There are various degrees of this "suckeritis" disease. The victims may range from the high-grade nugget type to the low-grade spotted type. Can't you see the manager of this unmoral enterprise weighing the various candidates upon his delicate balances and assigning them to the different divisions of his mailing list? We can imagine his joy and satisfaction when he discovers a Class A name. It is probable that he handles it with reverent care and with secret admiration for an individual who can work and save and then consistently give his money away to him. Picture the disdain of this crafty individual as he throws a name into the Class D list and the utter contempt with which he must regard the fellow who consistently inquires but never bites.

Improving Our News Service

WHATEVER VALUE news may have is increased by promptness in reporting it. Desirous of continuing the efficient service that by reason of its location the *Mining and Scientific Press* in the past was able to give its subscribers with respect to happenings west of the Rockies, the *Engineering and Mining Journal-Press* has arranged to receive from its correspondents by telegraph the news of important events that may occur in the Far West. Thus will be saved the time that may hitherto have been lost in mailing such reports. Western subscribers will receive a service practically as prompt as any rendered by the *Press* in the past, and those in the East will get important Western news with greater dispatch.

Use of the telegraph in reporting news events had long been the practice of the *Engineering and Mining Journal*. In a recent issue, detailed reports were published of two conventions that had taken place at Spokane and Vancouver but a short time before, something that would have been impossible had anything slower than the telegraph been depended on. Many similar instances in the last two years may be cited. For some months, moreover a cable service for foreign news has been established.

The first requisite of news is accuracy, and the next speed. In judging of the promptness of foreign mining news, however, due allowance must be made for the possible remoteness of certain districts.

Extended Use of Electric Furnaces Will Stimulate Production of Copper

THE EXTENDED USE OF ELECTRICITY as a source of heat is of interest to the great copper-mining companies, for electric equipment and transmission absorb considerable quantities of the red metal. We learn that the largest electric steel-melting furnace designed to date has been ordered by the Ford Motor Co. It will be of the Greaves-Etchells type and will be manufactured by the Electric Furnace Construction Co. The new unit will have a capacity of sixty tons of steel, and will be used in conjunction with two smaller furnaces of similar design, already in operation, and two others on order.

The Functions of Institutes—I

By T. A. Rickard

A RECENT bulletin of the Canadian Institute of Mining and Metallurgy contains an article on 'Institute Policy', by Mr. G. C. Mackenzie, who is secretary-treasurer of that organization. This article is prompted, it is stated frankly, by the reluctant conclusion that the Canadian Institute "has, perhaps unconsciously, been drifting for the past few years, lacking a sense of direction, and without a definite idea of voyage in the interests of the allied industries it represents and of the members of the society". Later in the same article Mr. Mackenzie says: "There is a strong under-current of feeling within the Institute that it is not functioning along the lines laid down in the charter". This is interesting because it recalls the comment frequently to be heard in regard to the policy of our own organization. The American Institute of Mining Engineers started, as its name implies, as a society of professional men; for many years it was such a professional society; then it lowered the bars and admitted almost anybody connected with mining affairs, including illiterate foremen, promoters of mining companies, agents of machinery houses—indeed almost anybody willing to pay $10 per annum. The membership became so nondescript that a group of professional men expressed their protest by starting a rival organization, the Mining and Metallurgical Society of America. This was founded in 1908 with the idea of restricting membership to mining engineers, metallurgists, and geologists of good repute. Unfortunately, the Society set forth early in its career to be exclusive rather than representative; it was un-American in spirit; its membership has continued to be so small as to render ridiculous its arrogation of a national title; today it is essentially a delightful dining club in the city of New York. However, it has done much good work in the study of current problems, such as the licensing of engineers and the revision of the mining law; it has been a *pied-à-terre* from which the Institute itself was reorganized in 1911; and it serves as a nucleus of unrest to which any dissatisfied members of the Institute can turn, for its members almost without exception are members of the Institute as well. However, the Society has not replaced the Institute; it might have done so if it had been started in a more generous spirit; it has helped to discipline the management of the Institute, but it has not succeeded in giving the mining profession the kind of national organization that either it or the Institute started to establish. The one is a mere coterie; the other is nondescript. Here I ought to say in all fairness that the members of the Society claim to avoid rivalry with the Institute, especially by excluding the discussion of technology. In the latest presidential address, that of Mr. J. E. Spurr, the idea of co-operation between the two organizations is advocated, including a joint meeting once a year. I write as a detached critic. Of late years an effort has been made to exclude undesirables from the Institute; and for a time the qualifications for election were more closely scrutinized; but the edge of reform was blunted as soon as a sustained effort was made to increase the membership, particularly in 1920. At that time a campaign of solicitation rendered futile any attempt to scrutinize closely the qualifications of candidates who had been invited to join in response to the urging of the membership committee, seconded by a president who was one of the most distinguished men of this generation. Rarely is solicitation compatible with selection. At the end of 1920 the Institute had 9323 members, whereas the Society had 302. The comparison is eloquent; obviously either the Institute is nondescript or the Society is non-representative; actually the adjectives apply, without the alternative. The Canadian Institute may have avoided both extremes, but it also has been generous in its welcome to membership, so that it includes many who are not technicians or professional mining engineers, metallurgists, or geologists. It is fair to say that to be a member of the American or the Canadian institute is no more evidence of professional standing than to be a subscriber to the 'Engineering and Mining Journal-Press'. On the other hand, membership in the Mining and Metallurgical Society does connote professional respectability. This is true also of the Institution of Mining and Metallurgy, in London, which has 1000 members, 1000 associates, and 350 students. This society, started in 1892, has aimed to make membership a voucher for good standing in the profession; and in large measure it has succeeded in doing so, because it has never engaged in a campaign of solicitation or tried to aggrandize itself by mere numbers. Like all such societies, it includes some weak sisters and even an occasional black sheep, whose weakness or blackness has developed since election to membership, but on the whole it does mean something to be a member of the Institution. The members are representative in number as well as in character. Our Institute with 10,000 members and the Mining and Metallurgical Society with 300 members are not representative, because an American mining engineering society that aimed to be representative would include about 3000 members; if it included many less it would hardly be representative; if it included many more it would hardly be selective.

The Institution in London has been well managed, thanks largely to its secretary, Mr. Charles McDermid, who has been wise both to the duties and to the limitations of his office. Another factor favorable to the success of the Institution has been the central position of London, which attracts the mining fraternity from every part of the British empire. The leading practitioners live in London, and have their offices in the City; the mining engineering profession of Great Britain is concentrated in London, and those engaged in other parts of the world gravitate to London at frequent intervals. Therefore it is easy for the Institution to maintain monthly meetings. These are well attended and are rendered pleasant by sundry social amenities. The discussions are not usually of a high technical standard, because many of the British engineers stay in London too much and are therefore out of touch with the technique of their profession, but the discussions are conducted in an agreeable manner and serve admirably to promote good-fellowship. That, after all, is one of the chief purposes of such an organization.

DISCUSSION

Heat Requirements of Chloridizing Volatilization

Bureau of Mines Official Takes Exception to Some of the Statements Made by the Late Harai R. Layng

In THE *Mining and Scientific Press* of Feb. 25 Harai R. Layng presents the results of some calculations on the fuel consumption necessary in chloridizing volatilization as practiced in the horizontal rotating kilns tested by the Bureau of Mines and in his own proposed shaft furnace. Because of his critical comments on the work done by the Bureau of Mines investigators I feel it necessary to call attention to the premises on which Mr. Layng bases his arguments.

Several months ago Mr. Layng wrote me stating that he was carrying on some calculations on the thermal efficiency of the 20-ft. experimental kiln in our Salt Lake laboratory, using such data as he had been able to gather, asking for more, and also inquiring whether we had ever struck a heat balance on this kiln. The metallurgists at the Salt Lake laboratory asked me to tell Mr. Layng that they did not consider extensive calculations on this small kiln to be of much value. The fuel consumption was known to be high in the laboratory kiln, but tests had been made on much larger kilns, and it was felt that a better practical correction factor was available for the small-scale tests than any thermal balance.

From Mr. Layng's calculations, the Salt Lake kiln used the equivalent of about 55 gal. of fuel oil per ton of ore. This is due to the small size of the kiln and the difficulty of keeping out excess air. Instead of discussing this small kiln, permit me to present some figures from the operation of several larger kilns.

A kiln operated by the Yellow Pine Mining Co., of Goodsprings, Nev., afforded the following figures: Treating a zinc-lead-silver carbonate ore at 900 to 1,000 deg. C., in a kiln 50 ft. long and 6 ft. in diameter, set at the proper slope and rotated at the proper speed to let 35 tons of ore pass through in sixteen hours, the oil consumption was 12 gal. per ton. A Bruckner-type kiln, 16 ft. long and 4 ft. in diameter, operated by Morris Kirk in a semi-commercial plant at Harbor City, near Los Angeles, treated similar ore with a consumption of up to 16 gal. of oil per ton.

In the chloride volatilization plant of the Pope-Shenon Co., at Salmon City, Idaho, a kiln 25 ft. long by 3 ft. internal diameter treated forty tons of oxidized copper ore in twenty-four hours at a temperature of 900 deg. C. with an oil consumption of 10 gal. per ton, and when treating thirty tons in twenty-four hours, the oil consumption was 12 gal. per ton. The largest kiln yet operated is capable of treating 125 tons daily of old patio tailing at Pachuca, Mexico, and is operated by the Blaisdell Coscotitlan Syndicate. I am informed by the manager, P. A. Babb, that the kiln is 125 ft. long and 8 ft. internal diameter, heats the ore to nearly 1,000 deg. C. and uses 12 gal. of 18,500 B.t.u. oil per metric ton when treating 125 metric tons of ore daily. This is equivalent to 10.1 gal. of 20,000 B.t.u. oil per short ton.

Mr. Layng calculates that his stack furnace *should* use only the equivalent of 8 gal. of 20,000 B.t.u. oil. I am little inclined to carry on a discussion over the difference between an observed figure of 10 gal. per ton in two operations in actual practice and a calculated consumption of about 8 gal. for an untried furnace. All I wish to do is to agree that Mr. Layng's calculations for his furnace sound reasonable.

However, with these figures in mind, I wish to discount the indictment which Mr. Layng brought against the Bureau of Mines work in the following words: "The calculations that I have made, as well as other work and studies that I have done, cause me to be firmly convinced that the work on chloridizing volatilization being performed by the Bureau of Mines engineers with the experimental kiln has done and is doing more harm than good to the advancement of the art of chloridizing volatilization." I feel that the fuel consumptions obtained in actual practice of chloridizing volatilization have amply justified us in ignoring the fuel consumptions of the small kiln. The whole discussion here should merely give point to the conclusion that roasting tests in the laboratory are difficult to interpret, particularly from the standpoint of heat losses and fuel consumption.

I do not wish to condemn the work of any man as flatly as the Bureau of Mines work has been condemned by Mr. Layng, but, while we are handing around the bouquets, it might be well to say that the Bureau engineers have looked at the Layng stack furnace[1] with a great deal of honest skepticism and have read his claims for it with increasing wonder. The superintendent of the Intermountain Station at Salt Lake asks me to call attention to the fact that a false impression exists about the fuel economy of the old Stedefelt stack furnace for chloridizing roasting. Although the literature reports low percentages of coal and coke used, the ore is described as "sulphurets" and contained rather high percentages of sulphur, which served as fuel. Also, the ore was dried and heated to 200 to 300 deg. F. before it was dropped through the furnace, and the hot material had then to be piled in heaps to finish the chloridizing. Mr. Layng is the only reported witness to the efficiency of the Layng stack furnace for chloridizing *and* volatilizing, and, if I must say it, we have been so little convinced by his claims that we have never felt justified in going to the expense of checking them.

Mr. Layng also gives credit to us for "recommending" the addition of 15 per cent of limestone to certain ores to prevent sintering. I am informed by Messrs. Varley and Stevensen, authors of *Reports of Investigations*, Serial No. 2,247, that what they actually said in that paper is, "the addition of 5 to 15 per cent of lime-rock will prevent sintering in some of the worst ores."

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[1] Mr. Layng described this furnace in *Engineering and Mining Journal* of Nov. 12, 1921.—EDITOR.

It will be remembered that this fact was patented by C. S. Wigton (U. S. Patent 1,264,586, April 30, 1918), the metallurgist of the Chief Consolidated Mining Co., an independent and able inventor in chloride volatilization. Messrs. Varley and Stevensen made a statement of fact, not a recommendation, but I fancy they are willing to recommend such treatment of exceedingly bad ores when it is necessary.

With regard to the questions on latent heats of vaporization, data on which Mr. Layng is unable to find, he states that the Bureau engineers informed him they had no data on the subject and he is grieved that we do not accumulate such data. He feels that we ought to specialize on the measurement of such data and leave to practicing engineers and inventors the experimental engineering work. He even intimates that we may "not realize the importance of the latent heat of evaporation," although he does acknowledge that we have devoted considerable time to determining the vapor pressures of lead chloride and silver chloride.

These accusations were unjustified. Without attempting to point out the statutory functions of the Bureau of Mines, as established by act of Congress, nor attempting to explain just how far it can go in the measurement of physical constants without getting into the fields of other departments of the Government, I wish in reply to point out the facts. Mr. Layng has in his files a letter written to him by me under date of Dec. 5, 1921, giving him the only available data we had on the heats of vaporization of several compounds. It is quite difficult to measure the heats of vaporization of these compounds in the range of temperatures involved, but it is easy to calculate them from vapor-pressure curves of the substances by using the so-called van't Hoff Isochore—not Williamson's formula. This method is thermodynamically sound and is the accepted one for calculating latent heats if no direct determinations are available. The figures which I gave him are also of interest to anyone else who wishes to make a heat balance, and I therefore give them as follows:

HEAT EQUIVALENTS, IN CALORIES PER MOLECULE

Heat of vaporization of lead chloride	40,600
Heat of sublimation of lead chloride	45,750
Heat of vaporization of sodium chloride	44,300
Heat of sublimation of sodium chloride	51,500
Heat of vaporization of potassium chloride	40,500
Heat of sublimation of potassium chloride	46,900
Heat of vaporization of sodium hydroxide	31,500

We shall soon have available for publication data on the vapor pressures of silver chloride and also of zinc chloride, and from them can be calculated the corresponding heats of vaporization and sublimation. The important metal chlorides for which we still lack data are those of copper and gold.

Without trying to check Mr. Layng's calculations in detail, the following errors have been apparent to myself and my co-workers: Mr. Layng uses 1,337.50 B.t.u. per lb. as the heat of formation of calcium carbonate and seemingly forgets that for purposes of his calculation he must subtract the heats of formation of CO_2 and CaO. The correct figure for his purpose was only 768 B.t.u. He speaks of the Williamson formula, evidently meaning that of P. B. Williamson (*Chemical and Metallurgical Engineering*, Vol. 22, pp. 1151-55, 1920), with its accompanying note and table by Wallace Savage. Most of Mr. Layng's figures on the heat of vaporization seem to be derived from this table, and, if so, he has made mistakes in calculating the heats for zinc chloride and hydrochloric acid.

What I wish to call particular attention to is the criticism of the Williamson formula made by Savage to the effect that the formula is accurate for temperatures higher than the boiling points of liquids, but it is greatly in error at lower temperatures. In chloride volatilization we are dealing mainly with the molten chlorides below their boiling points, and we depend mainly on the *evaporation* of these compounds, not on *boiling* them. Consequently, we are dealing with a range of temperatures in which Williamson's formula is not accurate, and this supplies another reason for ignoring the opportunity to check over carefully Mr. Layng's figures. In this connection, however, it is pathetic to see Mr. Layng calculate his chemical analyses to four decimal places and carry out his thermal calculations with similar thoroughness. For instance, in estimating the radiation from a 100-ton stack furnace he feels it would be "about 135.23 B.t.u. per sq.ft."

It would be interesting to know if Mr. Layng has made any analyses of his furnace gases for chlorine and hydrochloric acid, or whether his figures given in Table 3 are likewise estimates.

I have read Mr. Layng's various letters and papers on chloride volatilization with the impression that he was carrying out the very justifiable enterprise of calling attention to his own style of furnace, which he has patented, with the object of getting its advantages before the public. His repeated use of the words "my process" in various contexts makes him seem to be the inventor of everything that is good in chloride volatilization. It is perhaps well to call attention to the fact that the real inventors were probably Pohle and Croasdale, who received their first patents in 1903. The process did not flourish, for lack of a suitable fume catcher, and it was not till the Bureau took it up that the process was resurrected through our use of a Cottrell electrical precipitator on the fume. Mr. Layng has a fume catcher all his own, and whether it is any better than all the other non-electrical catchers is of little interest to us if only his furnace can live up to the claims made for it. We ourselves are not satisfied with the rotating kiln as a chloridizing volatilization furnace, but so far it has proved the best simple furnace for carrying on the operation.

I record the fact, as a matter of interest, that on the basis of the present development in the chloridizing volatilization process the Western Precipitation Co. has been organizing a separate company to exploit it, probably hoping thereby to find more customers for the use of that company's electrical precipitation process. The four present commercial installations are shut down, owing to low metal prices and the general financial troubles that afflict the mining industry, but are regarded as metallurgically successfully and will ultimately be resumed. With this in mind, I find it my duty to controvert the animadversions of Mr. Layng against the work done by the investigators of the Bureau of Mines.

OLIVER C. RALSTON.

Berkeley, Cal.

The Webster Process

I would like to offer some comments on your editorial on the Webster process of treating copper ores which appeared in the March 18 issue of *Engineering and Mining Journal*. In the first place, I do not think that it can properly be claimed that this method will preferably be adopted for the treatment of straight oxide ores of copper, as might be inferred from the editorial, except possibly where such ores carry gold and silver, which is not usual. The problem of treatment of oxidized ores of copper—that is to say those which carry practically all their copper in acid-soluble form—it seems to me can be considered as settled. We have at least two large installations, and it seems quite reasonable to expect that improvements in details of these methods, which even now compare favorably in cost of copper produced with the costs of older established methods, will result in economies which will render predictions made at present unsafe. In my opinion, even with present leaching practice, there seems no doubt as to the relative economy of a regenerative leaching method, involving electrolysis, for straight oxide ores, except for special conditions.

As to the limitations of leaching as you state them with respect to the cost of the acid, iron, power for precipitation, and the necessary degree of crushing, I think it can be shown that the cost of power is by far the most important of these, and that acid cost need not necessarily be a factor of importance, in view of regenerative possibilities, all of which possibilities have not yet reached their full application.

Though I would not consider straight oxide ores a part of the field of the Webster method, the "mixed-ore" problem is a large one, and it is distinctly unsolved to date, although considerable sums are being spent on it by several large companies, and it is in this field that I think future application of the Webster process will lie, although in some instances possibly not a complete solution of it.

I think you are correct in saying that the process as a whole will find definite application where the cost of acid and of finely divided iron are not prohibitive, provided you make the above limitation of the statement. This, however, brings up another question—that of the necessary finely divided iron. This is the "sponge iron," on the production of which much work has been done for many years, but which is so far not a commercially obtainably commodity, although it is understood that considerable progress has been made toward its production in the Southwest.

It seems to me evident, therefore, that in any event the large development of the Webster method will have to await the evolution of the commercial production of finely divided iron at a reasonable cost.

Though not wishing to be unduly critical, I do not quite agree with you in the statement that flotation is a nominal expense. Even the flotation royalty that must be paid can hardly be called nominal, and I know of a number of large applications of flotation to copper ores where the reduction of its present cost to a nominal figure, outside of royalty, would be welcomed with some enthusiasm. G. D. VAN ARSDALE.

Los Angeles, Cal.

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Birthday Congratulations

According to the announcement in the *Journal*, this is the birthday of the *Engineering and Mining Journal-Press*, and even if it is born under such adverse signs, as stated in the last issue of the *Journal*, let us hope for the best, and I here wish it the greatest success. I have mightily enjoyed the *Journal*, not alone for the valuable information it contains, but for the vein of humor, which among the sterner realities helps to flux our troubles and afford encouragement.

Gold Hill, N. C., April 1, 1922. THOMAS SMITH.

The Westly Electric Furnace

I have read with interest the article on the "Westly Electric Furnace for Copper Smelting" in the March 4 issue of *Engineering and Mining Journal.*

I doubt if the authors take their claim for greater sulphur conservation seriously. The atmospheric oxidation of this element in standard reverberatory smelting method is almost nil, the 30 to 40 per cent elimination occurring in practice being due to sulphide-oxide reactions which take place to some extent in the electric furnace. The claim for lower loss due to a cleaner slag is certainly not supported by data in the table on page 357. In Canada or the United States the production of a slag containing 0.50 per cent copper with a 26 per cent matte would be just and sufficient cause for the dismissal of three shift bosses and, perchance, a superintendent. One quarter of 1 per cent might be allowed, in which event the electric-furnace method would have to cut the quantity of slag made in half to keep the pounds of copper lost as low as in fuel furnace operation. This would mean doubling the percentage of SiO_2 in slag. A reverberatory runs nicely on a 40 per cent SiO_2 slag, but I dislike the idea of an 80 per cent one, which might be made, but concerning which one could hardly say, "See how it runs!"

A small dust loss in reverberatory smelting, even with waste-heat boilers, is admitted. Some loss of this type would also take place in the electric furnace, even if there is a "thorough quiet settling at a perfectly controlled temperature." And is the temperature control more perfect than the oil- or coal-dust fired reverberatory? This loss in the reverberatory averages less than 2 lb. of copper per ton of charge, so even without a dust loss, and with only one-half the slag production, the estimated copper saving of 6.6 lb. is exaggerated.

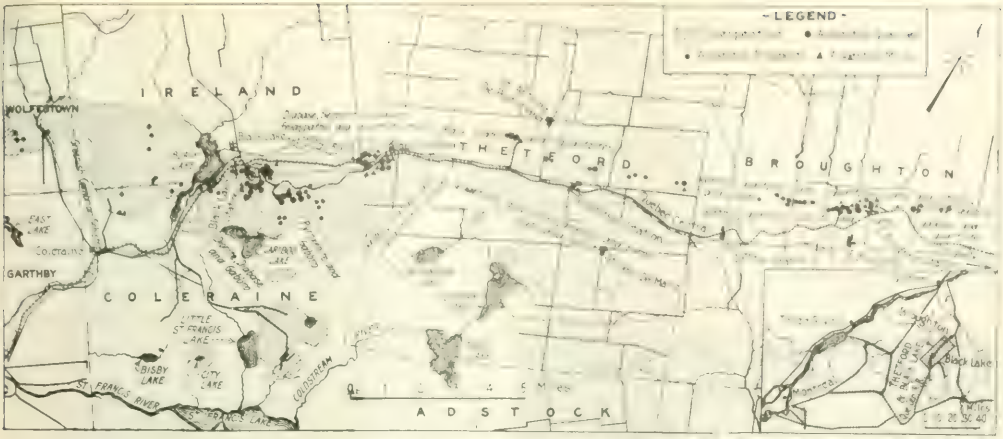
That higher operating labor cost would be offset by cheaper upkeep is entirely unproved.

In the table on page 360 the gross fuel consumption per ton of charge appears to be given. The net—i.e., the gross minus fuel equivalent of steam generated in waste-heat boilers—would be at least 25 per cent less. For example: At Clarkdale, Ariz., 0.62 bbl. of oil is burnt per short ton of charge. (This corresponds to 4.4 bbl. per 6.5 metric tons.) In addition to carrying on the smelting, steam is generated. The production of this amount of steam would require that 0.20 bbl. of oil be burnt under power-plant boilers. In this case the net oil consumption per short ton of charge is only 0.42 bbl. ($0.62 - 0.20 = 0.42$), or about 0.46 bbl. per metric ton. With pulverized coal one net metric ton will smelt at least eight metric tons of charge. This would make coal at $12.40 per metric ton correspond to electrical energy at 0.2c. per kw.-hr.

The above-noted criticisms may seem like waste of time and space. For, if the comparison table be taken as correct, localities with 0.2c. per kw.-hr. energy available are as scarce as gulls following a Scotch ship. Plants where pulverized coal is delivered to furnaces at less than $10.08 per metric ton are common.

My reason for rushing into print is that the technical journals contain too many articles of this nature in which the side of fence next to authors is given several coats of paint in a thorough and painstaking manner. The other side is covered imperfectly with daubs applied in careless style. And, whether we like it or no, fences have two sides. H. N. THOMSON.

Vancouver, B. C.



After map by Canadian Department of Mines

Map of Quebec's asbestos region

Asbestos Mining and Milling in Quebec—I

Understanding of Local Geology an Essential Aid to Proper Working of Deposits—Open-Pit Operations the Rule—Object of Mining To Recover Largest Possible Amount of Crude Asbestos—More Efficient Methods Being Introduced

By Walter A. RuKeyser

Asbestos, in addition to being a non-metallic in which only a limited interest was long taken, has failed of full appreciation of its general utility and value, for want of suitable publicity, owing to the prevalent attitude of the operators themselves. This has been especially true in the important Quebec district, which has been producing from 80 to 90 per cent of the world's asbestos. In contradistinction to most mining districts of the world, there has been little exchange of information among the asbestos operators of Quebec. Flow sheets have been evolved in each individual mill; cost data and operating results have been withheld with the utmost secrecy. Admission to many mines is extremely difficult to obtain, and most mills refuse absolutely to receive visitors. Operators have in the past shown little desire to co-operate technically with one another—in fact, a spirit of jealousy has made any attempt at co-operation ineffective.

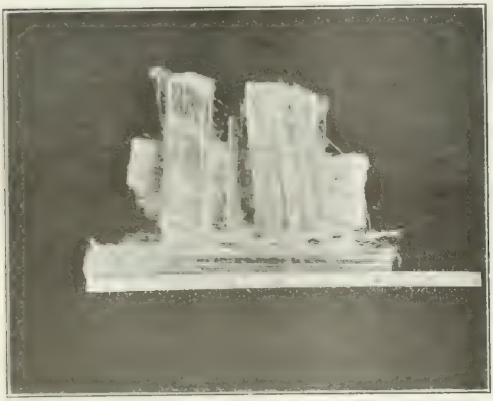
Until 1921 there existed no organization through which the mine managers and heads of departments could get together to discuss general problems, and this condition had been permitted to develop in a district representing a capital investment of well over $50,000,000, supporting a population of nearly fifteen thousand people, and with over twenty mines in operation. It is no great wonder, therefore, that the mining and engineering professions at large have little if any accurate knowledge of what has grown to be an important mining industry.

Competition Active in Asbestos Industry

There are definite and good reasons why the attitude above noted developed. The asbestos industry has been highly competitive, more so than almost any other mining business. Under the low prices prevailing up to 1916, many asbestos properties were subject to a continuous and periodic shutting down and reopening. The "marginal producer" during the periods of depression either had to perfect his mining and milling practice, reduce costs, and increase general overhead efficiency, or drop out of competition. Before the war supply exceeded demand—for the many present uses for the product had not been evolved. It therefore behooved each operator to withhold as his "stock in trade" any details of operating practice which would give him a handicap over his competitor. And that habit of business secrecy, once formed, is difficult to eliminate. Furthermore, the industry in Quebec was for the most part established, and until recently carried on, by the owners themselves. Prior to the last decade it was seldom that the operating heads of the asbestos mines were technically trained for mining asbestos, or, in fact, even skilled in other mining operations. It was natural, then, that there would not be a wide dissemination of knowledge about asbestos mining and milling or a stimulus to an interchange of ideas and technical data.

The great impetus given the industry by the war has been probably the largest single factor in effecting a change in this attitude of secrecy. During the war, demand exceeded supply for the first time since asbestos had been mined. Prices prevailed which permitted the accumulation of substantial reserve and replacement funds. The necessity of large-quantity production required thorough modernization of methods. Standardization of product became essential. This in itself implied a need of co-operation on the part of the various managements. Labor troubles, too, brought the operators together and impressed more clearly upon them the urgency of an "open shop" in technical and even business matters. Furthermore, the district has steadily been attracting a class of technically trained mine operators, executives who brought with them the experience and methods of the other mining fields of the world.

This is the background of Quebec asbestos mining and shows that there have been insidious factors existing from the early days of the industry with which the present-day operators have had to cope. Such conditions as placing a waste dump on the most productive part of a property, or finding that the mill had been located without any attention to geological factors, or that large expenditures had been entailed with insufficient pay rock in sight to establish operations on any satisfactory scale, cannot in any way be attributed to the present generation of operators in the district. As so often happens the "doctor" is called in after the mischief is done, and then there only remains to make the best of what has gone before. These facts have been mentioned in no spirit of apology for the methods used in the district today, but rather to explain that those methods have had to be evolved. The advance which has been made since the industry has been placed in a healthy condition financially, the low operating costs which prevail despite the manner in which most of the properties were originally opened up and developed—in spite of the tonnage which has already been removed—speak well for what is being done today in that district. Just how the peculiarities of the district, with its foreign language, its peculiar labor conditions, its climatic factors, affect mine operation will be brought out in the description of the problem of asbestos mining and milling which follows.



Asbestos Crude & Fiber Corporation

Chrysotile crude or cross-fiber

OCCURRENCE OF ASBESTOS WIDESPREAD

Asbestos in several different forms has been found in the following states: Arizona, California, Idaho, Maryland, Missouri, New York, Nevada, North Carolina, Oregon, South Dakota, South Carolina, Texas, Washington, Wyoming, and Vermont, and among the foreign countries reported as producing it are Australia, Brazil, British India, Cyprus, China (Mongolia and Shanghai), Cuba, Canada, France, India, Italian Alps, Japan, Korea, Newfoundland, New Zealand, Mexico, Peru, Persia, Philippine Islands, Russia, Spitzbergen, Syria, and South Africa.

Although asbestos is widespread in occurrence, a factor other than geographical position has made the Canadian deposits so pre-eminent that the large majority of the world's supply is furnished from them—the peculiar physical properties inherent to the chrysotile variety of the mineral as developed in the Quebec serpentine belt. Typical chrysotile asbestos from that district is of high tensile strength—a fundamental requisite—yet the fibers are so delicate that they can be spun into a single strand of thread which will run about 32,000 ft. to the pound, and cloth can be woven from that thread which will weigh less than eight ounces to the square yard. Canadian chrysotile has a hardness of from 3.0 to 3.5 and a specific gravity of 2.2 to 2.3. Its luster is resinous, it is translucent along thin edges, is greasy to the touch, and is white to light green in color en masse.

Chrysotile is normally prismatic, both in respect to habit and cleavage, and fibrous in structure. The separate fibers are white, lustrous, and extremely silky—"silkiness" being, next to tensile strength, an important commercial asset, permitting facile handling in the carding process which precedes the manufacture into finished rope or fabric.

In the Quebec deposits, the fiber occurs largely in commercial lengths—the "Crude No. 1" measuring from 1 in. to possibly 5 in. or 6 in.—and is of a variety of asbestos which easily resists a temperature of 2,000 to 3,000 deg. F. Temperatures as high as 5,000 deg. F. have produced no other effect than a dehydration, with attendant loss of tensile strength. Chrysotile occurs in three distinct types of deposits, cross-fiber, slip-fiber, and mass-fiber.

Cross-fiber constitutes a network of veins throughout the mass of the inclosing or parent rock, in which the growth of the crystals has been normal to the walls. This type of occurrence gives rise solely to the most valuable product, the "Crudes," and in the handling of the rock all other grades are subordinate to them. The fact that the longer fibers—milled or crude—command such a higher price than the shorter controls the entire process of mining and later extraction in milling. The deposits at Thetford Mines, Black Lake, Coleraine, and Danville are primarily of the cross-fiber type.

Slip-fiber asbestos is the type found disseminated throughout the rock mass in a form in which the fibers show a definite tendency toward orientation along an original vein direction. As the term indicates, this result has probably been produced by lateral movement or slickensiding. As applied to the Quebec deposits it is confused with the third mode of occurrence, mass fiber, but the term is so generally employed in describing these deposits that it will be used here in its more colloquial sense.

The deposits at Thetford and other Canadian places contain a considerable percentage of slip-fiber, and as one progresses northeast along the strike of the belt one sees a lessening of the proportion of cross-fiber veins, until at Robertson, five miles distant, the slip-fiber predominates. At East Broughton the deposits are practically entirely of this latter type, at least to the present depth of operations. In mass-fiber there is no definite orientation of the fibers, which are scattered irregularly throughout the parent rock.

Following is a list of the asbestiform minerals after A. L. Hall:

1. The Serpentine Group.—Hydrated magnesium silicate with a theoretical composition $2H_2O$, $3MgO$, $2SiO_2$. Characterized by a high percentage of magnesia and

water. To this group belong the Quebec deposits, chrysotile, and picrolite.

2. The Rhombic Amphiboles.—Silicate of magnesia and iron with the composition $(MgFe)O_2SiO_2$. Anthophyllite.

3. The Monoclinic Amphiboles.—Tremolite, a silicate of calcium and magnesium of the composition CaO, 3MgO, $4SiO_2$; actinolite, a silicate of magnesium, calcium and iron, with the composition CaO,3(MgFe)O, $4SiO_2$; crocidolite, a silicate of iron and sodium, with a composition given by Dana as NaFe $(SiO_3)_2$,$FeSiO_3$; and amosite, a new variety of asbestos identified in 1918 and named amosite from the initials of the "Asbestos Mines of South Africa," the company chiefly interested in its production. This variety is characterized by a high percentage of iron, with considerable and variable amounts of aluminum, magnesium, and calcium. Soda may or may not be present.

The following analyses bring out the chemical differences between the three main varieties of asbestos:

	Chrysotile (a)	Crocidolite (b)	[illegible]
Silica, SiO_2	40.49	51.64	[illegible]
Alumina, Al_2O_3	1.27		
Ferrous oxide, FeO			[illegible]
Ferric oxide, Fe_2O_3	2.53	34.38	32.00
Magnesia, MgO	41.41	2.64	3.96
Lime, CaO		0.05	Tr.
Soda, Na_2O	.	7.11	2.12
Carbon dioxide, CO_2			
Water, H_2O (const.)	14.06	4.01 [illegible]	[illegible]

(a) Average of eleven analyses given by Cirkel
(b) Dana, "System of Mineralogy," Sixth Edition
(c) Best quality, white, analysis by C. Gardthausen

The high percentage of magnesia, the practically total absence of lime, and the high water content characterize the chrysotile. As here used the generic term "asbestos" will always refer to the chrysotile variety unless otherwise noted.

CHRYSOTILE OCCURS IN TWO GEOLOGIC ASSOCIATIONS

Chrysotile is found in one of two modes of occurrence. The first is illustrated by the asbestos of Arizona, Carolina, and Africa, in which the cross-fiber veins of chrysotile are associated with serpentine in limestone or dolomite. The second occurrence is in serpentine derived from peridotite or pyroxenite. This association is the more important one and characterizes the Quebec deposits.

The geology of these deposits is generally not complex, although questions of origin are considerably involved. The so-called "serpentine belt" which gives rise to the occurrences of the mineral extends in a broken outcropping from northern Vermont to the Chaudiere River in Beauce County, Quebec. Occurrences of the same rock north of the St. Lawrence River are roughly along the same line of strike and have been identified as belonging to the same intrusion.

The belt has a general trend of approximately northeast for a distance of nearly 150 miles. The main productive area centers at Thetford mines (Thetford), extending sixteen miles northeasterly to East Broughton and about forty miles southwesterly to Danville, where the productive zone of the province ends. In the Thetford-Black Lake district the serpentine has a maximum width of about 15,000 ft. (at Black Lake) and narrows down to approximately 5,000 ft. as far as is known, four miles further at Thetford. The next outcropping, three miles northeast, exposes the serpentine as a narrow, inclined-sill structure with a maximum width of about 1,000 ft. The workable belt at Robertson is between 300 and 500 ft. wide, and this width is maintained irregularly to East Broughton, ten miles distant, where the furthermost mining operations are to be found.

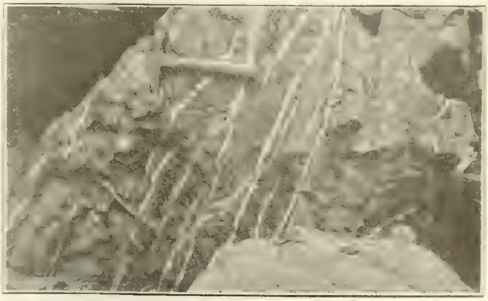
QUEBEC SERPENTINE DERIVED FROM PERIDOTITE

The serpentine, from which the chrysotile has been derived, is a metamorphic derivative of peridotite and associated basic rocks solidifying from a molten magma probably in the form of batholithic stocks and sills. The structure of the Thetford-Black Lake district is represented by a batholith or stock, and that of the Robertson-East Broughton by sills, the initial difference in structure being responsible for the two distinct types of economic deposit which have resulted—the "Thetford Phase" and the "Broughton Phase."

The peridotite is closely associated with allied rocks, particularly pyroxenite and gabbro, into which it grades imperceptibly. Diabase is found on the outermost margins of the stocks of the Thetford phase and the uppermost portion of the sills of the Broughton. Where I have observed this rock in the field it has been a hanging-wall rock, fresh and unaltered, with sharply defined contact, and in some places capping a badly foliated and dry-appearing serpentine which carried asbestos.

BASIC ROCKS INTRUDED BY GRANITIC DIKES

In addition to the series of rocks from basic magmas, those of the Thetford phase are in many localities intruded by dikes and sheets of white or pinkish granite and aplite. The dikes may vary in width from mere stringers to over 60 ft., and the sheets often become batholithic in character, forming some of the main topographic features in the vicinity of Black Lake. The dip is usually nearly vertical.



Chrysotile asbestos in serpentine

Dresser believes the granite to be the most acidic but a somewhat later phase of the same intrusion, which began with the ultra-basic magmas and which became more and more acidic in character as the intrusive action neared an end. In the same way the chrome ores which are found in commercial deposits near Black Lake and Coleraine are attributed to magmatic differentiation. The chromite, like the pyroxenes, grades imperceptibly into olivine-rich peridotite, and passes from almost the pure mineral through a series of dunites into peridotite and pyroxenite free from any chromite whatsoever. The granite, however, forms sharp contacts with the peridotite, and occurs always, as far as I have observed, in well-defined structures, with attendant contact phenomena. In fact, most of the rare minerals which have been identified in the locality, such as colerainite, for example, seem to owe their origin to contact metamorphism by the granite or aplite.

An open-pit operation at Thetford in winter

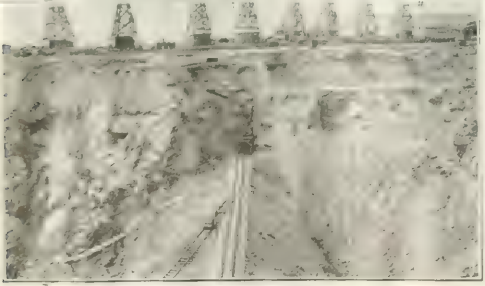
Dresser, in his classical "Memoir No. 22" of the Canadian Geological Survey, on page 27, compares the igneous rocks of the two phases as follows:

THETFORD PHASE	BROUGHTON PHASE
Peridotite partly altered to serpentine	Soapstone Serpentine
Pyroxenite	
Gabbro	Greenstone schists
Porphyrite Granite Aplite	(Lacking)

I have pointed out that the deposits of asbestos in the Province of Quebec fundamentally owe their origin to a series of basic igneous rocks which were forced up from great but unknown depths. These igneous masses broke through a series of stratified rocks, generally conceded to be of Cambrian age, consisting of slates, quartzites, and sandstones, which in their present condition are typical products of regional metamorphism.

The Cambrian is overlain on the southeast by altered black slates of Ordovician age. On the northwest, or underlying side, the gray slates and quartzites are succeeded by quartzose and sericitic schists. In the accompanying map the area representing rocks of sedimentary origin is shown as undifferentiated Paleozoic.

After the intrusion of the Thetford series in post-Devonian times, the entire district was further subjected to a series of uplifts and depressions accompanied by lateral pressure. The stratified rocks, as already pointed out, were greatly deformed and altered into their respective metamorphic derivatives. The fact that the serpentine *and asbestos* of the Broughton phase have been subjected to regional compression, as shown by the extreme foliation of the rock at Broughton, leads me to believe that the rocks of both the Broughton and the Thetford series were subjected to such regional stress at a much later date than that of the intrusion. The larger masses of the stocks and batholiths at Thetford by their very form were better able to withstand compression than the thin sills characterizing the Broughton phase. Thus, the original form of the intrusion played an important part, determining in what form the asbestos eventually occurred. As further evidence of this theory we find the sill at Broughton to have an interstratified appearance with the metamorphic derivatives of the sedimentary formations. It dips with them approximately 65 deg. to the southeast.



An open-pit mine at Black Lake

ALTERATION TO SERPENTINE A DEEP-SEATED PROCESS

Serpentinization may well be a deep-seated process, evidenced by the fact that the parent rock is of plutonic origin, as well as the granite which in turn intruded the massive basic series. The alteration to serpentine consists simply in a hydration of the peridotite. It is more logical to believe that this hydration has been accomplished by siliceous magmatic waters rather than that it was produced by meteoric (descending) ones.

Alteration by siliceous magmatic waters is expressed possibly by the equation:

$$\underset{\text{Olivine}}{3Mg_2SiO_4} + 4H_2O + SiO_2 = \underset{\text{Serpentine}}{2H_4Mg_3Si_2O_9};$$

whereas a possible alteration by descending solutions carrying water and carbonic acid might be represented by the following:

$$2Mg_2SiO_4 + 2H_2O + CO_2 = H_4Mg_3Si_2O_9 + MgCO_3.$$

However, in the field or under the microscope, I cannot remember seeing any evidence of the presence of magnesite ($MgCO_3$) associated with the resultant serpentine. In which event one would further suspect the origin of the circulating waters to be magmatic.

CONSTANT PROPORTION OF ASBESTOS TO SERPENTINE

It is interesting to note that the olivine of peridotite gives rise to serpentine, the pyroxene of the pyroxenite being altered to soapstone. Under the microscope the serpentine in thin sections reveals a fibrous structure, although without orientation. Serpentinization occurs along narrow bands in the peridotite, at the center of which may or may not be included veins of asbestos. If present, these veins of asbestos always seem to bear a constant relation of approximately one-sixth of the width of the serpentine band. The band of pure serpentine is always an invariable accompaniment to the veins of asbestos.

The two outstanding problems in the genesis of asbestos are the source of the vein material and whether the veins are the result of the filling of open fissures in the rock mass or a crystallographic outgrowth beginning with minute cracks.

SOURCE OF VEIN MATERIAL GENERALLY CONCLUDED TO BE FROM THE SERPENTINE

The consensus of opinion at the present time is that chrysotile has been derived by a solution and subsequent crystallization of the more or less amorphous serpentine. The serpentine is thus the source of the asbestos, and there has been little if any migration of the solutions. The theory becomes well supported when one considers the microscopic evidence of serpentine having a fibrous although unoriented structure, as well as that the chemical composition of both serpentine and chrysotile is practically the same. This is brought out in a comparison of the following analyses, taken from page 60 of Dresser's "Memoir No. 22":

	Peridotite	Serpentine	Asbestos
SiO_2	38.16	40.08	[illegible]
TiO_2	None	None	
Al_2O_3	0.63	2.11	[illegible]
Fe_2O_3	3.32	1.18	[illegible]
FeO	4.76	1.70	[illegible]
MgO	41.84	37.90	[illegible]
CaO	0.68	0.20	[illegible]
K_2O	0.20	0.10	[illegible]
H_2O (−110°)	0.47	1.38	0.43
H_2O (+110	9.63	13.80	[illegible]
	99.69	98.46	100.33

(a) Probably low

Field evidence usually shows the increased presence of the mineral—i.e., the richest ground—near the granite dikes. I consider this due not necessarily to the action of the magmatic waters, which would have had undoubtedly a chemical reaction on the material, but to the fact that these intrusions would create a great increase in the number of cracks and potential fissures. The loci for the later vein formation would naturally result from shrinkage of the rock mass due to dehydration during contact metamorphism. There would also be a shattering action on the rock by the stresses set up upon the intrusion of the granite.

One more fact substantiates the theory of the formation of the veins of asbestos in place. I have frequently seen in the granite masses of the Black Lake-Thetford district, and in the siliceous rocks of the hanging-wall contact in the Broughton district, veins of quartz having the appearance of pseudomorphs after asbestos—i.e., having a crystalline structure elongated at right angles to the vein direction, with the typical asbestos "bundle" appearance, without, of course, the true fibrous structure.

ORIGINAL FRACTURES CRACKS AND NOT OPEN FISSURES

The conclusion from all the evidence is that the veins are portions of serpentinized bands which have crystallized in place, a view by no means original and expressed by Dresser, Diller, and others.

Most students of the origin of asbestos hold to the belief that the great number, the size, and the position of chrysotile veins in the ground, which may run as high as 10 per cent in mineral, make it improbable that the spaces now occupied by the asbestos were once open fissures. It is pointed out that as the serpentinization was probably a deep-seated process at such depths as were involved it would not be mechanically possible for 10 per cent of the total rock mass to exist as open fissures, some of which are 100 ft. long and an inch or two wide.

Ox-team haulage still used in district

The following suggestions have been made as to the origin of the cracks or fractures: (1) That they were contraction joints resulting from the cooling of the peridotite from the molten magma. (2) That they resulted from fissuring of the rock mass under the stresses set up by the increase of volume during serpentinization—a process of hydration. (3) That they are the results of fracturing upon the intrusion of the granitic masses, both by actual compression and by contact metamorphism (dehydration). (4) That they were created by straight regional metamorphism. (5) That the fractures were caused by exfoliation of concentric shells from angular blocks already formed by the other factors.

The general conclusion is that the veins did not exist originally as open fissures but rather as potential fissures, partings in the rocks, cracks, or fractures which acted as channels for the permeating waters, the asbestos being crystallized from the solution of the serpentine.

SLIP-FIBER ASBESTOS SHOWS EVIDENCE OF SUBSEQUENT SHEAR ACTION

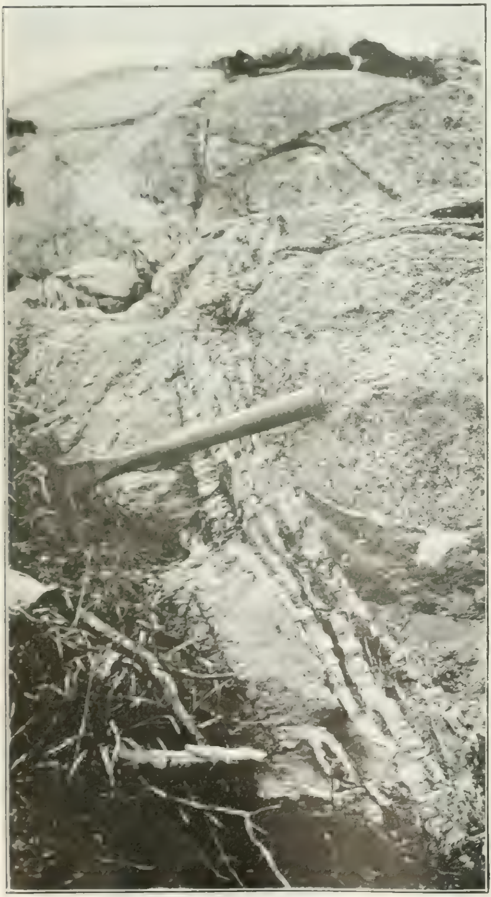
The slip- (or rather mass-) fiber asbestos of the sills at Broughton occurs always in those parts of the structure which have been most sheared and shattered. This may be due to the fact that the shearing action has evidently accentuated the microscopically fibrous nature of the serpentine and has permitted facile permeation of the entire rock mass by circulating waters. The parallel arrangement of the asbestos suggests that it was formed after the shearing action had ceased. In passing, I consider the asbestos of the Broughton phase to be of two distinct ages, evidenced (1) by the veins of cross-fiber which exist and which appear sheared by a later movement of the rock mass, and (2) by the slip- or mass-fiber which it is clear was formed at the same time or subsequent to the shearing movement.

MODE OF ORIGIN INDICATES ASBESTOS CONTINUES WITH DEPTH

The fact that the original peridotite is a plutonic rock and that the serpentinization, the fracturing, and the action of magmatic waters are also deep-seated processes leads to the conclusion that the asbestos deposits may extend to depths below those of economic mining. The deepest actual development work in the Quebec district extends well over 500 ft. below the surface, without noticeable change in the quality or quantity of the asbestos. Recent diamond drilling has proved reserves to continue with depth for all purposes of practicable mining for a generation to come.

The second practical deduction refers to the quicker rate of erosion of the softer and asbestos-bearing rock. The richer ground may therefore be found at lower elevations than the harder and more barren—and at the same time the tendency would be for the good areas to be covered with glacial drift rather than by a capping of rock.

In late geological times the district was subjected to a major glaciation which advanced from the north-northwest and which peneplained the region. In the retreat of these ice sheets as well as that of the local glaciers the deposits were for the most part covered over by drift. This drift forms the overburden, which must be removed before open-pit operations are attempted, and comprises one of the chief overhead and development charges in modern asbestos mining.



An outcrop of a crude asbestos vein

The present methods of mining the Quebec deposits have sprung from, and of necessity been evolved from, the former operations dating back to the initial exploitation of the district. The past methods were directly influenced by the geology of the deposits and a lack of capital in the hands of small individual owners. The modern tendency has necessarily been based to a far greater degree on considerations of climate, size of holdings, type of labor, and several other technical factors.

First Commercial Production in 1862

The history of the district dates back to 1862, at which time the first commercial exploitation of asbestos was attempted on a large scale by an English company. Cirkel reports that at this time the first asbestos in the Province of Quebec was discovered near the village of St. Joseph, on the River Plante. This occurrence is a few miles beyond East Broughton, the end of the commercially important deposits; and though the fiber was of good quality, the quantity was not sufficient to constitute a commercial deposit. In 1877, however, asbestos was discovered near Thetford. Some stories relate that it was actually the cutting of the right of way of the Quebec Central Ry. which resulted in the uncovering of the deposits. It is certain that the railway, being so located as practically to follow the serpentine belt throughout its strike, was the greatest factor in the immediate development which followed, aided by the outcropping of the deposits or to their being only slightly covered with glacial drift. Furthermore, the district was ravished by forest fires, which greatly aided in the uncovering of the deposits.

Operations Carried on Only for the "Crude"

The first mining operations were begun in 1878. At that time their object was merely to get into the richest fiber-bearing rock as quickly and cheaply as possible. Owing to the geology of the deposits, the method adopted was feasible and practicable. The owners of the land were generally the operators. At that time only the crude fiber had any value; milled fiber was unthought of. Thus, the best, the longest, silkiest asbestos was cobbed out; and what would today constitute a high grade of mill rock was thrown out on the dump with whatever waste accumulated during the operations. The dumps were often placed without any thought for the future, regardless of the geology of the deposits, and without consideration of the fact that the industry might some day develop to such an extent as to necessitate an entirely different method of exploitation.

For the next twelve years or more the district developed rapidly. Villages sprang up in the neighborhood of the mines, the properties were exploited on an ever-increasing scale, prospecting was conducted actively and large capital was attracted to the industry. Thus, in 1885 seven mines were reported as producing an annual total of about 1,400 tons of asbestos—naturally all crude, the cream of the deposit. The industry then employed 350 men, and the total value of the product could not have far exceeded $75,000. At that time, the "first quality" brought $80 per ton at the mine; the "second quality," $60; the third, $40, and the poorest, $10. During the peak prices of early 1920, the top quality, No. 1 Crude, brought from $2,000 to as high as $3,000 per ton, and the "sands," which are practically barren of fiber, brought as high as $15 per ton.

From 1885 there had been a slow but steady increase in the value of the product, until in 1900 the best quality crude brought $300 per ton. This so stimulated production that an oversupply resulted, and a diminution in prices followed during the succeeding years. Thus, at the beginning of the war, No. 1 crude was bringing about $200 a ton. All but the mines producing the best quality of asbestos had been forced to close down; and many properties either changed hands, were forced to reorganize, or, to effect more economical operation, were consolidated under one management. Furthermore, owing to the increased prices of the better grades, the manufacturers of asbestos had been experimenting to develop a process for utilizing the shorter fibers. Many new uses for these shorter grades were found. All this created a demand for what is now known as the "milled fibers," the products of mechanical concentration. Mechanical milling methods were first attempted on an experimental scale, about 1890, and twenty years later fifteen mines in the district were sending material to about nineteen mills, with a combined total daily capacity of 8,520 tons, according to Cirkel. The combined output of these mills and mines in 1909 was:

	[illegible]	[illegible]
Crude	[illegible]	[illegible]
Fiber	14,776	[illegible]
Fiber No. 2	[illegible]	

The average price of the crude was $187.22 per ton and for the fiber, $28.35 per ton. The year 1920 found asbestos at the height of its demand and the peak of its market value.

Because of lack of capital and the fact that the asbestos-bearing deposits outcropped, the early operators found it feasible and economical to exploit them by means of small open pits. The pit was usually started by means of a swinging-boom derrick, using boxes which held perhaps a ton. The rock was drilled either by hand or by heavy, steam-driven, tripod, piston drills. At the beginning the plant of an asbestos operator consisted primarily of one or more derricks, a hoist, and possibly a piston drill and a boiler. The mine would be worked only for the crude, milling not then being commercially practicable.

Prospecting with open pits and shaft

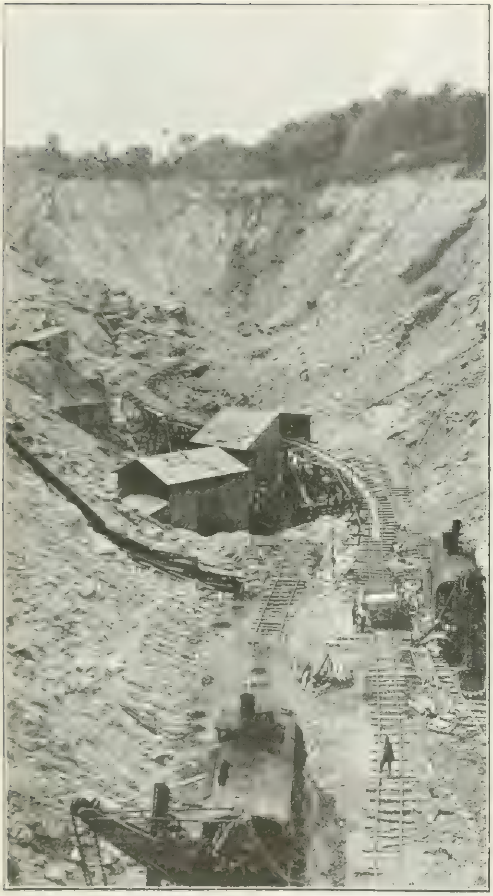
When the pits became 30 or 40 ft. deep, the derricks were supplanted by a cableway or by two or more cableways. These were of the most primitive type and had a capacity of about 100 tons per ten hours. This method of operation has persisted in principle to the present. Even in respect to detail there has not been evolved a marked change in method. However, during the last three to five years the industry has found itself at the beginning of a new era, which demands output on a much larger scale, with costs kept at a minimum. This is largely due to the unrivaled demand, the accumulation of reserve funds which permitted of costly experimentation, and the attainment of depths in some pits no longer safe nor economical for open-pit mining (especially true of those mines whose property was hemmed in by others); and in addition the mills had so increased in capacity that the problem of room for the waste dumps had become a serious one. Mines which had been "high-graded" of the best crude had to be "trimmed-up" so as to permit further working. The district was beginning to attract a type of technically trained operator, and finally, with the already advanced stage of development of the open pits, the severe Canadian winters were more and more interfering with efficiency and continuity of operation. As a result of such considerations there is today a distinct trend toward the application of combined or underground metal-mining methods, and the most recent development has been with that end in view. The Thetford mine of Consolidated Asbestos, Ltd., is thus producing its entire output from such workings. Even in stripping the overburden, it has now become necessary to employ, in Thetford at least, mechanical or semi-mechanical methods. The immediate future demands that ground covered by the deepest drift be no longer neglected.

Cableway for working asbestos open pit

The methods used in stripping the overburden preparatory to open-pit mining vary from the most primitive, involving hand labor and slow transportation, to those processes that are dependent upon a minimum of the human element. The overburden consists of unconsolidated clays, sands, and gravels containing glacial boulders of all sizes. There is considerable vegetation. The drift varies in depth from little or no covering to as much as 60 ft. Where excessive, it is most amenable to the application of underground mining.

The choice of stripping method depends, of course, upon the depth of overburden, facilities for handling and disposing of the cover, and a balance between initial

Calyx drill used in prospecting



Steam shovels used in mining slip-fiber asbestos. Note primary crusher house in pit

outlay and operating charges. At many of the mines—and this is especially true of the Broughton deposits, where the drift averages but 5 to 10 ft. thick—a high initial investment is not warranted, and hand methods are nearly always used. The work is usually contracted on a cubic yardage basis, the rate varying from 60 to 90c. per cu.yd., depending upon the nature of the drift. Light cars on portable track are being used to an increasing degree, instead of the dump carts formerly employed to move material, but it is extremely difficult to get the class of labor which is available to adopt any method to which the men are not accustomed. Scrapers and drag-line excavators have also been tried out, but with no great success, as many boulders have to be handled. Where the stripping to be done is of larger lateral extent, and there is enough yardage to justify the first cost and upkeep, light cableways are used. This method has been particularly successful if there is enough material within the length of the span and within the reaching distance of each set-up of the cableway to justify the installation. With this method the cost can be reduced to as low as 30c. per cu.yd. with each cableway handling about 200 cu.yd. per shift. The boxes commonly used hold about 1 cu.yd. The earth is loaded by hand or by steam shovel.

Where the overburden assumes a thickness of 15 ft. over a sufficiently large area, steam shovels are used in conjunction with side-dump cars of the Western type, the cars being hauled by contractors' locomotives. Until recently this was the method generally employed at Thetford, at the Bell mine of the Keasbey-Mattison Co., the Bennett-Martin mine, and the Beaver and King mines of the Asbestos Corporation of Canada. Although the railroad type of shovel is used to some extent the smaller, more flexible caterpillar or tractor type has found wider application. This last noted machine has a 1- to 1½-cu.yd. dipper and handles from 300 to 500 cu.yd. per shift.

HYDRAULIC STRIPPING LATEST METHOD ADOPTED

The Asbestos Corporation of Canada decided in 1920 to strip a large area at its King mine, at Thetford, where the drift reaches a thickness of over 60 ft., an area approximately 1,300 ft. by 1,000 ft. requiring stripping down to the solid serpentine—a volume of about 600,000 cu.yd. being involved. Bids were asked for from several contractors, the choice of method being left to the bidder. The Fraser-Brace Co. was awarded the contract, and that company decided to adopt hydraulic methods. Most of the preparations, plant erection and the like, were completed before the end of 1920, but, owing to severe winter conditions, the actual work of stripping was not attempted before the spring of 1921.

The plant consists of a 3,500-gal. centrifugal pump, which pumps water from the Thetford River through a 20-in. pipe line 3,000 ft. long. This water is discharged through giant nozzles, the run-off flowing to a specially prepared sump. From this the disintegrated overburden is pumped out by means of a 6,000-gal. pump through a pipe line 4,000 ft. in length to a point beyond the Thetford River at the end of the dumping grounds of the company. Wooden pipes, reinforced by iron hoops, are used for both the clear water and the mud.

I am told that difficulty has been experienced in the use of the method described, owing to the extremely clayey nature of the material to be handled. Furthermore, the frequent occurrence of boulders, some of which weigh many tons, necessitates a great deal of supplementary work, and, finally, the work must be suspended in winter.

By any one or a combination of the above-noted systems the overburden is removed from the deposits which are to be worked by open methods. The stripping is carried on sufficiently ahead of mining operations to prevent admixture of the soil with the mill feed. Under conditions where the cover becomes excessive, or where the dumping facilities are limited, underground methods have been adopted. Thus, in the operation of the Thetford mine of Consolidated Asbestos, Ltd., I believe this to have been a contributing factor in the decision to change from the open-pit mining to underground.

With a depth of cover of 20 ft. the charge per ton of mineral developed is approximately 4c., with the average depth of the pit 150 ft.

MINING DIFFERS IN THETFORD AND BROUGHTON TYPES

Present-day operations differ essentially in the cross-fiber and the slip-fiber deposits. Wherever cross-fiber—or, to be more exact, crude—is to be mined, the controlling factor of the method adopted is that the entire mass of broken rock must be fine-combed for the crude before being sent to the mill. The slip-fiber deposits, on the other hand, do not necessitate such handling, for the fiber is disseminated throughout the entire rock mass, and practically the entire output of the mine goes to the mill.

By "Crude No. 1" is meant all hand-cobbed veins of unbroken fiber-length of 1 in. or over. This is sold on color and length, the Thetford product being extremely silky, white, and of great tensile strength. The Black Lake crude is darker in color, slightly harsher than the Thetford, but of similar tensile strength. No. 2 crude averages ¾ in. and refers to material recovered from veins between ½ in. and 1 in. long. "Run-of-mine" crude refers to a product in which the lengths have not been carefully sorted, and may contain material as short as ¼ in.

For every thousand tons of rock mined approximately one ton of crude is cobbed out. But when one considers that at peak prices No. 1 crude brought from $2,500 to $3,000 per ton, against $500 to $800 for the best grade of milled fiber, and an average of not over $100 per ton for the latter, it is easy to understand why so much stress is placed upon the recovery of the crudes, whatever process of working is adopted. This, then, is the reason why so much hand labor is used in the Quebec asbestos industry and why the methods of mining appear inefficiently planned to one not familiar with the problem.

The methods by which asbostos is now mined in Quebec may be broadly classified as follows:

1. Open pits.
2. "Glory holes" and shrinkage stopes.
3. Combined open and underground workings.

In open-pit operations involving the handling of crude, the cableway has survived throughout the life of the industry, and this method is still responsible for the greater proportion of the rock hoisted. All of the rock mined in slip-fiber deposits comes from open pits, but the steam-shovel method has partly supplanted the cableway. Where the pits have become too deep for safe and economical operation, where property holdings are too restricted to allow of suitable expansion, or where the overburden cannot be economically removed, the open pit has been developed so that the rock is milled down to a lower level and hoisted through a shaft. A typical shrinkage stoping system has been developed at the Quebec Asbestos Corporation mine. This method permits of a large wet-rock storage in the stopes and more flexibility in operating during the severe Canadian winters. Wet-rock storage on the surface is restricted in winter because of excessive freezing.

The "combined" methods, a designation that I have used for those in which the topography permits of development by means of a tunnel or adit driven at an elevation above that of the mill bins, are especially applicable to the nature of the ground at Black Lake.

The pit is generally carried in benches varying from 20 to as much as 75 ft. in height, with a usual average of 40 ft. In drilling, preparatory to blasting, the modern tendency has been distinctly in favor of the lighter hammer drills, although the slow piston drill, both steam and air driven, is still used. Holes were formerly drilled to 12 or 16 ft. in depth, but experience has proved the efficacy of the deep hole. For this purpose, the Ingersoll-Rand "88," the I-R "submarine," the Denver Rock Drill Manufacturing Co.'s "turbo-rotator," and similar drills have found excellent application—drilling holes 2 in. in diameter as deep as 40 ft. In an unusually interesting operation, a Sullivan submarine drill is used at the Quebec Asbestos Corporation's mine at East Broughton, drilling a 3-in. hole to a depth of 75 ft.

The drill holes are generally put down nearly vertically in a series 15 to 30 ft. from the face, and are spaced 10 or 12 ft. apart. "Lifters" are then put in at a slight angle to the horizontal. They are charged heavily, usually with 40 per cent gelatine dynamite, but under difficult conditions, where granite is encountered, as high as 60 per cent is used. Ammonia powder also finds considerable favor both in Thetford and at Broughton. Series firing by battery is almost universal. Block-holing is done by various drills of the jackhammer type by some operators in the district, though often "mud-capping" is practiced.

Churn drilling has not been found economical, owing to the fact that the subsequent operations are not on a sufficiently large scale to warrant the installation of machinery capable of handling the resulting blasted rock without considerable rebreaking. This is especially true at East Broughton, where the mills are capable of handling only up to 1,000 tons per day and the steam shovels of the caterpillar type have comparatively small buckets.

To be concluded

Small Canadian Platinum Production

Previous to 1919 no attempt was made in Canada to recover metals of the platinum group, according to the Canadian Department of Mines. The principal source of these metals is believed to be the nickel-copper ores from the Sudbury district, the matte from which was previously exported for refining either in the United States or Wales. Both the International Nickel Co. and the Mond Nickel Co. still export their product in the form of residues or nickel-copper matte containing precious metals. These latter are recovered at the refineries in New Jersey and Wales, respectively.

No data regarding recovery of platinum metals at Swansea have recently been made available, and as a consequence it has been somewhat difficult to determine the quantity of platinum contained in ores produced in 1921. The British America Nickel Corporation, which began operating its refinery at Deschenes, Quebec, early in 1920, but which was closed down early in 1921, will be in a position to recover platinum and related metals when operations are resumed. A few ounces of native platinum are won every year from the alluvial sands in the Tulameen district of British Columbia, but to date no large-scale working of these deposits has been attempted.

Taking no account of the platinum contents of the Mond matte which was exported to Wales, regarding the platinum contents of which no data were available, the platinum production from Canadian ores in 1921 amounted to 269 oz. Other associated metals were palladium, 591 oz.; iridium, rhodium, ruthenium, and osmium, 56 oz. Only 8 oz. was reported as recovered during the year from the alluvials of British Columbia. The Ontario output was produced in part by the Deschenes plant refining Sudbury matte, and was partly recovered in New Jersey by the International Nickel Co., treating residues from the Port Colborne refineries.

The Trade Association[*]

Rapid Development of This Type of Organization Stimulated by War and Post-War Industrial Activity—Large and Useful Field Open to Them—Secretary Hoover Sees Opportunity for Their Employment To Help Stabilize Business

By Felix Edgar Wormser
Assistant Editor, *Engineering and Mining Journal-Press*

MINING ENGINEERS are perhaps most familiar with the trade associations through the activity of these organizations in their own industry, although the notoriety which the disclosures of the Lockwood Committee, investigating the housing shortage in New York City, have heaped upon some of them in the building trades may have helped to make the name more popular—and unpopular. The American Iron and Steel Institute, the American Petroleum Institute, the American Zinc Institute, the National Coal Association, the Copper and Brass Research Association, and the Talc and Soapstone Producers' Association are a few examples of the organizations covering the various branches of the mining industry, and although they are of comparatively recent growth, the trade association is by no means a new development. The old English guilds may be considered direct ancestors of the present bodies. However, it is only during the last ten years, a period for the most part of intense commercial activity, that the trade associations have multiplied like rabbits. Well over 1,000 of them are known in the United States alone, and they cover almost every industry from the manufacture of noodles to zinc. The zenith has been reached in an association of such associations.

The trade association is organized for the mutual benefit of the companies or individuals engaged in a particular kind of business—competitors, in other words. It should not be confused with commercial associations, chambers of commerce scattered over the country, whose membership is made up of manufacturers of a *variety* of products. Naturally, trade associations must have a definite objective to justify their expense of maintenance, but the sphere of activity has not been any too strictly defined, although the courts have occasionally rendered decisions affecting their legal boundary of action. In general, they are formed to tackle problems of common concern, perhaps the tariff, or fostering the consumption of the article produced and manufactured by an industry, or some kindred problem. Of the many important activities in which they may interest themselves a few are: To promote a friendly feeling among members, to discourage unfair competition, to encourage high standards in the industry, to improve commerce and trade, to establish a code of ethics for the guidance of members, to compile statistics of the industry, and to watch legislation affecting the industry. Each trade association usually has definite ideals which are carefully set forth in its articles of incorporation.

The trade association has a great opportunity for constructive work and is here to stay. Several trade associations have overstepped the bounds of legality in their actions, not without severe censure, and have unfortunately showered uncalled-for criticism upon the shoulders of the law-abiding ones. The respectable associations are so much stronger that intelligent publicity, which they are only now beginning to receive, should soon eliminate any bad impression that may have been created by others. In those circumstances in which trade associations have been prosecuted, collusion has generally been shown to exist between members to maintain high prices and restrict competition. They have thus followed in the footsteps of the old guilds in endeavoring to bring about set prices through the use of force. So many other activities are distinctly within the range of activity of the trade association that it is a pity that some have taken the line of least resistance and brought unwarranted opprobrium upon others.

The Fields of Activity

At present there is clearly a field in which the trade association may gambol to its heart's content, another one in which it may not trespass, and a contact zone containing an indistinct dividing line. Any step taken collectively which is intended to restrain competition may subject the association to criminal action. Trouble has arisen in dealing with prices—a subject that is still in a twilight zone, but which the courts are helping to define so that these organizations should soon know exactly what information they are permitted by law to collect and distribute and that which is forbidden.

A few groups have gone so far as to collect and disseminate the daily prices at which members' business has been transacted, maintaining what they termed an "open competitive price" plan, but which was neither open nor competitive. This scheme contemplated the daily collection from each member of information regarding bids made in competition, prices received for the product sold, together with data covering production and stocks. All this information was collected by a central agency and distributed to the individual members of the trade association. The plan was openly competitive only as far as the producer was concerned, for the information was not available to both buyer and seller alike. Much harm has been done by the use of this misleading designation. Most of the bodies adopting this practice have got into serious trouble. The exchange of price information among members places a weapon in their hands which can readily be used for abuse in restraining production, raising prices, and for other objectionable activities. Secretary Hoover, who is rendering inestimably valuable service to the honest trade association, has intimated that publication of the statistical records of these bodies, whether past prices, stocks, or production, will place both consumer and producer on the same footing, enabling them to plan operations according to market indications and discouraging one from taking undue advantage of the other.

Publicity the Greatest Stumbling Block

Much persuasion will no doubt be required to induce trade associations to make their statistical compilations public. Some of them have already wholeheartedly turned their records over to the Department of Commerce, which has used them in its new monthly publication, *Current Survey of Business.* The American Zinc Institute is issuing valuable figures every month to the Government and the public.

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[*] The first of a series of articles on the trade association movement. The second will deal with the work of the trade associations in the mining industry.

Some groups are fearful of the result of publishing their statistical records. Their attitude is well illustrated by the remarks a metal producer made to me recently, who maintained that the former publication of certain metal statistics covering production, consumption, and stocks worked satisfactorily while the statistical position was good, but that as soon as stocks began to accumulate consumers became unduly influenced by the reports. Hence the service was abandoned.

The fear that the consumer will profit to a greater or even an equal extent by the publication of trade statistics doubtless restrains some associations from making their compilations generally known. Education is needed to convince many that group publicity is for their best interests. Trade associations covering the raw materials will profit by the information gathered by manufacturers' associations using the raw materials, and vice versa. It is difficult to see how Mr. Hoover's admirable object of achieving stability in production and distribution can be attained unless both producers and consumers are advised of the actual market conditions, so that they may act intelligently and not upon hearsay and rumor.

The intensity of world competition makes it absolutely imperative that American business men should exert every effort to improve their costs of production. Not an unimportant byproduct of the successful use of the trade association will be easier competition with foreign trade, the elimination of waste in industry, and the lowering of the cost of living, objects which Mr. Hoover has in mind in endeavoring to bring about a broader development of the trade association. If these are not desirable ends there is little use in bothering with the organizations.

WIDE FIELD OPEN TO THE TRADE ASSOCIATION

The industries which have been the most competitive are the ones which have been the quickest to see the advantages of the trade association. They have turned to it rather than to the other alternative, consolidation or amalgamation of the various units of the industry. After becoming federated in a trade association each member can co-operate with his fellows in establishing relations whereby the many problems which face the industry may be collectively attacked.

The collection of statistical information is only one of the important functions of a trade association. The other activities have doubtless been obscured by the notoriety achieved by unscrupulous societies tampering with prices and competition. Standardization offers great possibilities, to mention but one field. The unnecessary variety of products produced by some industries and the complete lack of a uniform standard in others—witness some of the non-metallics—are fertile fields. If intelligently directed there should be no harmful effect because of over-standardization, stifling of originality and initiative. The work of the National Paving Brick Manufacturers, upon which editorial comment in *Engineering and Mining Journal* was made several months ago, was surely worth while. In but a short session the number of different sizes of paving brick was reduced from sixty-six to seven.

Disregarding for the present the collection of statistical information concerning prices and costs, the trade association is fitted to collect promptly and efficiently other data of great practical value to industry information regarding production, consumption, and stocks. Frequently, trade associations have felt that the consumer receives an advantage for which he does not pay if these figures are made public, leaving out of consideration the advantage derived by companies not affiliated with the trade association but in the same business. Publicity in statistical compilations will do more to give the trade association a good name in the public mind than any other step. The definite trend is in that direction, which is due largely to Mr. Hoover's efforts and the work of the judiciary.

COMPETITORS GIVEN EQUAL OPPORTUNITIES

Were a trade association to do away with competition no fate would be too hard for it. On the contrary, it promotes rather than restrains trade; it gives competition intelligent direction and can help eliminate great waste in industry. One of the great advantages possessed by a large industrial organization is its ability to profit by information which it is in a superior position to acquire with the aid of a well-spread-out business. Trade associations, in distributing information to members regardless of size or importance, place them all on the same footing and eliminate a tendency to consolidation and the formation of trusts.

Last December the Supreme Court of the United States, in the now popularly known "Hardwood Decision" (American Column & Lumber Co. et al. vs. the United States of America), decided that the "open competition plan" as interpreted and administered by the American Hardwood Manufacturers' Association was intended to and did restrict production and restrain competition and increased rather than stabilized prices. The plan required members to make daily reports of sales, shipments, copies of orders and invoices, monthly production, stocks, and any changes in prices as soon as made. This information was gathered and distributed by skilled employees of the association to the members only and was supplemented by a regular monthly meeting for a discussion of subjects of interest to members. The court held that this arrangement afforded an opportunity for combining upon agreements expressed or implied, and that the evidence showed beyond discussion that the purpose of the organization, and especially of the frequent meetings, which were held several times a month, was to bring about a concerted effort to raise prices.

The Hardwood Manufacturers' Association maintained in its defense that the data distributed among its members were of the same nature as the reports contained in newspapers regarding commodities bought and sold upon the organized exchanges. The court, however, called attention to the "distinguishing and sufficient difference" that the reports in the press go to the buyers and sellers alike; the trade association's compilations were confined to its members and subject to interpretation by skilled officials.

At first it was thought that this decision would have an adverse effect on the existence of trade associations, but it is now realized that it applied only to that particular case, and referred to a trade association organized to exploit the "open-price" plan and to use its statistical information for its own ends. It has, however, been a lesson to some bodies to steer clear of any steps that would tend to restrict competition.

Secretary Hoover's interest in the trade association has been so deep that he has corresponded with the Attorney General to learn definitely those activities in which the trade association may engage without being prosecuted. The Attorney General was careful to make the important reservation in his reply to Secretary Hoover, that whatever is done must not be a scheme to restrict production, enhance prices, or suppress competition. There is no objection to a trade association furnishing a standard system of accounting, provided costs are not exchanged by the members. The trade association may advocate uniformity in the use of trade names, provide for the standardization of quality and grades, provide standard forms for contracts, and standardize machinery and processes. It may determine means for eliminating waste, raise the ethical standards of the trade, collect credit information, handle the insurance of its members, engage in collective advertising welfare work, and urge legislation affecting the industry such as tariffs, taxes, transportation rates, employers' liability acts and other similar questions, tremendous activities in themselves. It may collect statistics from each member showing the volume of production, capacity to produce, wages paid, consumption and distribution, and stocks. This information may be compiled by the trade association into a consolidated statement showing total volume of production, wages by districts, consumption in foreign and domestic trade, distribution, and stocks. After compiling this information the trade association may file the statement with the Secretary of Commerce for distribution by him to the members of the association through the public press and to the public generally. There seems to be no objection to a trade association collecting statistics of prices received for past sales data which may be consolidated into one report, without, however, giving individual information to any member of the association. The consolidated report may be sent to the Secretary of Commerce for public distribution.

Engineers have frequently been indicted as poor business men and narrowly technical. It is not without some measure of pride that they can point to the efforts of Secretary Hoover to introduce an engineering search for the facts on which trading, prices, prosperity, and other business elements are built. One of his steps in that direction is to make better use of the trade association in what he has characterized as "groping for stability"—a vivid expression. The mining industries need not be told what a great aid it would be to eradicate the plunges from capacity production to complete closure—from phenomenally high prices to unusually low ones.

Bureau Calcining Dolomite

The investigation of dolomite cements will be continued at Columbus, Ohio, by the U. S. Bureau of Mines. Free lime in dolomite cements, calcined above 800 deg. C., causes excessive shrinkage and cracking in the finished cements. Dolomite cements, containing practically no free lime, may be prepared by calcining the rock at a sufficiently low temperature (below 800 deg. C.) to decompose the magnesium carbonate but not the calcium carbonate. The investigation will consist of calcining dolomite at a temperature high enough to decompose both the magnesium and calcium carbonates and adding suitable agents to react with the lime.

Investigation in Wisconsin Zinc District

Since the beginning of the milling to recover zinc, the Wisconsin field has borne an undesirable reputation on account of the marcasite which is associated with the sphalerite. The separation has been difficult. A fairly satisfactory process of magnetic separation for grading up jig concentrates which are contaminated with marcasite was finally developed and has for some time been in operation, but the fines are not amenable to this process and have been wasted. The purpose of an investigation conducted by the U. S. Bureau of Mines at the Wisconsin State Mining School, Platteville, is to utilize the fines. Since the year 1911 some of the mining companies have made an earnest effort to use the fines in the tailings but without satisfactory results being achieved.

Examination of the current mill tailings shows that the minus 20-mesh material therein is the most amenable to profitable re-treatment. The evidence so far gained is that by screening the tailings on 20 mesh, 65 per cent of the zinc content will be concentrated in the fines. The fines will amount to 25 per cent of the whole; that is, the ratio of concentration will be four to one and the recovery 65 per cent.

Laboratory tests indicate that concentrating tables placed in the mills to treat the fines will recover 90 per cent of the zinc content in a low-grade concentrate assaying about 20 per cent zinc, and that this concentrate can be graded up to 62 per cent in central plants where flotation and gravity concentration are combined. An estimate has been made that this practice would have added about one million dollars annually to the revenue for zinc. In some instances the lead recovered would have been appreciable. Two byproducts, marcasite and ground limestone, would have been available for sulphuric acid and agricultural purposes, respectively.

The work is conducted through a quadrangular co-operative agreement among the operators, the Wisconsin Mining School, the local assayer, and the Bureau of Mines. The laboratory results are encouraging and will probably lead to a commercial try-out of the process as soon as the zinc market encourages the operators to reopen their mines.

Georgia Kaolin in Pottery

English china clay is preferred to Georgia kaolin by many American potters. In comparing the two it is found that the English clay disintegrates in water more readily, produces a body which casts more satisfactorily, gives lower drying and bisque losses, requires less linseed oil to produce a spreading condition for oilcloth, and produces a paper of better finish and more resistent to moisture.

In the preliminary work by the Bureau of Mines it was found that after calcining Georgia kaolin to low temperatures (500 to 600 deg. C.) it possesses properties similar to the English china clay—i.e., its adsorptive properties are decreased to that of the English china clay and the rate of capillary flow and the permeability of water is increased. Further tests are to be made to determine its commercial feasibility. The effects of aging the calcined clay in air and water are to be studied to determine how far the calcined clay will revert to its original condition and also to determine the varieties produced by different calcination temperatures.

Sulphatizing Roasting of Semi-Oxidized Copper Ores

Process So Conducted as To Produce Maximum Content of Water-Soluble Copper—Close Temperature Regulation Necessary

By Percy R. Middleton
Consulting Metallurgist, New York

THE PRESENCE of oxidized copper minerals is one of the stumbling blocks in the efficient application of the flotation process to many copper ores. Although excellent recoveries of the sulphide are made, the greater part of the oxidized mineral is lost in the tailing. Numerous processes have been devised for the treatment of semi-oxidized copper ores, and they may be classified as follows:

1. Sulphiding, or filming the oxidized mineral with a sulphide, to make the particles more adaptable to the flotation process.

View of furnace during erection, showing Dutch oven and ports for oil burners on lower hearths

2. Combined flotation and leaching, the oxidized copper being leached with acid either before or after the flotation of the sulphides.
3. Solution of the acid-soluble copper, precipitation of the copper in the pulp, and the recovery of both metal and sulphide by flotation.
4. Roasting the ore, whereby a large percentage of the copper minerals is converted into the sulphate, and leaching the calcine with acid. The copper is recovered by any known method of precipitation.

This article will deal only with the last-named method.

The idea of the sulphatizing roast is by no means new, but hitherto has not met with much success. After considerable experimental work in both the United States and Australia, I patented (U. S. No. 1,376,025) a method of roasting which has given satisfactory results on both semi-oxidized and heavy sulphide copper ores. This method of roasting does not require special apparatus, and may be conducted in any standard type of roasting furnace. The results obtained depend on temperature control, and the operation may be divided into two stages as follows:

1. The ore is heated to a reacting temperature, below the ignition point of the sulphur in the ore. (By ignition point is meant the temperature at which a blue flame is distinctly visible over the surface of the ore; this flame is due to the rapid oxidation of the sulphur and is accompanied by a rapid rise in temperature of the charge which prevents the desired reactions taking place.) During this stage of the roast the direct oxidation of the copper and iron sulphides occurs presumably in accordance with the equation

$$3CuFeS_2 + O_{18} = Cu_2S + 3FeSO_4 + CuSO_4 + SO_2.$$

2. Following the completion of this direct oxidation, the temperature is gradually elevated to about 1,100 deg. F., further reactions occurring which may be expressed as follows:

$$Cu_2S + O_5 = CuSO_4 + CuO.$$
$$2Cu_2S + 2FeSO_4 + O_{11} = 4CuSO_4 + Fe_2O_3$$

From the above reactions it will be seen that the greater part of the sulphatizing action is due to the iron sulphate formed during the first stage of the roast, and it has been found that this compound also reacts with the oxide of copper, forming copper sulphate.

The possibilities of this method of roasting were demonstrated in a series of laboratory tests on various ores, the sulphur contents of which varied from 1.5 to 40 per cent sulphur. These small tests were so satisfactory that the manufacturers of the Herreshoff furnace supplied a small ten-hearth furnace for experimental work on a larger scale, and the following are particulars of a test conducted on a sample of ore from the Burro Mountain Branch of the Phelps Dodge Corporation.

The ore was crushed in a standard-type ball mill. An analysis of the crushed product gave the following results:

Sized Products: Mesh		Total Cu, Per Cent	Oxide Cu Per Cent	Weight, Per Cent	Cumulative Weight, Per Cent
On	35			1.4	
	48	2.09	0.11	4.0	5.4
	65	2.16	0.11	5.8	11.2
	100	2.39	0.14	6.4	17.6
	150	2.57	0.20	5.6	23.2
	200	2.65	0.33	12.0	35.2
Through	200	2.47	1.32	64.8	100.0

Copper, 2.49 per cent; oxide copper, 0.73 per cent; sulphur, 7.8 per cent; iron, 7.7 per cent.

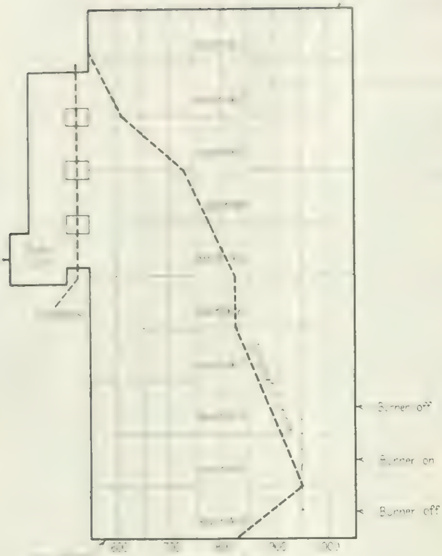


Fig. 1. Temperature range on various hearths

This crushed product was roasted in a ten-hearth Herreshoff furnace, 3 ft. hearth diameter. The second, third, fourth, and fifth hearths were heated by a Dutch oven, fired with an oil burner; the eighth, ninth, and tenth hearths were each provided with a burner, and in this manner heat could be applied to any part of the furnace. In operation, only one burner was used on the lower hearths, which, together with the Dutch oven, brought the temperature of the upper hearths up to the reacting point of the first stage of the roast. Each hearth, with the exception of the first, was fitted with a thermocouple, connected through a multi-point switch with a Brown indicating pyrometer and arranged in such a manner that the actual temperature of the ore bed was recorded. Fig. 1 is a graphic illustration of the temperature throughout the furnace under the most favorable roasting conditions. The temperature of each hearth was recorded every fifteen minutes and entered in a log book for reference. Samples from the furnace discharge were taken every fifteen minutes and a composite for each four hours was assayed for total and soluble copper. In addition to these discharge samples, a daily sample was taken from each hearth, to show the progress of the roast; Fig. 2 shows the soluble copper content of a series of hearth samples and also the temperature throughout the furnace at the time of taking the samples.

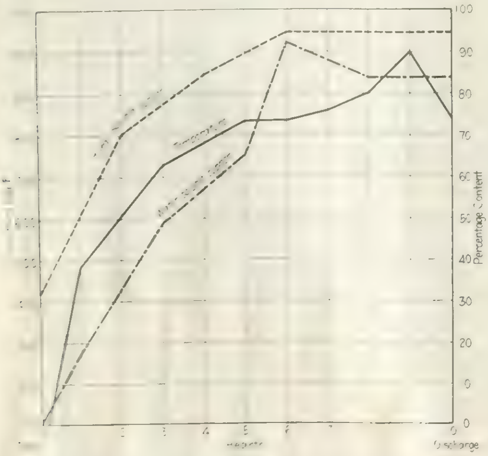


Fig. 2. Copper content and temperature of material on different hearths.

The experiments extended over a period of eleven days, and the total amount of ore treated was 17,272 lb. The amount of ore roasted per day, together with the results of the daily assays of water- and acid-soluble copper, is shown in Fig. 3. Analyses of sized composite samples of the calcines produced during the test are as follows:

ANALYSIS OF SEVEN-DAY COMPOSITE CALCINES

10,052 lb. Ore Roasted

Sized Products: Mesh		Weight, Per Cent	Cumulative Weight, Per Cent	Total Cu, Per Cent	Total Soluble Cu, Per Cent	Water-Soluble Cu, Per Cent	Per Cent Cu Soluble in Water	Per Cent Cu Soluble in Acid
On	35	1.6	...					
	48	3.6	5.2	1.89	1.51	0.86	35.5	79.8
	65	10.2	15.4	2.62	2.37	1.32	50.4	90.5
	100	8.8	24.2	2.62	2.50	1.61	61.5	95.4
	150	8.2	32.4	2.81	2.60	2.40	85.4	92.5
	200	7.8	40.2	2.78	2.75	2.42	87.0	99.0
Through	200	59.8	100.0	2.47	2.37	2.09	88.2	96.0

Cu, 2.52 per cent; soluble Cu, 2.39 per cent; water-soluble Cu, 2.02 per cent, per cent of Cu soluble in water, 80.2; in acid, 94.9.

ANALYSIS OF FOUR-DAY COMPOSITE CALCINES

7,220 lb. Ore Roasted

Sized Products: Mesh		Weight, Per Cent	Cumulative Weight, Per Cent	Total Cu, Per Cent	Total Soluble Cu, Per Cent	Water-Soluble Cu, Per Cent	Per Cent Cu Soluble in Water	Per Cent Cu Soluble in Acid
On	35	2.0	...	1.54	0.68	0.13	8.5	45.0
	48	4.4	6.4	1.97	1.31	0.70	35.6	66.5
	65	7.0	13.4	2.42	1.80	0.83	34.3	74.4
	100	5.6	19.0	2.77	2.18	1.03	37.2	78.8
	150	12.8	31.8	2.87	2.32	2.12	74.0	81.0
	200	7.8	39.6	2.89	2.62	2.39	82.7	90.7
Through	200	60.4	100.0	2.53	2.30	2.14	84.6	91.0

Cu, 2.65 per cent; soluble Cu, 2.26 per cent; water-soluble Cu, 1.79 per cent; per cent of Cu soluble in water, 67.6; in acid, 85.3.

The following methods were used in estimating total and water-soluble copper:

Total Soluble Copper. Two grams of the sample were weighed out and boiled for five minutes in 50 c.c. of a 3 per cent solution (by volume) of sulphuric acid. After filtering and washing with hot water, the copper was estimated in the filtrate by the electrolytic method.

Water-Soluble Copper. Two grams of the sample were weighed out and boiled for five minutes with 50 c.c. of water, filtered and washed with hot water and copper estimated in the filtrate by the electrolytic method.

Easy Temperature Control

No difficulty was experienced in the operation of the furnace, and it was found possible to hold any hearth within 25 deg. F. of the desired temperature. In actual practice it would be advisable to use automatic temperature-control pyrometers, which operate the oil burners and keep the temperature within a few degrees of that desired. Owing to the small hearth area of the furnace used on this experimental work, no actual figures were obtained as to the capacity of a large-size furnace, but it is estimated that a ten-hearth 21 ft. 6 in. diameter furnace would treat from 200 to 250 tons of ore per day of twenty-four hours.

The above-outlined experimental work was conducted on the assumption that either sponge or scrap iron would be available for precipitation. With this in view the furnace was operated to produce a calcine containing as much water-soluble copper as possible, so as to reduce the acid consumption to a minimum. However, if the electrolysis of the leach solutions had been contemplated, the furnace product from the above test would not have been suitable, on account of the large amount of copper sulphate in the calcine, which would result in the regeneration of an excess of sulphuric acid over the requirements of the process and the discarding of a large quantity of solution at each cycle in order to keep the acid contents of the circuit constant. High water-soluble copper is not desirable in a calcine when electrolysis is the means of precipitation to be employed.

Roasting experiments show that to obtain a high total solubility it is necessary to sulphatize practically all the sulphide copper; in other words, the roasting of the sulphide direct to the oxide does not give satisfactory results. However, when the sulphate has been formed it can readily be converted to the oxide by increasing the temperature on the lower hearth of the furnace to the decomposition point of copper sulphate, which begins at 1,200 deg. F. and is practically complete at 1,300 deg. F., the following reactions taking place:

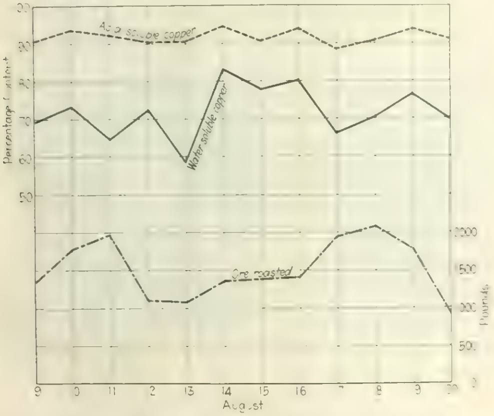


Fig 3. Copper content and tonnage treated each day

At 1,200 deg. F.

$$2CuSO_4 = 2CuO, SO_3$$

or

$$2CuSO_4 = CuO + CuSO_4 + SO_3$$

At 1,300 deg. F.

$$CuSO_4 = CuO + SO_3$$

It has been found possible so to control the decomposition of the copper sulphate that the calcine produced will contain practically any desired percentage of the total copper in the water-soluble form and in this way regulate the regeneration of acid to the requirements of the process.

The treatment of the calcine for the recovery of the soluble copper will not present great difficulty; in fact, the latest methods used in cyanide plants may be applied with a few minor modifications. For example, the Dorr counter-current system of decantation may be applied either to the whole of the furnace product or to the slime only, after making a separation of sand and slime. In the latter operation the sand would be treated by percolation in tanks fitted with filter bottoms. The application of electrolysis to the recovery of copper from leach solutions has been successful in two large plants, and there is no doubt as to this feature of the process.

Looking at the matter from the commercial standpoint, the following working costs have been compiled and for comparison an estimate has been made of the cost of treating the same ore by flotation and smelting. The relative cost of plants is not considered:

ROASTING COSTS PER TON
BASIS 200 TONS PER 24 HOURS [illegible]

	Cents
Fuel, 6.2 [illegible]	[illegible]
Labor [illegible] per shift [illegible] $4	[illegible]
Power, repairs and [illegible]	[illegible]
Total	44

TREATMENT COSTS, ROASTING AND LEACHING—BASIS 1,000 TONS PER DAY, ORE CONTAINING 2 PER CENT CU (0.75 PER CENT OXIDE)
Assume Recovery of 90 per Cent or 36 Lb. Copper per Ton

	Cents
Crushing	30
Roasting	45
Leaching	20
Precipitation @ 3c. per lb. Cu	108
Freight and casting cathodes @ 1c. per lb. Cu	36
Selling expenses, @ 0.15c. per lb. Cu	5
Total	244
Cost per lb. of Cu	6.79

TREATMENT COSTS PER TON—FLOTATION AND SMELTING
Assume Recovery of 70 per Cent or 28 Lb. Copper per Ton

Milling, including crushing, flotation and [illegible]	$1.50
Freight on concentrate to smelter	0.15
Smelting concentrate, per ton of ore	0.50
Freight and refining blister @ 1.5c. per lb. Cu.	0.42
Selling expenses @ 0.15c. per lb. Cu	0.042
Total	$2.612
Cost per lb. of Cu	9.32

SUMMARY
Treatment Cost per Lb. Cu

	Cents
Flotation and smelting	9.32
Roasting and leaching	6.79

Balance in favor of roasting and leaching 2.52 cents per lb. Cu.

The experiments conducted on Burro Mountain ore indicate that this class of material may be roasted and a calcine produced containing at least 90 per cent of the copper in soluble form, which may be extracted by a modification of the apparatus used in modern cyanide work, and the copper recovered from the leach solutions either by electrolysis or by precipitation on scrap or sponge iron. The only novelty in the process is the roasting, which can be conducted in any standard type of ore-roasting furnace.

Investigation of Georgia Clays By Bureau of Mines

The kaolins and bauxites of Georgia occur principally in the coastal plain, the belt running diagonally across the state from east to west. The lines of the Central of Georgia R.R. reach about 80 per cent of the white clays and bauxites of the coastal plain. The white clays are being mined at a few points, principally at Gordon, Claymont, McIntyre, and Butler, and are sold principally to the filler trade. Bauxite mining has been carried on in the Cuthbert, Toomsboro and Andersonville districts.

The investigation undertaken by the Ceramic Station of the Bureau of Mines, at Columbus, Ohio, in co-operation with the Central of Georgia R.R., will consist in experiments to devise better refining methods and to test the physical properties of the different separations obtained.

Philip Argall

An Appreciation by T. A. Rickard

PHILIP ARGALL died on March 19 at Denver, Col. He was the son of a Cornish mining engineer. His life of sixty-eight years was full of useful work and persistent study. As a boy he had few educational opportunities, but he made the most of those that offered. At the age of sixteen he was working ten hours per day in the ore-dressing plant of an Irish copper mine and learned the first principles not only of concentration but of the leaching of copper ore. A Dublin professor gave him a blow-pipe and a few books. With these he started to study minerals and rocks. He grew up among mines and metallurgical plants, and used his scientific curiosity to good purpose. When twenty-one he was a shift boss in another Irish mine, and soon became superintendent. He had begun already to write on geology, and throughout his life he was as willing to give information as he was eager to gather it. When twenty-five he was given charge of a detinning plant at Swansea, in Wales, and showed his metallurgical ingenuity by devising a new way of smelting the slag. Then he went to Cornwall, and formed professional ties with the firm of Rickard Bros., for whom later he traveled in Australia and elsewhere. He was manager of the Kapanga mine, in New Zealand, for a year. In 1887 he became manager of the La Plata smelter and began his long association with the mining industry of Colorado. When the sulpho-telluride ores of Cripple Creek presented a new metallurgical problem, he set about to devise a method for their successful reduction; and he succeeded in adapting cyanidation to this purpose, by aid of fine crushing and preliminary roasting. He designed several successful mills, including the Metallic plant at Florence. Later, when the flotation process came into use, he played a conspicuous part in adapting it to the treatment of zinc ore in New Mexico. In 1903 the Institution of Mining and Metallurgy (London) awarded him a gold medal for his paper on "Sampling and Dry Crushing in Colorado." During the last years of his life he was engaged in the microscopic study of free gold in quartz and in sulphides from all over the world, and spent some time in the laboratory of the U. S. Geological Survey at Washington, where he conducted an interesting research, the result of which will be published, I hope, by one of his sons. He was the father of five sons, two of whom—Philip and George—were in partnership with him. On them he bestowed a much better education than he had been able to obtain for himself, so that he left the United States five good citizens—nay eight, for his three daughters also are citizens of the best type. Philip Argall would have won the warm regard of Theodore Roosevelt, because he reared and educated a large family of capable sons and daughters; he and his wife gave the United States the best return that a citizen can give to his adopted country. Although born in Ireland, he was of Cornish origin, but he exercised his privilege of becoming an American citizen as soon as he established his residence in Colorado. He was a notable example of a man that makes the most of his opportunities; he was an eager student throughout his life; he was keen to devise new metallurgical methods; he made many notable contributions to technical science; he was willing always to take part in the public discussion of technical affairs; he was a helpful man, and therefore a highly civilized man. He said that his "best achievement" was the introduction of the eight-hour shift in the cyanide mills of Colorado. That bespeaks his humane feeling for his fellow-workers. It would be well if such a sentiment could be labeled American. At any rate, Philip Argall was a splendid American in spirit, in initiative, in capacity for hard work. The mining profession in the United States has reason to be proud of him, and to hold his memory in honor.

Philip Argall

Briquetting Zinc-Bearing Material For Distillation

As a step in the electrothermic smelting of zinc ores, some large-scale briquetting tests were initiated on roasted ore and on a zinc residue concentrate at the Mississippi Valley Experiment Station of the U. S. Bureau of Mines at Rolla, Mo. Briquets were made of ore, coke, and pitch, and were shipped to a smelter at Fort Smith, Ark., for distillation in the retorts of a natural gas fired furnace. Ordinary retort distillation on the residue concentrate (containing 36.0 per cent Zn, 9.5 per cent Fe, 21 per cent Pb, 3.1 per cent CaO, and 3.2 per cent S) results in a low recovery of zinc and rapid destruction of retorts. The distillation of this material in briquet form resulted in 97 per cent zinc extraction, although only 70 per cent was recovered, owing to cold furnace fronts on account of a low firing of the furnace for the experimental work. Retort destruction is practically nil with the briquets, and a larger charge can be handled in retorts when in briquet form. This work is to be continued on a practical scale at Fort Smith, and the installation of an electrothermic unit to handle blue powder and dross is under consideration.

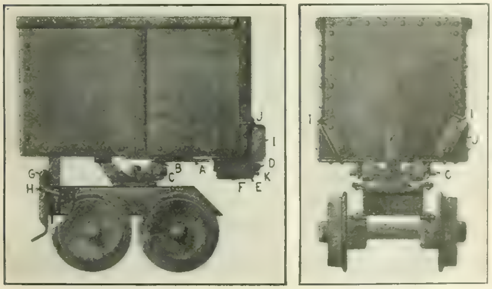
USEFUL OPERATING IDEAS

Improved Automatic Mine Car

Body Latch Operated by Foot, Remaining Open —Tilting Thirteen Degrees Releases Door— Both Devices Positively Locked

By L. S. Farnham

As a RESULT of observed deficiencies and need of improvement in the usual type of mine car in Butte and most Rocky Mountain mining districts, the Davis-Daly Copper Co.'s engineering and mechanical force has designed, built, and placed in operation an automatic latching and unlatching mine car, which bids fair to displace the standard type of lever-latched cars now in use in the company's properties.



Automatic mine car developed and used by Davis-Daly Copper Co.

The typical Western mine car has a lever at its rear end which releases successively the body, for tilting, and the door for dumping its contents. The failure of this lever, with its attached hook rod and the co-acting body and door, to function effectively is the principal cause of accident, delay, and annoyance with the car. The lever is often hard to move, on account of its hook or latch rubbing the door, which is pressed against the latch by its load of rock. When the car is to be dumped at the side of the track, turning the body 90 deg. on the bolster or turntable on top of the truck, the lever must be moved far enough to unhook the body from the truck, but not sufficiently to unlatch the door until the car has been turned. Sometimes the lever sticks and then lets go with a jerk, opening the door too soon and dumping part of the load on the track.

Often, when dumping straight ahead into a chute or skip or over the edge of a dump, the car is run against the stop at sufficient speed to tip by its momentum, but, by the lever sticking, the operator fails to unlatch either body or door, and the car, with load and truck, is tipped into the chute or skip or over the dump, with the door closed. It is then a laborious and troublesome job to get the car righted. A man has sometimes been taken over with the car and seriously injured. The lever, being placed at the rear end of the car, is subject to bumping from other cars and requires more repairs than any other part. It not infrequently catches the operator's fingers and injures them. The improved car eliminates this lever entirely and utilizes the tilting movement of the car to release the door.

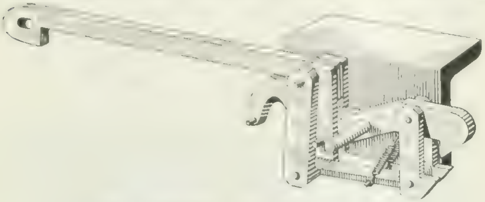
Experience has shown that, to be serviceable and "fool proof," a car with automatic door release and body latch must have positive locking devices on both of these pieces of mechanism. With this purpose in mind, the car embodying this feature has been designed and is now in operation. This combines mechanism which will unlatch the rear of the car body from the truck, independently of the car door latch; keep the catch unlocked as long as desired, and latch the same automatically after dumping the car. It will also unlatch the car door automatically for either end or side dump, whenever the bottom of the car has been raised to an inclination of 13 deg. from the horizontal, and not before; latch the door again upon returning the body to the horizontal, and positively lock the door in such position as to insure against the latch opening accidentally by knock or jar which might cause the door to be opened and the contents to be discharged in such a manner as to cause a wreck in drift, crosscut, or hoisting shaft. The locking device for the door latch is so arranged that it cannot lock until the door is fully in place, so that should the door fail to latch automatically by its own weight, after dumping, it can readily be kicked back into place.

The door is positively released by a lever (*A*) connected to the turntable at (*B*) eccentric with the pivot (*C*) of the car body, releasing the latch (*D*) when the body has been tilted at an angle of about 13 deg. In closing, the door automatically latches, and is positively locked by a secondary latch (*E*), auxiliary to latch (*D*). The latches (*D* and *E*) are free to open independent of the lever (*A*), except when the door is closed; then the latch (*D*) is positively locked by its auxiliary latch (*E*), which acts on the end of the lug (*K*), attached to the door, to prevent latch (*D*) from being raised.

The latching mechanism is composed of six simple forgings and four light coil springs, mounted on a pair of 3½ in. angles (*F*) riveted to the bottom of the car body. The forgings are of simple shapes, and can be made and repaired by the ordinary blacksmith. They are assembled almost entirely by use of pins and cotters, and can easily be changed, without special tools, when worn out or accidentally broken, and without taking the car to the shops. The working edges of latches are case-hardened.

The car body is secured in the rear to the truck frame by a latch (*G*), which is released by a foot treadle. This latch is held open by a pawl (*H*) until the body is tilted, and latches automatically when the body is returned to its original position. This feature of holding the latch open has the advantage of allowing the operator to release the latch while the car is approaching the dump, thus permitting him to stand with both feet on the ground or with one foot on the wheel, in the most convenient position for him while dumping the car. Dumping the car straight ahead, where the wheels strike a stop, is extremely convenient. The treadle is pressed by the foot when the car nears the stop, and, moving with slight impetus, the car dumps itself without any effort by the operator, the door never failing to release positively.

The typical car, if it has any form of bumper, usually has it so placed as to strike the door of a contacting car, inside of its edge, so as to bend it inward when cars come together with some force. This is one of the most common accidents and necessitates frequent repairs, which are avoided by the improved car here described. The bumpers are 2½ in. angles (*I*), riveted across the lower corners of the door, and extending beyond the sides and bottom plates and reinforcing bands (*J*) of the body of the car, thus insuring that all the bumping strains will be taken up by the sides and bottom, rather than by the door and the end plates.


Door releasing and locking device.

The car dumps equally as well over the side as on the end, the door release being so constructed that the body can be tilted sufficiently to give ample clearance in revolving, without the door opening. It is adaptable to either center draw-bar or side-chain pull.

These cars have been in test operation for five months, under actual working conditions, and are giving satisfaction. Patent has been applied for by the inventors, J. L. Bruce, S. A. Worcester and L. S. Farnham.

Buckets and Bucket Accessories

Buckets are used in prospecting, sinking, and to a small extent in ore hoisting. The commonest type is cylindrical, with the bail attached close to the upper edge. Barrel-shaped buckets are also employed under some conditions. In the former type, the bucket edges are rounded in to prevent catching under the shaft timbers. The barrel type, on account of the larger middle diameter, is less likely to catch timbers. To facilitate dumping, bucket bails are sometimes attached below the middle part of the bucket, and a locking device to prevent overturning when hoisting is attached either to the bucket or to the bail. A safety shackle, or "sister hooks," is necessary for the rope attachment. Bucket sizes range from several hundred pounds' capacity up to one or two tons.

As ordinarily used, buckets are likely to sway from side to side, and to prevent this crossheads and guides are preferably used. The crosshead is a simple timber frame through which the rope passes and which is raised and lowered with the bucket. A type of "safety crosshead" with automatic safety catches is also used to some extent and is to be preferred to the ordinary forms. Hoisting buckets weigh from 30 to 40 lb. per cu.ft. of capacity.

Value of Diamond Drill in Prospecting for Oil and Gas

The experience of W. K. Gordon in using the diamond drill for oil and gas prospecting in Texas, according to the California State Mining Bureau, has led him to conclude that

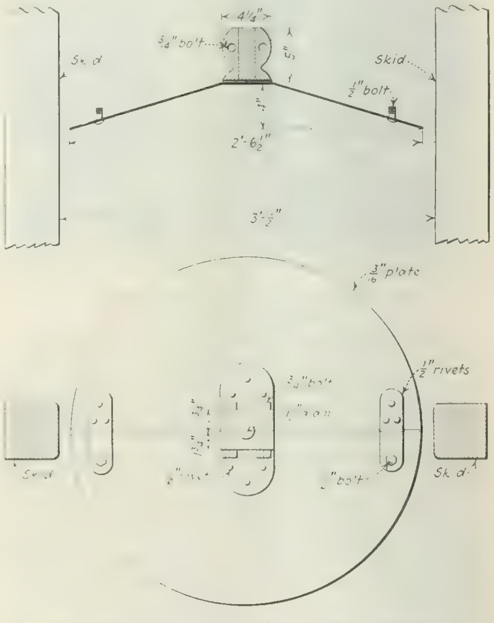
1. The diamond drill can be operated at less cost than the percussion drill to depths less than 1,000 ft. At greater depths the time consumed in removing cores and running tools back into the hole cuts down the footage per day.

2. Quicksands, surface waters, and caves necessitate reducing the diameter of the hole from, say, three inches to smaller, to case off water and sand. This reduction of hole soon eliminates any practical value of the diamond drill in testing for oil.

3. Gas will show in diamond-drill holes, but oil will not. Oil-stained cores of an oil-bearing formation have been taken, but they gave no indication of the quantity of oil in the stratum.

Protecting Shield for Shaft Repair Men

A circular steel shield for the protection of repair men working in a shaft has been devised by the Ivanhoe Gold Corporation, of Kalgoorlie, Western Australia. This is a shallow cone made in halves to facilitate its removal, as shown in the accompanying sketch, which is reproduced from the report of the Department of Mines of Western Australia. A device of this kind, varied to suit different shaft conditions, is desirable in shafts where, by reason of their depth, the velocities of the smallest falling bodies cause them to become dangerous to the life of the workmen who may happen to be employed in the shaft.



Steel shield used by Ivanhoe Gold Corporation to protect shaft repair men

THE PETROLEUM INDUSTRY

Immediate Oil-Well Drilling Advocated by Bureau of Mines

Delay in drilling into an oil structure or sands after they have been opened up may cause losses of from 5 to 50 per cent in the ultimate amount of oil produced from the well, according to a statement issued by the U. S. Bureau of Mines.

Oil is an underground nomad. It moves through the deep sand layers, propelled by the gas pressure behind it, ever searching for the opening through which it may spout or be pumped to the surface. The first wells penetrating the sand operate under high pressure, but those drilled after the gas pressure has been reduced almost without exception come in for a much smaller initial production.

In fields where small tracts form a "checker-board," drilling in any one tract forces the owner to the adjoining tract to begin an immediate drilling program. If he delays drilling, he will see oil which might have been his coming from his neighbor's well, and the longer he delays drilling his offset well the less oil will his well yield. It is only when a structure has not been "tapped" and has no faults along the edges through which the oil may seep that it is possible to conserve oil underground.

One of the "game laws" of the oil fields corresponds to an English law regarding deer which provided that, no matter how many differently owned pieces of land the deer crossed in its flight, it was the property of the owner of the land on which it was killed. Regardless of the number of tracts under which the oil may pass in a structure, it belongs to the owner of the well through which it leaves the ground.

The men in the oil fields know this and know also that the early driller gets the most oil. If an owner of a tract neglects to drill and thereby loses the oil which passes under his land to another well, he must accept his loss without complaint. It is an axiom of the oil fields that, if a man wants oil, he must drill.

Studies made by an engineer of the Bureau covering a great many wells in Oklahoma, Louisiana, and California show that the loss due to delay in drilling is in places as much as 50 per cent. The seriousness of this loss is shown in the following extracts from his report, now in manuscript form and to be published in the future as a Bureau of Mines bulletin:

"During the early life of a pool, wells are brought in with large initial production. As the pool becomes older, there is a marked decrease in initial production of new wells, due to a fall in gas pressure. Naturally, a loss in recovery per acre results, being due to drainage of gas and also in some cases to drainage of oil. The drainage factor is important to the operator if his property has not been protected properly by line wells. In order to obtain the maximum amount of oil from a tract in a pool where there are other operators, a fast drilling program is necessary, thus obtaining wells of large initial production and consequently large ultimate production."

In three typical fields of Oklahoma, the Adair pool, the Bartlesville-Dewey district and the Nowata district, losses in total recovery of oil from adjoining wells varied from 5 to 53 per cent when all conditions were apparently similar except time of drilling. The greatest difference was between two adjoining wells, one of which was drilled in 1905 and had an ultimate production of 5,785 bbl. per acre and the other drilled in 1906 for an ultimate production of 2,700 bbl. per acre. Delay of one year in drilling caused a loss of 3,085 bbl. per acre to the second driller.

Another example cited is in Buena Vista Hills, Midway field, California. Here the ultimate recovery for a certain drilled-up tract which is at least as favorably situated as an adjoining drilled-up tract is estimated to be 24 per cent less per acre, due apparently to a delay of two years in drilling.

In the Hewitt field of Oklahoma, four wells on ten acres all came in for more than 500 bbl. per day initial production. One and one-half months later a neighbor's offset well came in for 220 bbl. the first twenty-four hours, and four months later an offset well made only 120 bbl. the first twenty-four hours.

"It is evident from the records," the Bureau of Mines report says, "that the production of oil from these wells is directly dependent upon the gas pressure included in and associated with the oil. The loss in the initial production of wells due to delay in drilling reflects the loss in pressure, and varies with the number and proximity of producing wells in the same pool, the size of the pool, and the time of delay in drilling."

Petroleum Notes From Texas

SPECIAL CORRESPONDENCE

Several interesting oil developments have been made recently in Texas. In Young County the Ra [illegible] has completed its No. 1 Roark well, making 2,000 bbl. of oil from 3,780 ft. This production is made from the top of the gray lime, similar to that in Stephens County but at greater depth. The well is situated southeast of the Bunger district, in the southern part of the county and north of the Stephens-Palo Pinto County line. The Pioneer district, Eastland County, was extended about one mile east by the completion of the Diamond Drilling Co.'s well, making about 450 bbl. of oil and much gas from 2,475 ft. Ten wells are producing in this district, drilling is increasing, and leasing is active. Prices for outlying acreage have increased greatly. Both the shallow and deep proved areas of the Electra field, Wichita County, have been extended. Many new wells would now be drilling if the water supply were sufficient.

In the coastal fields, Orange is the most actively developed. On March 29 the Gulf Production Co. brought in its Lee Hager well, making 4,000 bbl. through a deeper from 3,940 ft. This well is of much interest, as it is east of Cow Bayou. The plank road to the field has been completed, making it possible to haul in five-ton loads. At Barbers Hill, Chambers County, the Texas Co. has acquired leases on 1,600 acres around the northwest, north, and northeast sides of the dome. Drilling on this block must begin within sixty days. The White Point Development Co., drilling a deep test for oil in the White Point gas field, passed through a gas-bearing stratum in its new well at 1,430 ft. The pressure was strong. Pierce Junction received a temporary setback when a tornado blew down seventeen derricks.

It is believed that two new salt domes in the coastal belt have been discovered recently. Eight miles south of Richmond, in Fort Bend County, the Gulf Production Co. struck what is believed to be the cap rock of a dome in its No. 1 Wheat well at 600 ft. A later report stated that the well was standing full of oil. The second dome is in Jackson County, where the Jackson County Oil Syndicate is drilling near Horseshoe Lake, six miles northwest of Edna. Here the No. 1 Drushel well developed gas pressure at 2,600 ft. sufficient to blow the drill stem from the hole, and a second blowout stuck the drill stem in the well and necessitated its abandonment. No. 2 well, a short distance to the east, is drilling below 1,300 ft. with strong gas pressure at 900 ft. A surface dome at Horseshoe Lake is additional evidence of the possibility of this being a salt dome.

Analysis of Louisiana Crude Oil

A representative sample of crude oil from the Haynesville, La., field has been analyzed by the Bureau of Mines with the following results:

Gravity	34.7 deg. Bé.
Sulphur	0.42 per cent
Carbon residue of residuum	7.26 per cent

Distillation by the Bureau of Mines, Hempel method, showed approximately, the following results:

Gasoline and naphtha	21 per cent
Kerosene	16 per cent
Gas oil	15 per cent
Light lubricating distillate	16 per cent
Medium lubricating distillate	6 per cent

The gravity of the crude is comparable with that of the crudes obtained from the Rocky Mountain district, and the sulphur content is not unusually high. The gasoline and naphtha content is moderate, and the percentage of gas oil is large. The magnitude of the figure for the carbon residue of residuum probably indicates that the residuum can be worked up into cylinder stock by proper chemical treatment.

Syndicate To Drill in British Columbia

Special Correspondence

A syndicate of Vancouver and Seattle business men, which owns 350 acres of natural gas and petroleum leases at Hall's Landing, near Revelstoke, B. C., has made arrangements to drill the area, and work will be started as soon as the necessary machinery can be procured. Considerable excitement was created in this district last year by the discovery of natural gas issuing from the surface, and a large amount of ground was covered by gas and oil leases.

Petroleum Refineries Show Large Increase

Petroleum refineries in the United States on Jan. 1, 1922, numbered 479 completed plants, with 30 additional plants in process of construction, according to a statistical summary prepared by H. J. Lowe, petroleum economist of the U. S. Bureau of Mines. The indicated daily refining capacity of these plants is 2,164,050 bbl. of crude oil.

Texas at present leads all other states in the volume of oil refining business, with 63 operating plants, with a daily capacity of 345,150 bbl.; in addition, the state had on Jan. 1, 46 refineries shut down and 9 other plants were being built. Oklahoma is the second state in number of refineries, with 54 operating and 43 shut down; operating plants in this state had a daily capacity of 234,650 bbl. California, with 34 operating plants, was refining 314,360 bbl. daily. Pennsylvania had in operation 48 plants, with a daily refining capacity of 114,930 bbl. New Jersey, with but 5 refineries, treats 224,000 bbl. of oil daily.

The importance recently attained by the State of Louisiana in this industry is indicated by the fact that 14 refineries were treating 114,350 bbl. daily, and 11 plants were shut down. Kansas, with 19 operating plants, was refining 57,650 bbl. daily; Illinois, with 12 plants, was handling 62,050 bbl.; Wyoming, with 11 plants, was refining 89,900 bbl.; and Indiana, with 5 plants operating, was reported to be handling 54,300 bbl. daily.

Copies of the directory of petroleum refineries in the United States may be obtained from the Bureau of Mines, Washington, D. C.

Red River Bed Ownership in Doubt

Special Correspondence

The State of Arkansas has entered the list of claimants to the bed of Red River. This matter is now under suit before the Supreme Court between the Government, the states of Texas and Oklahoma, and private individuals. Arkansas, under a motion for permission to intervene in the dispute, filed by Attorney General Utley of Arkansas, also asserted its title to a large portion of Texas. In this petition declaration is made that the boundaries of Arkansas laid down in the act of admission to statehood extend not only to the bed of Red River but over that part of Texas lying between the Louisiana boundary and the 100th degree of longitude and north of the thirty-second parallel. The Supreme Court has not yet decided whether it will consider this claim in connection with the Texas-Oklahoma Red River boundary case.

Oil-Shale Plant Starts Operation

The $300,000 oil-shale extraction plant of the Index Oil Shale & Refining Co., at De Beque, Col., is making its initial try-out with apparent success, treating about 250 tons every twenty-four hours, from which the extraction is approximately 60 gal. of crude oil per ton of shale.

Operations of the plant have demonstrated the necessity of minor changes in equipment, and the management announces that as soon as the required machinery can be installed the plant will be operated continuously. Contracts, it is reported, have been let for two other plants in this field.

SOCIETIES, ADDRESSES, AND REPORTS

Trade Associations' Work Vital to Industry

Hoover Advocates Publicity in Statistics—Chairman Gaskill of Federal Trade Commission and Senator Edge Outline Government's Views

By Felix Edgar Wormser

ALTHOUGH it was Secretary Hoover's plan to hold the Washington conference on trade association activities in the Department of Commerce building on April 12, the attendance was so large that it was necessary to adjourn to the larger auditorium of the Department of the Interior. Several hundred trade association executives listened to Secretary Hoover's opening address, in which he outlined the useful field of the association in foreign trade, simplification of trade products and practices, and the elimination of waste in industry. It was his duty under the law, he said, to promote trade, and one of the methods of doing so was presented by closer co-operation with the trade association. "Contact can only be secured through trade and industrial organizations, for without organization there can be no representation. We hold that the legitimate trade association work is vital and should be encouraged." Only a small minority were engaged in activities which brought them under suspicion. Activities on the border line of legality or in the twilight zone were secondary. Mr. Hoover emphasized the importance of making public statistical compilations covering production, consumption and stocks.

Dr. Julius Klein, director of the Bureau of Foreign and Domestic Commerce, and Mr. Durgan, of the Division of Simplified Practice, expressed a willingness on the part of their bureaus to work with the legitimate trade associations. Dr. Stewart, of the Census, said that it was a tremendous job to gather and publish promptly statistics of all the country's industries.

Secretary Hoover called upon many of the representatives the trade associations present to get their viewpoint. Some of them said that they were already furnishing the Department of Commerce with a complete record of their statistics and advocated the fullest publicity in that matter. Secretary Hoover urged the trade associations to get out of the twilight zone, to quit skating near thin ice, and to take a broad view of their functions. He believed that the war has brought about a fundamental difference in our economic life. Standards of living in other countries have been lowered and intense competition must be met.

Chairman Gaskill of the Federal Trade Commission suggested that the trade associations give closer attention to the competitive system under which society was organized, a system whose purpose was to give the greatest measure of social justice to all. Monopoly was destructive to competition, and all things tending toward monopoly must be weeded out. It was not a question of too much government in business or vice versa, but of the closer co-operation of both, to mutual advantage.

Secretary Hoover called upon Senator Edge, who said that he felt business should know where it is at, and to that end had introduced a bill designed to aid the trade associations in defining their activities. Co-operative help from Congress is as necessary to business as it is to agriculture, he declared.

A representative of a Southern trade association said that the conference writes a new page in the history of American business and would make April 12 memorable for that fact. Another said it afforded a golden opportunity to organize industry in harmony with the law and that each trade association should consult frankly with the Department of Commerce as to its activities. In fact, the discussion showed that each association had its own problems to contend with and that a general solution of all of them was not feasible.

The solicitor of the Departmtent of Commerce emphasized the voluntary nature of the support from trade associations, and that the department had no means of compelling or desire to compel them to give their aid or conform to certain regulations. Secretary Hoover in his closing remarks said that the conference was merely a meeting of information and education and was not sufficiently organized to go into details. He was ready to meet each association with its individual problems and to go into details with it. He stated that only about one-third of the associations compiled trade statistics and that the Department of Commerce has never attempted to impose a statistical service upon the associations. The voluntary statistical contributions of trade associations were gladly received and used.

Secretary Hoover said that the vital function of the trade association was as an educational body. Education is the foundation of business and the life of the country, he declared. The problems of business practices, ethics, and business contact with other activities were practically all educational. Trade associations might be considered as colleges of business in their own fields. When they stepped out of their educational work into the twilight zone of questionable practices the first step out was publicity—the elimination of secrecy.

Brass and Copper Officials To Eliminate Overlap

It was intimated by one of a party of operating officials of the American Brass Co., who recently visited Butte, at a session of the Butte Section of the A.I.M.E., that their coming to Butte was for commercial purposes and that the Anaconda officials would return the visit. The plan is to eliminate any duplication of effort from the production of copper to the manufacture of finished brass products, and thus effect a considerable saving in cost. The Anaconda Copper Company has in mind a cost reduction in a number of brass articles, such as nails, to promote their more general use, and plans are being developed with a view to widening the merchandising field. Anaconda now has its copper-shingle propaganda under way, and the inquiries which it is receiving indicate the awakening of a widespread interest in this venture. There appears to be little doubt as to the success which the copper shingle will attain once its merits properly are brought before the building trades and home constructors.

Labor Conditions in Tin Mines Of Nigeria

W. E. Thorne, consulting engineer for the Consolidated Goldfields, South Africa, entertained the San Francisco Engineers' Club on March 30, with an interesting description of the conditions under which mining work is effected in West Africa, under British control. Mr. Thorne said that in the working of the alluvial tin deposits natives were employed and had to be trained by the white men who went in to take charge of the properties. When properties were first opened transportation was effected by natives, who could each carry a head load of 75 lb. Heavy weights were loaded upon four-wheeled trucks pulled by men. Burros and camels were next used. Camel loads were limited to 800 lb. At present motor cars, power trucks, and caterpillars are used. White operators are judge, jury, and father to the natives, who are superstitious and childlike.

MEN YOU SHOULD KNOW ABOUT

E. L. Miller, Jr., has joined the faculty of the Missouri School of Mines.

J. F. Newsom left San Francisco on March 15 for the Federated Malay States.

E. C. Warrener, of New York, is visiting the Kirkland Lake and Porcupine camps.

James M. Davis, superintendent of the Cary mine of Pickands, Mather & Co., has resigned.

John Power Hutchins is in Berlin, engaged in a study of German-Russian commercial relations.

Lee Frasier and **E. Norris Hobert**, of the A. S. & R. Co., are in Mexico City on company business.

G. C. Bateman, general manager of the La Rose Mines, Cobalt, has been made a director of the company.

F. R. Short left San Francisco on March 15 for Mayo, Yukon Territory, to take charge of the Keno Hill, Ltd.

W. H. Wiley, of Los Angeles, is making an examination of the properties of the Jib Mining Co. at Basin, Mont.

J. M. Shiner, of Los Angeles, is installing an experimental leaching plant on the property of the Anita Copper Co. at Lordsburg, N. M.

S. T. Kelsey, who has represented the International Society of Forestry and Mining in the Belgian Congo for several years, is visiting Ferndale, Cal., where he will remain for several months.

Henry S. Burnholz has been appointed mining engineer with the drill-steel investigations which are conducted under the joint supervision of the U. S. Bureau of Mines and the Bureau of Standards.

B. M. Concklin, chief engineer of the Arthur Iron Mining Co., at Hibbing, Minn., has returned from Washington, D. C., where he was attending to taxation matters relative to the properties of his company.

Glen Brandow, who has been in charge of the flotation plant of the East Butte Copper Mining Co., has left for Silver Plume, Col., where he will be associated with the operation of the East Butte's Pelican mill.

B. F. Hewett is making a geological reconnaissance of the Atlanta and Pioche districts, in Nevada. Before returning to Washington he will report on the underground water supply in the immediate vicinity of Searchlight, Nev.

H. C. Hixon, assistant general manager of the Mineral Point Zinc Co., of Chicago, is visiting zinc properties in New Mexico. He responded to a request from the State School of Mines at Socorro and delivered a comprehensive lecture on the subject of zinc.

Albert Burch, of San Francisco, chairman of the California Section of the A. I. M. E., addressed the Montana Section, at its annual meeting in Butte, the last week. Mr. Burch, who is eminent in the geological field, is in Butte in the interests of the Davis-Daly Copper Mining Co.

C. W. Wright, manager of the Soc. Romana per Esplorazioni Minerarie, Rome, Italy, has been appointed by **Dr. F. W. McNair**, president of the Michigan College of Mines, to represent that institution at the celebration of the seventh centenary of the Royal University, Padua, Italy.

E. C. Reeder, for the last five years chief engineer of the Rosiclare Lead and Fluorspar Mining Co., in charge of exploration, development, and construction work at Rosiclare, Ill., resigned on March 1 to enter the employ of the Hillside Fluor Spar Mines, of the same place, in a similar capacity.

R. T. Stull, who has been superintendent of the Columbus, Ohio, Experiment Station of the Bureau of Mines, has been appointed assistant chief of the Bureau's mineral technology division. In that position he will have technical supervision over the work in non-metallics and in ceramics.

F. D. Foley, a Bureau of Mines metallurgist, who has been in charge of iron and steel investigations at the Minneapolis Experiment Station, has been selected to take immediate charge of the investigation of breakage and heat treatment of rock-drill steels and other steels and alloys subjected to similar impact stresses.

William B. Daly, assistant manager of the Anaconda mines, was elected chairman of the Montana Section of the A. I. M. E. at its ninth annual meeting held at Butte, Mont., on March 25. Other officers chosen were: **L. V. Bender**, of Anaconda, vice-chairman; **E. B. Young**, of Butte, secretary-treasurer; **George T. McGee**, of Helena, and **E. N. Norris**, of Butte, members of the executive committee.

Mining and metallurgical engineers visiting New York City last week included: **Dwight E. Woodbridge**, of Duluth, Minn.; **George A. Packard**, of Boston, Mass.; **S. A. Ionides**, of Denver, Col.; **A. C. Bunker**, of El Paso, Tex.; **J. M. Sickler**, of Denver, Col.; **Ernest G. Robinson**, of Moore, Mont.; **John Davenport**, of Wausau, Wis.; and **H. S. Mulliken**, of Washington, D. C.

OBITUARY

Edward F. Russell was killed by a fall in the shaft of the Helen Ray mine, at Nogal, N. M., on March 29.

Prof. Hjalmar Sjögren, director of the Mineral Department of the State Natural History Museum, Academy of Science, Stockholm, Sweden, died recently. Dr. Sjögren had visited the United States several times. He was a member of the A. I. M. E. and the author of several papers which have appeared in the *Transactions*.

George J. Salmon died of pneumonia on March 2 in Philadelphia. Mr. Salmon was graduated from the Pennsylvania State College in 1914, and was first engaged as engineer for the New Rivers Collieries Co., at Eccles, W. Va. In 1920, he worked with War Mineral Resources Commission in Washington, and at the time of his death was supervising engineer with the U. S. Bureau of Mines, engaged in the leasing of public coal mines.

Knox Taylor, president of the Taylor-Wharton Iron & Steel Co., died on April 4 at his home at High Bridge, N. J. Mr. Taylor was the fifth generation of his family to manage the company, which was founded in 1742. He was born at High Bridge, Oct. 19, 1873, son of the late William Johnston Taylor and of Mary Alward Taylor. He began his education at Chester, N. J., where for a time his father operated an iron blast furnace. Later he attended the Hill School at Pottstown, Pa., the Model School at Trenton, and was graduated from Princeton University with the degree of Bachelor of Science in 1895. In college he was a member of the track, athletic and football teams, and was selected as all-American guard. Mr. Taylor's love of outdoor life led him to engage in mining engineering work in the Rocky Mountains for seven years after leaving college. He was a member of several clubs and associations, among them being the Engineers' Rocky Mountain and University clubs, American Society for Testing Materials, American Institute of Mining and Metallurgical Engineers, American Chemical Society, American Society of Mechanical Engineers, Society for Promotion of Engineering Education and Iron and Steel Institute (England).

Knox Taylor

THE MINING NEWS

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Leading Events

THE FORDNEY TARIFF BILL was finally reported to the Senate on April 10. A full account is given in this issue in News from Washington on pages 640-2.

The hearing on the accounting between the Butte & Superior and Minerals Separation companies, set for April 11, was again postponed.

Sale of Consolidated Arizona's holdings, scheduled for April 7, was negotiated in spite of the Treasury Department's lien for excess profits taxes which was filed last week.

Legislation effecting trade associations has been proposed in Congress. Such organizations would be brought under the Federal Trade Commission should the present bills become law.

Operators in the Coeur d'Alenes, Idaho, are encouraged by the recent advance in the price of lead. Two companies now shut down may resume.

The number of companies active in the Joplin-Miami district continues to increase, but production remains stationary.

Arizona Hercules Property Sold at Sheriff's Sale

By Telegraph to Engineering and Mining Journal-Press

Florence, Ariz., April 10—The property of the Arizona Hercules Copper Co. has been sold at sheriff's sale at Florence for $3,600,000 to representatives of the Empire Trust Co., of New York, acting as agents for the reorganization bondholders. The reorganization referred to is that of the subsidiary Ray Hercules Copper Co., now the Ray Hercules Mines, Inc.

Poland To Open State Oil Fields

By Cable from Reuters to Engineering and Mining Journal-Press

London, April 10—According to a dispatch received from Warsaw, the government has decided to open the state oil fields in southern Poland to private exploitation. The production of petroleum in Poland last year declined approximately one-third, as compared with the output for 1920.

Replogle Acquires Empire Steel and Iron Co.

The Replogle Steel Co. has acquired the Empire Steel & Iron Co. The former controls the Wharton Steel Co., which owns the Replogle or Scrub Oak mine near Wharton, N. J., as well as two modern furnaces at Wharton. The Empire company operates the Mt. Hope and Washington mines in the same state. The purchase will add 250,000 tons to the producing capacity of the Replogle company. The latter has also secured control of the Mt. Hope Mineral Railroad. Leonard Peckitt, president of the Empire Steel & Iron Co., will be elected president of the Replogle Steel Co.

Consolidated Arizona Holdings Sold Despite Tax Lien

By Telegraph to Engineering and Mining Journal-Press

Prescott, Ariz., April 10—The property of the Consolidated Arizona Smelting Co. at Humboldt, Ariz., was sold at Prescott on April 7 to J. L. McNeil, a Colorado banker representing the Southwest Metals Co., for $1,000,000. This was the only bid made at the sale. Robert M. Thompson, of New York, was also one of the leading backers of the new corporation. G. M. Colvocoresses, who has been receiver, will be general manager of the new corporation. He says that the $600,000 claim of the Government for excess taxes is not warrantable, and can be settled satisfactorily. It is planned to start the smelter about June 1.

Magma Copper Bonds Offered

Directors of the Magma Copper Co. have authorized the issue of $3,600,000 ten-year 7 per cent convertible debenture bonds, convertible into stock on the basis of thirty shares for each $1,000 bond or fifteen shares for each $500 bond. The bonds will be offered to stockholders for subscription and arrangments to underwrite the issue have been made.

Anaconda Co.'s Tailings Plant About to Resume

By Telegraph to Engineering and Mining Journal-Press

Butte, Mont., April 11—The Anaconda Copper Mining Co. will ship sixteen carloads of copper wire and rods to London, beginning April 12, on a rush order. The company's slime and tailings plant is preparing to resume and will treat 3,200 tons daily.

Argument Heard in Tom Reed Apex Case

By Telegraph to Engineering and Mining Journal-Press

Phoenix, Ariz., April 10—The Supreme Court of Arizona has heard the argument in the apex case of the Tom Reed Gold Mines Co. against the United Eastern Mining Co.

Japan Increases Duty on Copper

Japan has put into effect decided increases in the rates of duty applying to copper, according to cable advices to the Department of Commerce. The rate on copper ingots and slabs has been increased from 60c. a picul (133 lb.) to $3.50 per picul. The increase on copper bars and rods is from $4.45 to $7.50 a picul. The increase on copper plates and sheets is from $4.98 to $8 a picul. The cable dispatch states that the action is necessary to protect Japan's domestic copper industry.

Calumet & Jerome Defendants Make Answer

Answer has been made by the defendants in the Superior Court at Prescott, Ariz., in the case of J. O. Brown against the Calumet & Jerome Copper Co., George W. Avery, George H. Avery, and Joe Larson. It is asserted that Brown is merely a dummy stockholder, representing brokers, that the Averys have been directors ever since organization of the corporation in 1907, that much development work has been done, that there are no debts or bonds outstanding, and that the suit was instituted at the instance of certain New York brokers who became incensed when they were not given a contract to refinance the company.

News from Washington

By PAUL WOOTON
Special Correspondent

Senate Committee Reports Tariff Bill With Many Changes

Elasticity Secured by Powers Granted to President—American Valuation Abandoned—Bonded Warehouse Provision Rewritten—10 Per Cent Duty on Cyanide

IN AN EFFORT to meet an unprecedented economic situation, the Senate Finance Committee, after nearly nine months of study, has reported out an elastic tariff. To give the final draft of the measure the flexibility which the Senate committee believes to be necessary, fundamental changes had to be made in the bill which was passed by the House of Representatives last July.

AD VALOREM DUTIES BASED ON FOREIGN VALUE

The Finance Committee based ad valorem rates on the foreign values of imported merchandise. The American valuation plan as embodied in the bill passed by the House was abandoned because of the limited number of exactly comparable domestic and foreign products and the difficulty and probable litigation involved in defining comparability to the satisfaction of importers, domestic manufacturers, and customs officials. The committee feared disturbance to business while these difficulties were being adjusted.

Chairman McCumber states that the plan of assessing ad valorem duties on the American selling price of the imported articles was abandoned largely because of the unstable basis for assessing duties growing out of the importers' profits when selling in the American market. In many instances, he states, the importer's margin was over 100 per cent of the foreign cost price. A painstaking investigation of the question of margins between the foreign price of an article and the importer's selling price in this country was conducted for the benefit of the committee. In the light of the information thus disclosed it was decided to be far better to use the time-tried method of foreign valuation.

Elasticity in the tariff has been provided, the committee believes, by authorizing the President to modify rates within prescribed limits; to change the basis of ad valorem duties on certain items from the foreign value to the value of the domestic article in the American market; to impose penalty duties and prohibit the importation of particular goods; and to impose additional duties against any country which discriminates against the United States.

Never before in the history of tariff making has there been such acute conflict between the domestic mining industries and the consumers of mineral raw materials. The Senate committee made a large number of important changes in the House bill. Tin was put back on the free list. Arsenic, bismuth and cadmium, which formerly were on the free list, were made dutiable. The duty on magnesium metal was reduced by one-half. The quicksilver duty was reduced from 35c. to 25c. per lb., but a corresponding compensatory duty was placed on fulminate of mercury and other products containing quicksilver. The rates on zinc metal were increased slightly by the Senate committee so as to make them higher than the rates applying to the ore. Manganese ore and iron pyrites were placed on the free list. The House rates on tungsten ore were retained, but the specific rate on ferrotungsten was reduced. The rate on magnesite was fixed at four-tenths of a cent a pound in an effort to place the domestic product on an equal basis with the material imported from Central Europe at the chief steel-producing centers in the United States.

10 PER CENT DUTY ON CYANIDE

One of the surprises of the bill was the action of the Senate committee in making cyanide dutiable at 10 per cent ad valorem.

The rates of duty on metals and ores and other articles of concern to the mining industry, as contained in the bill, are as follows (the items are mentioned in the order in which they appear in the bill):

Refined bauxite, ½c. per lb.; potassium, aluminum sulphate, ¾c. per lb.

Antimony oxide, 1½c. per lb. and 25 per cent ad valorem.

Chemical compounds, mixtures and salts, of which gold, platinum, rhodium, or silver constitute the element of chief value, 25 per cent ad valorem.

Cobalt oxide, 20c. per lb.

Potassium cyanide, sodium cyanide, all cyanide salts, and cyanide mixtures, combinations, and compounds containing cyanide, 10 per cent ad valorem.

White acetate of lead, 2½c. per lb.; brown, gray or yellow acetate, 2c. per lb.; nitrate, arsenate and resinate, 3c. per lb. All other lead compounds not provided for, 30 per cent ad valorem.

Morate, resinate, sulphate and all other manganese compounds and salts not especially provided for, 25 per cent ad valorem.

Calcined magnesia, not suitable for medical use, ¾c. per lb.

Phosphorus, 8c. per lb.

Barytes ore, crude or unmanufactured, $5 per ton; ground or otherwise manufactured, $10 per ton; precipitated barium sulphate, 1¼c. per lb.

Litharge, 2½c. per lb.; orange mineral, 3c. per lb.; red lead, 2¾c. per lb.; white lead, 2½c. per lb.

Zinc oxide and leaded zinc oxides, containing not more than 25 per cent of lead, 1¾c. per lb.; mixed with oil or water, 2¼c. per lb.; lithopone and other combinations or mixtures of zinc sulphide and barium sulphate, 1¾c. per lb.

Strontium, carbonate, nitrate and oxide, 50 per cent ad valorem.

Thorium nitrate, oxide and other salts of thorium, cerium nitrate, cerium fluoride and other salts of cerium, 45 per cent ad valorem.

Magnesite brick, 1/10c. per lb., and 10 per cent ad valorem. Chrome brick, not glazed, 25 per cent ad valorem; glazed, 35 per cent ad valorem.

⅝C. PER LB. ON CALCINED MAGNESITE

Crude magnesite, 5/16c. per lb.; caustic, calcined magnesite, ⅝c. per lb.; dead-burned and grained magnesite, not suitable for manufacture into oxychloride cements, 4/10c. per lb.

Crude gypsum, 25c. per ton; ground or calcined, $1.40 per ton.

Pumice stone, unmanufactured, valued at $15 or less per ton, 1/10c. per lb.; valued at more than $15 per ton, ¼c. per lb.

Mica, unmanufactured, valued at not above 15c. per lb., 4c. per lb.; valued above 15c. per lb. 25 per cent ad valorem; cut or trimmed and mica splittings, 30 per cent ad valorem; mica plates and built-up mica, 40 per cent ad valorem; ground mica, 20 per cent ad valorem.

Talc, crude and unground, ¼c. per lb.

Graphite or plumbago, crude or refined: Amorphous, 10 per cent ad valorem; crystalline, crystalline lump, chipped or dust, 20 per cent ad valorem; crystalline flake, 2c. per lb. The term "crystalline flake" as used by the Senate committee is specified to mean "graphite or plumbago which occurs disseminated as a relatively thin plate throughout its containing rock, decomposed or not, and which may be or has been separated therefrom by ordinary crushing, pulverizing, screening or mechanical concentration process, such flake being made up of a number of parallel laminæ, which may be separated by mechanical means."

Metallurgical and chemical articles and utensils of all kinds, finished or unfinished, composed wholly or in chief value of glass or paste, 75 per cent ad valorem.

Spiegeleisen containing more than 1 per cent of carbon, $1.25. Spiegeleisen for the purpose of the act is specified to be "an iron-manganese alloy containing less than 30 per cent manganese."

Molybdenum ore or concentrates, 75c. per lb. on the metallic molybdenum contained therein.

45c. Duty on Tungsten Ore

Tungsten ore or concentrates, 45c. per lb. on the metallic tungsten contained therein.

Ferromanganese containing more than 1 per cent carbon, $2.50 per ton. Ferromanganese for the purpose of the act is specified to be "such iron-manganese alloys as contain 30 per cent or more of manganese."

Manganese metal, manganese silicon, manganese boron, and ferromanganese and spiegeleisen containing not more than 1 per cent of carbon, 20 per cent ad valorem.

Ferrotungsten, metallic tungsten, molybdenum, molybdenum powder, calcium molybdate and all other compounds and alloys of molybdenum, $1 per lb. on the molybdenum contained therein and 15 per cent ad valorem.

Ferrotungsten, metallic tungsten, tungsten powder, tungstic acid, and all other compounds of tungsten, 60c. per lb. on the tungsten contained therein and 25 per cent ad valorem.

Ferrochromium-tungsten, chromium-tungsten, chromium-cobalt-tungsten, tungsten-nickel and all other alloys of tungsten not specially provided for, 60c. per lb. on the tungsten contained therein and 25 per cent ad valorem.

Ferrosilicon, containing 8 per cent or more of silicon, and less than 60 per cent, 2c. per lb. on the silicon contained therein; containing 60 per cent or more of silicon, and less than 80 per cent, 3c. per lb. on the silicon contained therein; containing 80 per cent or more of silicon, and less than 90 per cent, 4c. per lb. on the silicon contained therein; containing 90 per cent or more of silicon, and silicon metal, 8c. per lb. on the silicon contained therein.

Ferrochrome or ferrochromium containing 3 per cent or more of carbon, 3½c. per lb. on the chromium contained therein; containing less than 3 per cent of carbon, and chrome or chromium metal, 30 per cent ad valorem.

Ferrophosphorus, ferrotitanium, ferrovanadium, ferro-uranium, ferrozirconium, zirconium-ferrosilicon, ferroboron, titanium, zirconium, tantalum, chromium-nickel, vanadium-nickel, zirconium-nickel, chromium-vanadium, chromium-silicon, zirconium-silicon, calcium-silicon, and all alloys used in the manufacture of steel not specially provided for, 30 per cent ad valorem.

Cerium metal, $2 per lb.; ferrocerium and all other cerium alloys, $2 per lb. and 25 per cent ad valorem.

Steel containing more than six-tenths of 1 per cent of nickel, cobalt, vanadium, chromium, tungsten, molybdenum, or any other metallic element used in alloying steel, 10 per cent ad valorem, in addition to other rates prescribed. An additional cumulative duty of $1.25 per lb. on the molybdenum content in excess of six-tenths of 1 per cent is to be levied and 72c. per lb. on the tungsten content in excess of six-tenths of 1 per cent.

Duty on Laboratory Instruments

Scientific and laboratory instruments, apparatus and utensils, not specially provided for, 55 per cent ad valorem.

Aluminum, aluminum scrap and alloys of any kind in which aluminum is the component material of chief value, in crude form, 5c. per lb.; in coils, plates, sheets, bars, rods, circles, disks, blanks, strips, rectangles and squares, 9c. per lb.

Metallic magnesium, 50c. per lb.; magnesium alloys, 50c. per lb., and 20 per cent ad valorem.

Antimony, as regulus or metal, 2c. per lb.; needle or liquated antimony, ¾c. per lb.

Bismuth, 7½ per cent ad valorem.

Cadmium, 15c. per lb.

Metallic arsenic, 6c. per lb.

German silver, or nickel silver, unmanufactured, 20 per cent ad valorem; nickel silver in sheets, strips, rods, and wire, 30 per cent ad valorem.

Duty on Copper Products

Copper in rolls, rods or sheets, 2½c. per lb.; copper engravers' plates, not ground, and seamless copper tubes and tubing, 7c. per lb.; copper engravers' plates, ground, and brazed copper tubes, 11c. per lb.; brass rods, sheet brass, brass plates, bars, strips, etc., 4c. per lb.; seamless brass tubes and tubing, 8c. per lb.; brazed brass tubes, brass angles and channels, 12c. per lb.; bronze rods and sheets, 4c. per lb.; bronze tubes, 8c. per lb.

Aluminum or tin foil, less than six one-thousandths of an inch in thickness, 35 per cent ad valorem; bronze powder, aluminum powder, powdered foil, powdered tin, brocades, flitters and metallics, manufactured in whole or in part, 16c. per lb.; bronze or Dutch metal, or aluminum in leaf, 8c. per 100 leaves.

Gold leaf, 60c. per 100 leaves.

Silver leaf, 5c. per 100 leaves.

Quicksilver, 25c. per lb.

Azides, fulminates, fulminating powder and other like articles not specifically provided for, 12½c. per lb.

1½c. Duty on Lead Ores

Lead-bearing ores and mattes of all kinds, 1½c. per lb. on the lead contained therein: *Provided*, That such duty shall not be applied to the lead contained in copper mattes until after 2,000 tons of such lead shall have been imported in any one year, to be allocated under rules and regulations to be prescribed by the Secretary of the Treasury: *Provided further*, That on all importations of lead-bearing ores and mattes of all kinds the duties shall be estimated at the port of entry and a bond given in double the amount of such estimated duties for the transportation of the ores or mattes by common carriers bonded for the transportation of appraised or unappraised merchandise to properly equipped sampling or smelting establishments, whether designated as bonded warehouses or otherwise. On the arrival of the ores or mattes at such establishments they shall be sampled according to commercial methods under the supervision of Government officers, who shall be stationed at such establishments, and who shall submit the sample thus obtained to a Government assayer, designated by the Secretary of the Treasury, who shall make a proper assay of the sample and report the result to the proper customs officers, and the import entries shall be liquidated thereon. And the Secretary of the Treasury is authorized to make all necessary regulations to enforce the provisions of this paragraph.

2⅛c. Per Lb. on Lead in Bullion

Lead bullion or base bullion, lead in pigs and bars, lead dross, reclaimed lead, scrap lead, antimonial lead, antimonial scrap lead, type metal, babbitt metal, solder, all alloys or combinations of lead not specially provided for, 2⅛c. per lb. on the lead contained therein; lead in sheets, pipe, shot, glazier's lead, and lead wire, 2⅝c. per lb.

Zinc Ores Under 10 Per Cent Free

Zinc-bearing ore of all kinds, containing less than 10 per cent of zinc, shall be admitted free of duty; containing 10 per cent or more of zinc and less than 20 per cent, ½c. per lb. on the zinc contained therein; containing 20 per cent or more of zinc and less than 25 per cent, 1c. per lb. on the zinc contained therein; containing 25 per cent of zinc, or more, 1½c. per lb. on the zinc contained therein: *Provided*, That on all importations of zinc-bearing ores the duties shall be estimated at the port of entry, and a bond given in double the amount of such estimated duties for the transportation of the ores by common carriers bonded for the transportation of appraised or unappraised merchandise to properly equipped sampling or smelting establishments, whether designated as bonded warehouses or otherwise. On the arrival of the ores at such establishments they shall be sampled according to commercial methods under the supervision of Government officers, who shall be stationed at such establishments, and who shall submit the samples thus obtained to a Government assayer, designated by the Secretary of the Treasury, who shall make a proper assay of the sample and report the result to the proper customs officers, and the import entries shall be liquidated thereon. And the Secretary of the Treasury is authorized to make all necessary regulations to enforce the provisions of this paragraph.

Zinc in blocks, pigs, or slabs, and zinc dust, 1⅝c. per lb.; in sheets, 1¾c. per lb.; in sheets coated or plated with nickel or other metal (except gold, silver, or platinum), or solutions, 2c. per lb.; old and worn-out, fit only to be remanufactured, 1c. per lb.: *Provided*, That for a period of two years beginning on the day following the enactment of this act the rates of duty shall be as follows: On zinc in blocks, pigs, [illegible] slabs, and old and worn out, fit only to be remanufactured, 2[illegible] per lb.; zinc in sheets, plates, strips, or coils, plated with nickel or other base metals, or in fabricated form, and zinc dust, [illegible] per lb.

Emery, corundum, and artificial abrasives, ground, pulverized, refined or manufactured, 1c. per lb.

MANY PRODUCTS ON FREE LIST

Among the articles on the free list are the following: Agates, unmanufactured; antimony ore; sulphide of arsenic; quicksilver flasks which have been exported from the United States; asbestos, unmanufactured; borax, crude; brass, fit only for remanufacture; Brazilian pebble; bullion, gold or silver; cerite or cerium ore; chalk, crude; chromite, or chrome ore; coal and coke; cobalt and cobalt ore; composition metal of which copper is the component material of chief value.

Also copper ore, regulus, black or coarse copper, copper cement, old copper and copper in plates, bars, ingots, or pigs not manufactured.

Also metallic mineral substances in a crude state, and metals unwrought, whether capable of being wrought or not; emery ore, corundum and crude artificial abrasives.

EXPLOSIVES ON FREE LIST; ALSO PETROLEUM

Gunpowder and all other explosive substances used for mining, blasting or artillery purposes.

Iridium, osmium, palladium, rhodium, and ruthenium and native combinations thereof with one another or with platinum.

Iron ore, including manganiferous iron ore and the dross or residuum from burnt pyrites.

Manganese, oxide and ore of.

Minerals, crude, or not advanced in value or condition by refining or grinding.

Monazite sand and other thorium ores.

Petroleum, crude, fuel or refined.

Ores of gold, silver or nickel; nickel matte; ores of the platinum metals; sweepings of gold and silver.

Platinum, unmanufactured or in ingots, bars, sheets or plates, not less than ⅛ in. in thickness, sponge or scrap; potassium, nitrate, crude.

Sulphur in any form, and sulphur ore, such as pyrites or sulphuret of iron in its natural state, and spent oxide of iron containing more than 25 per cent of sulphur.

Tin ore and black oxide of tin; tin in bars, blocks or pigs and grain or granulated and scrap tin.

Uranium, oxide and salts of.

DUTY ON POTASH FOR FIVE YEARS

Potash is grouped with the free list articles but carries a provision for duties during a period of five years. The paragraph reads as follows:

"Potassium chloride or muriate of potash, potassium sulphate, kainite, wood ashes and beet-root ashes, and all crude potash salts not specially provided for: *Provided*, That for a period of five years beginning on the day following the passage of this act there shall be levied, collected, and paid, on the actual potash (potassium oxide) content of all the foregoing a duty of 2½c. per lb. for the first two years; 2c. per lb. for the third year; 1½c. per lb. for the fourth year; and 1c. per lb. for the fifth year: *Provided further*, That thereafter the said potash content shall be free of duty."

DUTY ON TIN WHEN U. S. MINES PRODUCE 1,500 TONS PER YEAR

Tin ore is put on the free list with the following proviso: *Provided*, That there shall be imposed and paid upon cassiterite, or black oxide of tin, a duty of 4c. per lb. and upon bar, block, pig tin and grain or granulated, a duty of 6c. per lb. when it is made to appear to the satisfaction of the President of the United States that the mines of the United States are producing 1,500 tons of cassiterite and bar, block, and pig tin per year. The President shall make known this fact by proclamation, and thereafter said duties shall go into effect.

BONDED WAREHOUSE PROVISION CHANGED

The Senate committee rewrote the provision in the House bill with regard to bonded smelting warehouses. As altered by the Senate, a commercial assay rather than a wet assay is provided. The text of the Senate provision is as follows:

"That the works of manufacturers engaged in smelting or refining, or both, of ores and crude metals, may upon the giving of satisfactory bonds, be designated as bonded smelting warehouses. Ores or crude metals may be removed from the vessel or other vehicle in which imported, or from a bonded warehouse, into a bonded smelting warehouse without the payment of duties thereon, and there smelted or refined, or both, together with ores or crude metals of home or foreign production: *Provided*, That the bonds shall be charged with a sum equal in amount to the regular duties which would have been payable on such ores and crude metals if entered for consumption at the time of their importation, and the several charges against such bonds shall be canceled upon the exportation or delivery to a bonded manufacturing warehouse established under the preceding section of this title of a quantity of the same kind of metal equal to the quantity of metal producible from the smelting or refining, or both, of the dutiable metal contained in such ores or crude metals, due allowance being made of the smelter wastage as ascertained from time to time by the Secretary of the Treasury: *Provided further*, That the said metals so producible, or any portion thereof, may be withdrawn for domestic consumption or transferred to a bonded customs warehouse and withdrawn therefrom and the several charges against the bonds canceled upon the payment of the duties chargeable against an equivalent amount of ores or crude metals from which said metal would be producible in their condition as imported: *Provided further*, That on the arrival of the ores and crude metals at such establishments they shall be sampled and assayed according to commercial methods under the supervision of Government officers: *Provided further*, That all labor performed and services rendered pursuant to this section shall be under the supervision of an officer of the customs, to be appointed by the Secretary of the Treasury and at the expense of the manufacturer: *Provided further*, That all regulations for the carrying out of this section shall be prescribed by the Secretary of the Treasury: *And provided further*, That the several charges against the bonds of any smelting warehouse established under the provisions of this section may be canceled upon the exportation or transfer to a bonded manufacturing warehouse from any other bonded smelting warehouse established under this section of a quantity of the same kind of metal, in excess of that covered by open bonds, equal to the amount of metal producible from the smelting or refining, or both, of the dutiable metal contained in the imported ores and crude metals, due allowance being made of the smelter wastage as ascertained from time to time by the Secretary of the Treasury."

I. C. C. Members Differ on Freight Rate Reductions

Decided differences of opinion exist among the members of the Interstate Commerce Commission in the matter of the proposed reduction in rates. Rumor has it that certain members believe that the railroads can afford no reductions at this time. Some believe rates can be reduced on basic commodities and others believe there should be a general reduction on all commodities. With such a situation existing it is obvious that a considerable delay may ensue. So far as coal is concerned, the psychological moment was passed when the decision was not handed down on April 1. Had it not been for the strike, the delay in handing down this opinion would have had a serious effect on the coal industry. The delay is discouraging buying of a large number of commodities.

It may be that the Interstate Commerce Commission will await the action of the Railroad Labor Board, as the decision in regard to wages has an important bearing on rates.

Colorado River Commission To Meet Aug. 1

The Colorado River Commission, of which Mr. Hoover is chairman, and whose business is responsible for his recent trip to the West, will meet again Aug. 1 at Santa Fe, N. M., to sum up details and report on the development project.

Government's Silver Purchases

Purchases of silver by the Bureau of the Mint during the week ended April 8 amounted to 123,000 fine ounces. This brings the total purchases under the Pittman Act to 101,608,608, fine ounces.

Joint Rates to Foreign Points Considered by I. C. C.

Decision in International Nickel Case of Interest to Shippers Between U. S. and Mexico.

As there is difference of opinion among members of the Interstate Commerce Commission as to the interpretation of the Transportation Act with regard to jurisdiction over rates when part of the transportation takes place within a foreign country, the commission itself, in a decision rendered in the case of the International Nickel Co. vs. the Director General of Railroads, expresses the desire that the question be reviewed by the courts, so that they may establish judicially the extent of the commission's jurisdiction.

In the decision mentioned, the commission ordered reparation paid to the International Nickel Co. to cover unreasonable rates charged on blister copper, in carloads, from Port Colborne, Ont., to Constable Hook and Chrome, N. J. "The Grand Trunk hauled the shipments a little more than twenty miles, or less than 5 per cent of the total distance, but received as its division 35 per cent of the total revenue," says the opinion. "We must consider the reasonableness of the joint rate as a whole. We find that the charges assailed were unreasonable to the extent that they exceeded those that would have accrued at a rate of 23.5c per 100 lb." Commissioner Esch, dissenting, says, "It is clear from the report of the majority that the unreasonableness of the through rates assailed inhered in the divisions received for that part of the transportation which took place within Canada and that the charges received for that part of the transportation within the United States were not unreasonable."

The majority, however, bases its contention on previous decisions in which the position was taken that parties to a through rate are jointly and severally responsible for any damage that may result to a shipper on account of unreasonable charges. As the commission is without power to enforce an order against a Canadian or a Mexican railroad, it can hold the American participants in the rate severally responsible. Owing to the amount of the traffic in metals and ores between Mexico and the United States, the following excerpt which was cited by the commission in the International Nickel case is of pertinent interest:

"If the American line saw fit, it might doubtless name a rate to the Mexican border, and in that event we could deal only with the service up to the Mexican line. Instead of adopting that course the American carriers, in connection with the Mexican carrier, established a joint charge for the entire service from the point in the United States to the point in Mexico, and gave no information as to the part of that charge which would accrue to the American roads. This does not relieve the American carriers from obligation to impose a reasonable charge for their service; it does make it impossible for the commission to determine the reasonableness of that charge, except by examining the entire through rate.

"Clearly, we have no authority to establish a rate of transportation in Mexico; nor to order the maintenance of a rate for the future from a point in the United States to a point in Mexico; but we may require the American carriers to cease and desist from continuing to apply a joint through rate, or any rule, regulation, or practice in connection with that joint through rate, and we may, where such rate has been voluntarily maintained, inquire whether it has been reasonable, and if found unreasonable, award damages in that behalf."

Three War Mineral Awards Made

Awards recommended by the War Minerals Relief commissioner during the week ended April 8 were as follows: Frank Rose, $593.24; C. B. Parrott, $287.90 and Mrs. Maude E. Sisson, widow of Charles Sisson, $285.

Foreign Trade Increase Due to Mineral Shipments

An analysis of the increases in our foreign trade, Director George Otis Smith, of the U. S. Geological Survey, points out, shows them to be composed almost entirely of shipments of mineral products. Exports of agricultural and forest products contribute nothing to the increase. This leads Director Smith to ask if we are not basing our foreign trade too much on those crops of which there can be but one harvest.

Has Flotation Gone Too Far?

In view of suggestions and observations from various quarters, the question is asked at the Bureau of Mines if flotation has not gone too far in supplanting other methods of treating certain ores. There is a feeling that it is being overdone in some operations where good, clean mill work under the old system would result in greater profits. Though there is no tendency to dispute the important place that flotation holds, attention is directed to the fact that it is not the sole method of ore beneficiation.

Money Sought for Road Building in Alaska

To expedite the construction of roads, bridges, and trails in Alaska during the remainder of the current fiscal year, an effort is being made to put through legislation which will allow the board of Road Commissioners of the Territory to incur obligations prior to July 1 and make the payments out of the appropriations for the next fiscal year.

Mine Rescue Cars to Oil Fields

Owing to the demand in the oil fields and at the refineries for first-aid training, the Bureau of Mines has taken advantage of the idleness of coal mines in union territory to send several mine rescue cars into the oil fields. Another car is being sent into the lead district of southeastern Missouri on a similar mission.

Trade Association Legislation Proposed in Congress

Edge and McArthur Bills Put Such Bodies Under Federal Commission —Prosecution of Some Possible

Legislation defining the status of trade associations has been proposed in Congress by Senator Edge, of New Jersey, and Representative McArthur, of Oregon. They propose an investigation by a Congressional commission composed of three Senators and three Representatives of existing condition of industry and commerce, requiring it to report by December next legislation defining the rights and limitations of co-operative organizations as distinguished from illegal combinations in restraint of trade. Such legislation would be designed to limit monopolies; eliminate waste in production and distribution; lower costs; simplify and standardize methods, and increase efficiency. The resolution proposing the investigation points out that business is now hesitating because it is unable to secure guidance which will clearly indicate proper lines of conduct.

The Edge and McArthur bills propose that trade associations shall be under the jurisdiction of the Federal Trade Commission. Exception is made of labor unions, associations of bankers or of railroads, or organizations for social, charitable or scientific purposes. Unless excused by it, each association would be required to file with the Federal Trade Commission a statement of its general character and proposed activities, the names and addresses of its members, officers, minutes of meetings and resolutions or agreement, express or implied, whether between members of the association or between the association or its members and others.

The bills would also require trade associations to file with the commission statistics collected by it as to production, shipments, stocks, contracts, prices, credit information, and all others respecting the trade. The commission may, if it sees fit, give publicity to such statistics for the public interest, and unless prohibited by [illegible] association may [illegible] members sta[illegible] filed with the commission. The bills would also authorize the commission to have one of its representatives at any meetings of the associations.

Representatives of the Department of Justice recently told the House Appropriations Committee that a large percentage of the business of the country is carried on by business men who belong to various trade associations. They said that the high cost of living is due in very large measure to activities of these associations. The department is investigating these associations on the theory that the recent Supreme Court decision in the lumber case does not close the door, and members representing associations consider that it does not apply to them. If given sufficient funds the department representatives said they would proceed energetically against some associations.

News by Mining Districts

London Letter

Globe & Phoenix' Report Shows Poorer Position—Mysore Gold Mining Co.'s 1921 Output Smallest Since 1903

By W. A. Doman

London March 31—On more than one occasion I have referred to the technical position of the Globe & Phoenix Gold Mining Co. (in Rhodesia), pointing out that with each development report the position appeared to become less satisfactory. The annual report and accounts have now been issued, and the view I have taken is fully corroborated. If one looks at the ore-reserve position, it is seen that, though the total ore developed as at Dec. 31 last shows a fairly substantial increase over the quantity developed twelve months ago, the value is considerably less. This will be apparent from the following: At December, 1920, the total ore was 93,872 tons, containing 145,321 oz., or an average of 1.548 oz. per ton, whereas at the end of December last the aggregate was 110,000 tons, containing 140,100 oz., equal to 1.273 oz. per ton. Taken as an average, this last-mentioned value is good, but the position alters when we look at the available ore.

At the end of 1920 the available ore was 47,380 tons, containing 62,753 oz. of gold, equal to 1.324 oz. per ton, and in the latest report the available ore has risen to 62,000 tons, containing 58,300 oz., or only .940 oz. per ton. The ore in pillars, and therefore unavailable, is 48,000 tons, containing 81,800 oz.

Last year the new tonnage brought in was 82,935, or approximately 16,000 tons above the quantity milled. The cost of this new ore was £27,728, of which £19,723 was redeemed, leaving £8,000 added to the previous figure in the balance sheet, so that the total of development is now valued at £31,131.

Owing to a strike on the mine early in the year, and to heavy taxation, plus a fall in the gold premium, profits were reduced considerably, for the net amount last year was only £82,121, as against £254,374 in 1920. For 1921 two interim dividends totaling £80,000 were paid, and this would not have been possible had it not been for the gold premium of £77,250. At the standard price of gold, the output realized £289,437, and as the total available ore has a value at standard price of only £244,860, it follows that no final dividend is recommended. In point of fact, it was necessary, to show a good liquid position, to transfer £10,000 from the special development reserve of £100,000 to profit and loss account. This special development reserve was for the purpose indicated by the title, and the fact that 10 per cent of it has had to be taken for general purposes is regarded as rather discouraging. A considerable amount of development work was accomplished, but, generally speaking, it was unsatisfactory.

The principal operations were on the fourteenth level drive, in which, both north and south, 395 ft. were driven, of which 160 ft. were payable. David P. McDonald does not despair altogether, for he states that "at the bottom of the mine the reef maintains its patchy character, occasional good patches encouraging the hope that a new shoot may be near. From the appearance of the reef and its walls, the much-desired improvement in value may well be expected."

During 1921 the Mysore Gold Mining Co. crushed a smaller tonnage than in any year since 1903, the quantity being 202,289 tons, against 233,503 tons in 1920, and the yield 129,686 oz., in comparison with 156,800 oz. The revenue expenses per ton were 45s. 11d., or 3s. 7d. above the previous year's figure. The decline in the yield was due partly to a falling off in the gold content of the ore from 9 dwt. to 8.4 dwt. A favorable factor in working costs was the lower value of the rupee, the average of the exchange quotations during the year having been 1s. 4⅜d. while costs were increased owing to the greater amount of development work done, the addition being 6,691 ft. at 18,428 ft. The reserves of ore were estimated at the end of the year at 837 000 tons, as compared with 841,000 tons twelve months earlier.

SCANDINAVIA

Inquiry Into Kristianssand Company's Relation With British America Nickel Co. Ended

From Our Special Correspondent

Christiania—With the end of March the labors of the Government committee of inquiry into what, in Scandinavian circles, is termed the "nickel affair" provisionally came to an end. The documents in the case have undergone scrutiny and the parties alleged to have been implicated have been granted time to furnish their statements in writing, after which the committee will resume its sittings.

The committee, after a cabinet meeting, was, by royal decree, on March 8 appointed to make searching inquiry into, and pronounce its critical judgment on the Kristianssand Nikkel Raffineries Verk's and its trusted agents' relations with the British America Nickel Corporation, and the financing of the latter with the help of Norwegian capital.

The presence in the Norwegian parliament (Storthing) of twenty-nine Communist members plus eight Socialists renders the government one of compromise, and accounts for the haste of the ministry to take up the nickel affair, and, if necessary, throw any possible delinquents to the wolves.

The production of the Kongsberg Silver Mines, in Norway, in January, was: Kongens mine 543 kg.; Gottes Hülfe mine, 535 kg.; Gottes Gabe mine, 197 kg., and Samuel mine 1,017 kg. Total, 2,292 kg. of silver.

AUSTRALIA

Queensland

Mount Morgan Working Under Subsidy—New York Money Not for Steel Project

From Our Special Correspondent

Brisbane, Feb. 18—Work has been resumed at Mount Morgan mine. It will be two or three weeks before operations are in full swing. The government has increased from £1,000 to £1,100 per week the subsidy which it had promised to contribute to lessen the reduction in wages asked for by the company, and this has permitted the subsidy to be distributed among all employees instead of being limited to those coming under the industrial award, as had previously been insisted on by the labor unions. The company at first asked for a 20 per cent reduction in wages. The government subsidy will enable it to secure practically this reduction, but the men's wages will be actually reduced by an amount ranging from only 5 to 8 per cent. The government is also spending money at Chillagoe unprofitably to provide men with work, and as a result some people are demanding that it shall also bolster up other big companies, such as Mount Cuthbert, Hampden-Conclurry, and Mount Elliott, so that they also may resume operations, even with the price of copper down to a point as low as £58 per ton.

Some time ago the state government took over the copper mines known as the Mungana group, near the Chillagoe state smelter, paying a royalty on the output and having the option of purchase if developments proved satisfactory. These mines, with the Einasleigh copper mines, have been the chief source of ore supplies for the smelter. The Mines Department, on behalf of the government, has now purchased the mines outright and increased the force so that there may be ore enough to keep the furnaces running continously once they start.

Although the Queensland government has secured a second loan from New York, (£2,000,000), it is not intended to spend any of it on the proposed iron and steel works at Bowen, as it was thought would be done. Instead, the money is to be devoted to a big land settlement scheme and to the construction of railways, which will give work for the unemployed, who are far too numerous just now.

KOREA

Oriental Consolidated's March Clean-up Shows Improvement

Unsankinko—The March clean-up of the Oriental Consolidated Mining Co. was $91,000. A total of $73,703 was obtained in February, the mill tonnage being 14,428. The new Tabowie shaft was deepened 150 ft. in February and now lacks 400 ft. of reaching its objective.

CANADA

British Columbia

Cerk Province May Resume Soon—Silversmith Running Steadily—Operators Ask Duty on Copper Product

Kaslo—The Cork-Province Mines, Ltd., owning extensive holdings on the South Fork of Kaslo Creek, plans resumption of operations about May 1. The property is equipped with a modern mill, and after some cleaning up and a little development will be in shape to make shipments. It has been on the inactive list for over two years.

Revelstoke—This season promises a decided revival of mining in the Big Ben country, north of this point. San Francisco capital is interested in leases of placer ground on what is known as Goldstream. Extensive tests made in 1916 are reported as being sufficiently encouraging to warrant undertaking dredging operations. Lode-mining activities in and around Revelstoke also promise interesting developments this season.

Trail—One of the chief hindrances to profitable handling of the Rossland ores at the Trail smelter is the high price of coke, which now costs $14 per ton, as against $7 per ton in pre-war times.

Ore shipments received by the Consolidated smelter March 22 to 31 totaled 13,168 tons, of which the company mines produced 13,151 tons, the Anna mine, Slocan City, 6 tons, and the Ottawa, at Slocan City, 11 tons.

Sandon—Since starting operations with the new mill early in the year, the Silversmith has had no difficulty in maintaining an output of approximately 400 tons per month. The concentrate is of high grade. Development of the mine is showing an additional increase in ore reserves. Up to the end of March the mill had not been operated to capacity, but it is likely that during the spring and summer a monthly production of around 500 tons of crude ore and concentrate will be maintained.

New Denver—Petitions are being circulated throughout the Slocan, and receiving numerous signatures, requesting the dominion government to abolish the 1c. per lb. duty on lead returned to Canada after being smelted from Canadian ores at American smelting and refining plants.

Grand Forks—An investigation has been made recently of the Granby smelter dam, on behalf of the Granby company and the provincial government.

Victoria—The Associated Boards of Trade of British Columbia, representing 40 boards of trade of every part of the province, at the annual meeting held March 30 passed a resolution requesting the dominion government to impose adequate duties on copper bars, copper rods, scrap copper and brass, sheet zinc and sulphate of lead.

Nelson—Completion of the raise between No. 2 and No. 3 levels of California mine, on Giveout Creek, three miles from this city, by the end of March, placed the property in good condition for continuous production. The California company has been developing since 1917 and secured a lease of the Athabasca mill, which has been remodeled. The plant has a capacity of 50 tons per day, and the ore will concentrate 5 to 1, mill heads averaging about $20 per ton. It is planned to start milling early in May.

Three Forks—Several of the towers of the aërial tramway connecting the Queen Bess and Idaho-Alamo mines with the Cunningham mill at Alamo were taken out by slides the latter part of March.

Britannia Beach—N. J. Quigley, vice-president of the Britannia Mining & Smelting Co. has been inspecting the company's properties on Howe Sound. Rebuilding operations are in progress at Britannia Beach. A new concentrator is being constructed, and the town, which was wiped out by a flood, is being rebuilt on a different site. C. T. Browning, general manager, states that the new equipment should all be in place and ready for use by fall.

Alice Arm—No announcement has yet been made as to the plans of the Taylor Engineering Co. for 1922 with reference to the Dolly Varden mine and railroad. The assumption is that, if development is not continued on the former, the railroad will operate at least to the extent necessary to handle the ore offering from properties of the district. There is a probability that work will be done on the Wolf group, north of the Dolly Varden, with a view to the proving of orebodies believed to belong to the same formations as those of the Dolly Varden.

Ontario

La Rose Directors Re-elected—Lake Shore to Enlarge Main Shaft

Cobalt—At the adjourned annual general meeting of the La Rose, the old board of directors were re-elected. The Toronto element, which put up a strenuous fight for control of the company, received only about half as many proxies as the present board. The company will reopen the old La Rose Extension workings, where a shaft 400-ft. deep was sunk, but no ore found. This work is being undertaken as a result of the geological re-survey of the Cobalt camp by C. W. Knight of the Provincial Geological Staff.

Good results are being obtained in the development of the Castle Trethewey since it was reopened recently. If the 260 level is as good as the upper levels a mill will be built.

The Dominion Reduction mill will not be reopened for the treatment of the Peterson Lake tailings, as the two companies find it difficult to come to terms.

Kirkland—The Lake Shore is preparing to enlarge the main shaft between the surface and the 400 level. Below 400 ft. it has three compartments, and another compartment will be added between the 400 level and the surface. Underground mining will be stopped until the work is completed, but there is sufficient ore on the dump to keep the mill running.

The stock of the Wright-Hargraves, one of the principal mines of Kirkland, with a capital of $2,750,000, has been listed on the Toronto exchange. It is largely owned in Buffalo. The company has paid dividends of 7½ per cent this year.

Porcupine—During the eleven months ended Feb. 28, the Dome profits were $1,145,000. Production is about 900 tons a day. The capital has been reduced by reducing the par value of the shares from $10 to $9 and by the payment of that amount to the shareholders as capital return.

Stock of the Davidson is being extensively offered and advertised in London. The offer embraces 800,000 5s. preference shares entitled to two-thirds of the annual profits until 100 per cent has been paid and thereafter 20 per cent non-cumulative dividends in priority to ordinary shares. English financial papers look upon this flotation with considerable reserve.

MEXICO

Mexico—The Pasadena El Monte Silver Mines Corporation will hold a meeting in Mexico City on April 27, to ratify the acts of the board of directors.

Broken Hill Co.'s Steel Project in Need of Protection

When the Broken Hill Proprietary Co., Ltd., of Broken Hill, Australia, launched its iron and steel works enterprise in 1915, the general manager, G. D. Delprat, stated that there would be no need for protection. The position now, however, has greatly changed, due primarily to the large increases paid for labor and supplies. In other words post-war conditions are quite different from those ruling in pre-war times. H. V. McKay, one of the directors of the company, and widely known as the manufacturer of the Sunshine Harvester, recently reviewed the position of the iron and steel industry. He said that the Broken Hill company had a certain number of orders to complete, but that as no further orders were being received the probabilities were that the works would be closed down in the course of a few weeks. He explained that a considerable proportion of the country's output was in merchant bars, for which the company's present price was £16 10s. per ton, whereas the same steel could be landed in Australia from Great Britain at £14 14s. per ton. The closing down of such an industry is an indication that a reduction in the cost of manufacture is the prime necessity, if the country's secondary industries are to compete with importations. This view of the situation is evidenced by the slump in B. H. P. share values, prices having dropped from 65s. a few months ago to approximately 25s. recently.

CALIFORNIA

Jo Rand Smelting Project Considered Impracticable—Drainage Adit at Grass Valley Talked of Again

From Our Special Correspondent

San Francisco—Snowfall conditions in the higher Sierras are such as to presage a plentiful water supply during the coming year. The total snow at Summit registers 186 in., with corresponding amounts along the crest of the Sierras.

At Grass Valley, the possibilities of a long adit from the Bear or Yuba River for drainage and prospecting purposes are under discussion again, but an engineer long familiar with the conditions in that district doubts the economic need for such an adit and states that the subject has been under discussion many times before without tangible results. Until more definite action takes place the project must be looked upon as improbable.

The announcement of the incorporation of a new company in California, the Jo Rand Smelting Co., which purposes building a custom smelter at Mohave, Cal., has been followed by the statement that Bela Kadish is president of the company and that the office of the company will be in Bakersfield, Cal. Mining men are not impressed with the practicability of a custom smelter at Mohave. The restricted water supply, the difficulty of securing a supply of fuel, and the absence of sufficient amounts of lead ore, as well as the relatively small ore tonnage, available, are pointed out as difficulties. The fact that a custom smelter at Needles, Cal., was not a particular success casts doubt upon the future of the new project.

The Lewiston Gold Dredging Co. has been recently incorporated to work the Martin property near Lewiston. It is stated that the Valdor dredge recently shut down will be dismantled and moved to the property of the Lewiston Gold Dredging Co.

From the Mother Lode region reports emanate that the Maloney Mining & Milling Co. is to begin operations at Mokelumne Hill, and that the Easy Bird mine, in the same district, will be reopened within a few weeks. The Moore mine, as recently announced, will construct a twenty-stamp mill and erect an electric hoist. A report is current that the Hardenburg mine is to be reopened under a lease and bond.

At Randsburg, the Yellow Aster is diamond drilling with a view to finding extensions and new ore horizons. Five stamps are being operated for leasers, and thirty stamps are on ore from the vicinity of old workings. The California Rand is shipping six tons of concentrates and 100 tons of ore daily. At the neighboring Coyote mine, encouraging ore shipments have been made.

The Union Hill mine, a hydraulic mine at Douglas City, Trinity County, will resume work when the snow is off the ground.

Portola—The Walker, Berdsley, and Gruss mines are planning to resume.

NEVADA

Tonopah Divide Resumes Shaft Sinking—West End Announces Dividend—Blue Bird, at Hornsilver Sold

From Our Special Correspondent

Argentite — Despite deep snows, some development work has been accomplished at both the Francis and the [illegible] mines in the last few months. Each property now has a 200-ft. shaft, and drifts on the veins show good commercial ore. Preparations are being made for more active work during the spring and summer. The veins are large and well-defined and the district is regarded as one of promise.

Hornsilver—It is reported that the Blue Bird group, situated about 800 ft. from the Orleans Hornsilver mine, owned by Goldfield men, has been sold to Pittsburgh operators and that active development will be started before the end of April.

Divide—Shaft sinking has been resumed at the Tonopah Divide mine and the shaft is now 1,350 ft. deep. No water has been encountered. During the week ended March 29, 134 ft. of development work was accomplished. March production was heavier than usual, and was about 1,800 tons of $30 ore.

Eureka—Owing to prompt action by J. F. Shaughnessy, chairman of the Public Service Commission, the washout on the road between Palisade and Eureka has been repaired, and train service will be resumed at once.

Tonopah—The West End Consolidated Mining Co. in a letter to stockholders dated March 31, has announced that dividends of 20c. per share will be paid the coming year. The letter states that the dividend is made possible by the improvement in general conditions and the company's important reserves of ore. The MacNamara Crescent Mining Co., owning ground to the south of the West End, is resuming work on its 1200 level.

Ely—Gradual resumption of mining, milling and smelting by the Nevada Consolidated Copper Co. is definitely assured. There are many idle men now in Ely, and a further influx of labor is being discouraged.

Operations in Pioche District

By E. C. D. Marriage

Pioche—Settlement assays, received on April 4, on shipments of ore from the Comet district were as follows: Lyndon mine, first-class ore, 222.6 oz. silver and 9.4 per cent lead; second-class ore, 49.5 oz. in silver and 3.7 per cent in lead. Stella mine, first-class, 165.5 oz. in silver, 18.9 per cent lead; second-class, 64.1 oz. in silver and 16.2 per cent lead. The shipment totaled forty-two tons and will bring a substantial return.

The Bristol Silver Mines Co. and the Black Metals, Inc., both controlled by the Snyder interests, of Salt Lake City, continue to ship two cars daily. Mine conditions are satisfactory.

Among the companies recently incorporated is the Adra Mines Co., formed for the purpose of developing silver properties in the Silver Park district, forty-five miles north of Pioche. Twenty-three claims are owned by the company, three of which are patented. Three more patented claims are held by the company under lease and bond.

The Prince Consolidated Mining & Smelting Co. still continues to ship oxidized lead-silver ore from its upper levels. The company's railroad is not being operated, the ore being hauled by trucks to the main line at Pioche, a distance of about five miles.

UTAH

Bingham Canyon More Active—Magna Plant to Stay Down—Shipments From Park City and Tintic

From Our Special Correspondent

Salt Lake City—With the resumption of operations by the Utah Copper Co. the camp of Bingham, almost deserted for a time, is beginning to take on a new aspect. Production by the company is starting on a small scale and will probably gradually be brought up to the output of the period immediately prior to the shutdown, or about 50 per cent of capacity. The Arthur mill alone will be used as it was during the last months of production. The highest capacity of this plant is 10,000,000 to 11,000,000 lb. of copper monthly, and at the time of the shutdown it was producing 8,000,000 lb. a month. The Magna mill of the Utah company at Garfield, a table concentrating plant and not as modern as the Arthur mill, in which flotation has been installed, will not resume operations at present.

Alta—The Alta Tunnel and Transportation Co. is hauling its ore part of the way down the canyon by means of sleds, and stockpiling until such a time as the roads are open to teams the rest of the way down the canyon to the smelter at Murray.

Eureka—Ore shipments from the Tintic district for the week ended March 31 were 150 cars. Shippers were: Chief Consolidated, 44 cars; Tintic Standard, 38; Iron Blossom, 15; Colorado, 12; Eagle & Blue Bell, 12; Victoria, 12; Swansea, 4; Centennial-Eureka, 4; Alaska, 3; Bullion Beck, 2; Gemini, 2; Dragon, 3—two cars of ore and one car of fuller's earth; Grand Central, 1.

Park City—Shipments for the week ended March 25 amounted to 2,368 tons. Shippers were: Judge companies, 1,248 tons; Silver King Coalition, 645; Ontario, 475.

Shipments for the week ended April 1 were: 2,285 tons. Shippers were: Judge companies, 1,027 tons; Silver King Coalition, 570 tons; and Ontario, 688 tons.

WASHINGTON

Northport — Since resumption of operations at the property of Gladstone Mountain Mining Co., ore is being taken out from No. 5 chimney of the mine.

MONTANA

Anaconda Starts High Ore and Anaconda Mines—Hoist Breakage Shuts Down Steward Mine

By A. B. Keith

Butte—The High Ore mine of the Anaconda, one of the larger copper properties of the Butte district and the deepest mine in Butte, has resumed production together with the Anaconda mine, the resumption following rapidly upon the temporary suspension of activities at the Steward mine in consequence of the shafting of the hoisting engine breaking, which will necessitate a shutdown for five or six weeks. About 400 men were afforded employment at the Steward, and they were transferred to the High Ore and the Anaconda. The supply of experienced miners still continues lamentably small, and the wonder is where they all have gone. Nevertheless, it is said that there are employed at present in the Butte district more men than before the shutdown of the copper mining industry more than thirteen months ago. But many of the present employees are inexperienced men sandwiched in between old-timers.

The North Butte has not resumed, and neither has the Davis-Daly, nor the Tuolumne, and the East Butte is working approximately the same number of men it always had. The Anaconda is making all preparations to get back to a normal output of copper as quickly as is possible, and, furthermore, when that normalcy has been regained, to embark upon a program of ore development in the Butte district of materially greater extent than has been the rule. It is quite possible that this program may be launched before the copper-metal markets have regained their equilibrium.

More than 900 men are working in Anaconda's B. & M. smelter at Great Falls, and this number will continue to be increased as business justifies, until the entire works are running full blast. The zinc plant is reported operating at capacity now, turning out between 9,000,000 and 10,000,000 lb. of zinc monthly, this output having been reached within the last few days. The copper refinery is working at about 60 per cent, and is turning out 12,000,000 lb. of copper monthly, as against a capacity of 18,000,000 lb. The rod and wire mill is running at 50 per cent of capacity, and operations here will be increased steadily. The output of this plant is being put out over the West. About 11,000,000 lb. of Great Falls copper wire has gone to Chile and Peru.

The Washoe smelting works at Anaconda have coal stocks ample to care for the needs of plant for more than sixty days, and the works at Great Falls have a three months' stock.

The Hesperus Mining Co. has been refinanced, and the unwatering of its shaft on the Hesperus claim, south of the Davis-Daly's Colorado mine, has begun. Active development work will be undertaken. The company has opened more than 1,000 ft. of drifts.

IDAHO

Cœur d'Alene District

Advance in Lead Causes Optimism—Tamarack & Custer and Gold Hunter May Resume—Stewart To Be Worked

By A. J. Dunn

Wallace—The recent advance in the price of lead from 4.70c. to 4.90c. has had a most stimulating effect upon the mining situation in the Cœur d'Alene district. Though three of the larger producing mines have continued in uninterrupted operation throughout the long period of depression, the credit is due to the fixed price of silver and to a commendable disposition on the part of these companies to give consideration to the walfare of the people of the community in which they operate. With a strong market for lead and with an upward movement of the price that promises to reach 5c. soon, and possibly better, at least two other mines are expected to be on the active list again after being down for more than a year. These are the Tamarack & Custer and the Gold Hunter. Though no official information has been given out, apparently reliable reports indicate that the first will be in operation before May 10. The Gold Hunter will probably wait for lead to reach 5c. This will leave the Hercules and Callahan the only big producers still idle. There are no indications of a resumption at the Hercules, and the future of Callahan is even more uncertain, as its chief product is zinc.

A recent announcement by the president of the Stewart Mining Co. states that the old Stewart mine will be further developed. Expectation of uncovering sufficient ore to warrant continuous operation is expressed, and also hope that by the time the metal markets have recovered the company will be shipping ore. The Stewart is near Kellogg, and for many years was a steady dividend payer. The announcement also stated that the Nabob, on Pine Creek, which is controlled by the Stewart, would also be active, and that negotiations were pending for the consolidation of some of the adjoining properties and handling all ore by the Nabob mill.

The Western Union Mining Co., operating near Wallace, is installing a five-drill Ingersoll-Rand compressor to be driven by electric power, preparatory to carrying out an extensive plan of development. Since striking a rich lead-silver ore shoot in November, 1920, steady shipments have been made by leasers, the aggregate value of shipments to date as shown by smelter returns being $90,000.

The Federal Mining & Smelting Co. has purchased from N. C. Sheridan, mining engineer of Wallace, the Midnight claim, which is practically surrounded by the Morning group of claims, owned by the Federal. Besides the known and prospective mineral value of the Midnight, the purchase removes a possibility of apex litigation. The price paid was $25,000 cash.

COLORADO

Coal Production Exceeds Sales Despite Strike—River Smelting & Refining Co. to Resume

[illegible]

Denver—The end of the first week of the nationwide strike of coal miners finds Colorado operators producing more coal than can be sold within the state, and unless an outside market can soon be found, production must be curtailed.

The properties of the American Smelting & Refining Co., and the Colorado Fuel & Iron Co. are operated as non-union mines and were not appreciably affected by the walkout on April 1. There are at present more miners than jobs, and operators say that they are in a position to supply all the coal necessary for the mid-mountain territory as well as the plains region extending to the Missouri River.

The lack of orders is due chiefly to the fact that most of the large consumers laid in a large supply of coal in anticipation of the strike, and the warm weather has greatly reduced domestic consumption, and in many instances operators are faced with accumulating demurrage charges on account of a lack of market for the coal in cars.

Officials of the Colorado Fuel & Iron Co. announce that operations at the steel mill have been increased 30 per cent during the week, so as to make profitable use of the surplus coal produced by the company.

Florence—The River Smelting & Refining Co., which operates a zinc-oxide plant near this city, announces that it will at once resume operations, furnishing employment to 150 men. The plant has been closed for more than a year, and during this time has been overhauled and remodeled. It will treat about 100 tons of ore daily, obtained principally from Leadville. The product will be a zinc oxide and a matte carrying silver.

Cripple Creek—Development work is increasing throughout the Cripple Creek district and labor is becoming more plentiful. Among the more important projects [illegible] lateral from the Vindicator mine to the Roosevelt tunnel, which is nearing completion. The United Gold Mines Co. is continuing its diamond drilling campaign from its lower levels, with promising results. The tonnage shipped the past few weeks is increasing.

Ouray—The Welch-[illegible] Mines Syndicate, operating the old Wanakah, is driving a raise from the upper or third contact, exploring for a possible fourth contact above the large stopes which made the chief production of the mine. A 3 by 8-ft. Marcy roller mill has been ordered to increase the mill capacity and allow fine grinding for flotation.

Sam Fellin & Co. have abandoned leasing operations on the Neodesha, after more than two years of steady work. During that time some high-grade ore was extracted.

ARIZONA

General Engineering Co. to Erect Mill at Stargo Mine

Phoenix—The Howard Silver Co., which has property in the Black Canyon district, about forty-five miles north of Phoenix, is to sink to 500 ft. and to erect a flotation and concentration mill. The vein under exploration is said to sample 20 oz., and shipments of carload lots have averaged 250 oz. H. O. Howard is in charge.

Jerome—Two stringers of solid [illegible] have been struck in the southeast drift from the [illegible] level station of the Verde Central. The shaft now is approaching [illegible] ft. depth below the station. Four machines are being operated in addition to the sinking, and the shaft equipment is overburdened.

The lower workings of the Shea have been unwatered, and the property has had close inspection by Assistant General Manager I. B. Joralemon of the Calumet & Arizona Mining Co. It is believed that the C. & A. will include the Shea in its local scheme of development, which already embraces the Verde Central and Gadsden.

Clifton—General Manager J. P. Hodgson of the Phelps Dodge Corporation's Morenci branch states that Arthur Crowfoot and four other members of his staff have been working for two months on plans for remodeling No. 6 concentrator so as to handle an additional 1,000 tons of ore a day. These plans, now largely in the pencil stage, will be forwarded the New York offices soon. Whether authority for starting work on the improvement will be forthcoming soon depends entirely on the copper situation. A force of expert masons, sent by Kellog & Co., of New York, has started on repairs of the big brick stack at the Arizona smelter, below Clifton. The first of the cracks appeared at the time of the big strike, in 1916, and is assumed to have come from too rapid cooling.

The General Engineering Co., of Salt Lake City, has been awarded a contract for erection of a 100-ton silver-gold mill on the Stargo mine, near Morenci. The property is managed by Michael Hannon, for years a prominent miner at Bisbee.

Miami—The International smelter has its three reverberatories working steadily, mainly on concentrates, and is believed to be making a larger production monthly than any other copper-reduction works in America at present. It is more than equaling its maximum product of the past. There remain in the bins much of the concentrate supply of the Miami company, and a large concentrate tonnage is coming from the Inspiration mill, in which fourteen of the twenty sections are being operated. Old Dominion and Iron Cap are sending concentrates from Globe, and ore is being received from the Superior & Boston. Inspiration has avoided litigation and has secured a clear right of way up Webster Gulch a mile to the new Porphyry shaft.

Bisbee—Calumet & Arizona, which has been shipping about 300 tons of ore a day to its Douglas smelter, is increasing the tonnage as the smelter ore pits are being cleared out. Soon it will be sending 1,300 tons a day.

JOPLIN-MIAMI DISTRICT

Missouri-Kansas-Oklahoma

Number of Mines Increasing, but Ore Output Is at Standstill — Eagle Picher Starting Three Mines

By P. R. Coldren

Joplin—One of the significant features in this district just now is that the number of operating mines is increasing steadily, yet the district's zinc and lead ore production is apparently at a standstill.

Since March 1, at least ten concentrators have started operation, some of which had been idle for more than a year, yet the weekly production of the district in zinc concentrates remains around 7,200 tons, and is even being reported as lower than this figure.

At one time about two years ago the weekly production, which is not to be confused with shipments, was reported as high as 17,000 tons. This was the peak, and it compared with an average of about 5,000 tons previous to the war. That production should now be only about 7,200 tons per week with more than eighty mines operating is considered locally as explainable only in one way—namely, that the poor prices of the past months have made it so necessary for operators to mine the cream of their ore that this cream has been virtually exhausted. They believe that it would be altogether impossible at present to run production up above 10,000 tons; that it would probably be extremely difficult to make it exceed 8,000 tons weekly.

In the last three months only three new mines of any consequence have been developed in this field, and beyond doubt many more than this number have been badly depleted.

For the first time in many months there are rumors of a shortage of miners in the district during the last week. Even if production has not materially increased, the greater activity of mines indicates that more men are employed. The Bank of Picher cashed checks for miners to the extent of $65,000 on April 1, which is more than for any other Saturday since early in 1920.

The Eagle-Picher Lead Co. will place three mines in operation in the near future that have been idle for more than a year. This will give this company four going mines out of the eight which it owns. The St. Joe and Vantage properties will also resume operations as soon as they succeed in obtaining leases. Only one or two companies have as yet received new leases from the government on Indian lands in Ottawa County.

NEW MEXICO

Operations Resumed by the Chino Copper Co.

Santa Rita—The Chino Copper Co. resumed operations April 1 upon receipt of telegraphic instructions by General Manager John M. Sully from Charles Hayden, New York, chairman of the board of directors. About ten days will be required for clean-up work preparatory to beginning actual mining operations. These will start April 10, when a unit of the mill at Hurley will resume. More than enough labor is available at present for all requirements. About 500 men will be put to work at Hurley and Santa Rita. This force will be increased gradually until the output has reached a 50 per cent capacity. Preference will be given to old employees in recruiting the working forces.

The Lordsburg district was the only one to ship copper ores in March. During January and February no copper ores were shipped. They began to move about the middle of March, and a total of 2,667 tons was shipped. Most of this was from the Eighty-five mine to the C. & A. smelter at Douglas, Ariz.

The El Paso & Southwestern railroad, which is controlled by the Phelps Dodge Corporation and which recently took over the Arizona & New Mexico R. R., running from Clifton, Ariz., to Hachita, N. M., has put into effect new rates on crude ores from the Lordsburg district of New Mexico to the smelters at El Paso, Texas and Douglas, Ariz. The new rates became effective March 30, 1922.

MINNESOTA

Iron-Ore Prices To Be Fixed Soon, It Is Anticipated

Duluth—Iron-ore prices for the 1922 season have not as yet been set, but indications point to an announcement in the near future. Many of the blast furnaces are pressing the iron-ore operators for quotations for this coming season, but it has been the desire of producers to await the decision of the Interstate Commerce Commission relative to the adjustment of freight rates from mines to the dock. It is anticipated that this decision will be rendered by the middle of April, and that soon thereafter the producers will be in a position to quote prices on iron ore, which should not be later than May 1. It is also anticipated that the Lake freight rate this coming season will also be quoted at a lower figure.

MICHIGAN

Gogebic Range

Ironton and Colby Mines Preparing to Reopen Soon

Ironwood—The Ironton mine, at Bessemer, is preparing to reopen soon with a large force of men. The Colby mine likewise will probably be reopened. Both mines are operated by the McKinney Steel Co. and were recently visited by Mr. McNeil, the district manager.

THE MARKET REPORT

Daily Prices of Metals

Apr.	Copper, N. Y., net refinery* Electrolytic	Tin		Lead		Zinc
		99 Per Cent	Straits	N. Y.	St. L.	St. L.
6	12.40@12.50	28.625	29.375	4.90	4.70	4.825@4.90
7	12.50@12.625	29.25	30.00	4.90@5.00	4.70@4.80	4.85@4.90
8	12.625	29.50	30.375	5.00	4.80@4.85	4.90
10	12.625	30.125	30.875	5.00@5.10	4.80@4.90	4.90
11	12.625	29.75	30.375	5.00@5.10	4.85@4.90	4.90
12	12.625	29.50	30.25	5.00@5.15	4.85@4.90	4.90

*These prices correspond to the following quotations for copper delivered: April 6th, 12.65@12.75c.; 7th, 12.75@12.875c.; 8th to 12th, 12.875c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Apr.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
6	58⅜	59⅛	63½	144⅛	145¾	21⅞	21⅝	26	26
7	58⅞	59⅝	64½	147	148¼	22	21½	26⅛	26⅛
8	...	..	...	.....	..				..
10	59¾	60½	64½	152¼	153¾	22⅜	21⅞	26⅜	26⅜
11	59	59⅝	64½	150¼	151¾	22¼	22¼	26½	26½
12	58¾	59½	64½	148¼	149¾	22⅜	22¼	26½	26½

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Apr.	Sterling Exchange "Checks"	Silver: New York Domestic Origin	Silver: New York Foreign Origin	Silver: London	Apr.	Sterling Exchange "Checks"	Silver: New York Domestic Origin	Silver: New York Foreign Origin	Silver: London
6	438	99⅝	65¾	33⅝	10	441½	99⅝	65¾	33½
7	438⅜	99⅝	65⅞	33¾	11	440½	99⅝	65⅝	33½
8	439½	99⅝	65⅞	33¾	12	441	99⅝	65¼	33¼

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, April 12, 1922

A much more optimistic feeling is noticed among the metal producers and selling agencies. Demand for almost all of the metals has improved recently, and there is less of a tendency for weakly held stocks to appear on the market. Manufacturing interests generally are finding business better, and these improved conditions are being reflected in the raw-material markets. The advance in the stock market seems definitely established, and this has also made for optimism, though, of course, it is only a reflection of better business prospects. The coal strike is not yet taken seriously, though it seems to be slowly spreading to non-union ranks.

Copper

The copper market took a rather violent turn for the better last Thursday; in fact, it seems that the cheap supplies had been pretty well absorbed by Wednesday morning. Producers began taking orders at the advanced prices the next day, and soon all of the available metal for sale at 12.75c. delivered had been taken up, the larger producers meanwhile generally advancing from 12.75 to 12⅞ and 13c. During the last three days two or three producers have been willing to book desirable business at 12⅞c. delivered, but there is a marked tendency to come to the 13c. price; in fact, some has been sold at the higher level. On the other hand, one producer offered a large block of copper today at 12.75c. June to August deliveries have been in the greatest demand, not a great deal of prompt copper having been marketed. Sales have not been large, though a fair domestic business has been done.

Export demand has been moderate at advanced prices. The general quotation by the Copper Export Association for European delivery is now reported to be 13¼c., although outside interests report difficulty in getting so high a price. The import duty on copper to Japan was raised from 0.4c. to 2.5c. on March 29, so that exports to that country have temporarily ceased.

Lead

On Friday, April 7, the official contract price of the American Smelting & Refining Co. was raised from 4.90 to 5c., New York.

The lead market has been decidedly unsettled during the last week, with a big demand, which most producers have been unwilling to meet. The recent advance seems to have scared consumers into a desire to provide for future requirements, and as producers are not in the habit of selling for more than thirty to forty-five days in advance, these consumers have been anxious to buy prompt lead and hold it for future use. Some has no doubt been so sold against producers' wishes and has created an embarrassing shortage of April metal. It is felt that an undue advance in prices at this time would be bad for the trade, especially if much forward metal were sold, for it would likely be followed by a reaction later. However, there is no denying the existence of an improved demand for lead products, and if the price advance can be held within bounds, lead producers seem destined for an excellent spring and summer business.

Sales have been large during the last week, and practically all of those made by producers have been within the range of prices shown in the table on this page. However, there have been some quotations on a higher basis by unwilling sellers and by those who have been guided by what they believe the market might be rather than by facts. Quotations as high as 5c., St. Louis for common lead, have been made; in fact, desilverized has actually been sold at this price, a slight premium still being obtainable for that grade. In New York, old customers are able to obtain lead at 5c. for prompt shipment from the West, but buyers of odd lots from various producers are having great difficulty finding any metal for less than 5.15 to 5.25c.

Zinc

Demand from galvanizers has been rather better, and the price has stiffened further. It is understood that statistics to be released by the American Zinc Institute on Saturday are highly favorable, both as to shipments during March and as to tonnage on hand. This has encouraged producers and helped to establish the stronger prices. The only fear now is that the coal strike may, in time, cut down steel activities in the Pennsylvania, Ohio and Indiana districts. Demand in the last few days has been principally for forward zinc, May and June deliveries being particularly popular. Premiums of from 2½ to 5 points per month are being asked on such business. Export business has been placed with Japan.

High-grade zinc has been in good demand at unchanged prices—viz., 6c. delivered, where the delivery charge does not exceed 30c. per hundred pounds. Occasionally, some interests seem disposed to cut this price, but it is reported to hold for most business, nevertheless. The spiegeleisen market has been active at unchanged prices.

Tin

The price of tin advanced on Friday after an active demand. At the higher levels prevailing since that day, demand has fallen off perceptibly, and there seems to be a gradual softening of the market. It is reported that the advance in London was due partly to a desire to squeeze the shorts. Large arrivals recently have not had a particularly bullish effect. American electrolytic tin is in somewhat freer supply than for a time and has sold on the same basis as the best grades of Straits.

Tin for forward delivery is also quiet at practically the same prices as are asked for spot. In some instances ½c. premium has been charged for July deliveries.

Arrivals of tin in long tons: April 4, China, 150; Straits, 5; 5th, Straits, 15; 7th, Straits, 600; 10th, Liverpool, 35; London, 50; Straits, 75.

Gold

Gold in London: April 6th, 95s.; 7th, 94s. 9d.; 10th, 93s. 9d.; 11th, 93s. 5d.; 12th, 93s. 5d.

Silver

The market has been quiet recently, with a somewhat weak tendency. This is due undoubtedly to the approaching Easter holidays, with the consequent loss of business in London and the Far East. Fundamental conditions remain unchanged, with the market dependent upon China.

Mexican Dollars—April 6th, 50¼; 7th, 50½; 8th, 50½; 10th, 50¼; 11th, 50¼, 12th, 50.

Foreign Exchange

Political developments in their relation to the Genoa Economic Conference have influenced the foreign exchange market during the last week, but rates have generally been firm. On Tuesday, April 11, francs were 9.22c.; [illegible] marks, 0.3525c.; and Canadian dollars, 97.625.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 4.50@5c. for the week. Market has improved steadily, and it is difficult to obtain metal under 5c. today.

W.C.C. brand, 5¼@5¾c. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh) nominal at 5¼c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—Somewhat weaker at 6.5@7c. Some dealers asking up to 7.5c.

Bismuth—$2@$2.10 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Iridium—Nominal, $160@$170 per oz.

Nickel—Standard market, ingot and shot, 41c.; electrolytic, 44c. Small tonnages, spot, nominal at 32c.

Palladium—Nominal, $55@$60 per oz.

Platinum—$85@$90 per oz.

Quicksilver—$50 per 75-lb. flask. San Francisco wires $50. Firm.

The prices of **Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of April 8.

Metallic Ores

The prices of **Bauxite, Chrome, Manganese, Tungsten, Molybdenum, Tantalum, Uranium, Vanadium, Titanium,** and **Iron Ore, Zircon** and **Zirkite** are unchanged from the prices in the issue of April 8.

Zinc and Lead Ore Markets

Joplin, Mo., April 8—Zinc blende, per ton, high, $31.10; basis 60 per cent zinc, premium, $29; Prime Western $29.50@$28; fines and slimes, $27@$25; average settling price, all grades of blende, $26.85.

Lead, high, $65.95; basis 80 per cent lead, $68@$70; average settling price, all grades of lead, $63.92 per ton.

Shipments for the week: Blende, 9,493; lead, 2,083 tons. Value, all ores the week, $387,410.

Blende with iron content received the highest basis offering for the week. Ore production has been purchased ahead of production for the past two weeks.

Lead demand became acute late today, with ore selling up to $70 basis, in competition to secure a few ore reserves accumulated recently.

Platteville, Wis., April 8—Blende, basis 60 per cent zinc, $29. Lead, basis 80 per cent lead, $66 per ton. Shipments for the week: Blende, 702; lead 39 tons. Shipments for the year: Blende, 4,024; lead, 680 tons. Shipped during the week to separating plants, 345 tons blende.

Non-Metallic Minerals

Prices are unchanged from those in the issue of April 8, on **Asbestos, Barytes, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc.**

Mineral Products

The prices of **Copper Sulphate, Sodium Nitrate, Potassium Sulphate** and **Sodium Sulphate** are unchanged from the issue of April 8.

Ferro-Alloys

Ferromanganese — Domestic prices have advanced $5 to $67@$69, f.o.b. furnace.

The prices of **Ferrotitanium, Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotungsten, Ferrovanadium** and **Ferro-uranium** are unchanged from the issue of April 8.

Metal Products

The prices of **Copper Sheets, Lead Sheets, Nickel Silver, Zinc Sheets,** and **Yellow Metal** are unchanged from the issue of April 8.

Refractories

The prices of **Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick,** and **Silica Brick** are unchanged from the issue of April 8.

The Iron Trade

Pittsburgh, April 11, 1922

The coal strike, chiefly by reason of its extension into the Connellsville region, non-union during its entire existence, has brought about an almost complete suspension of trading in pig iron and steel. The steel mills are well stocked with coal and operations would not be impaired, at least for a while, on account of coal shortage, but the sharp decrease in Connellsville coke supply is a factor that was largely unexpected.

The looked for $3 a ton advance in sheets is now effective, with black at 3.15c., galvanized at 4.15c., blue annealed at 2.40c., and automobile sheets at 4.50c. Wire nails are up 10c. a keg to $2.50, a corresponding advance being made in staples and barb wire, but none in plain wire or fencing. Bars, shapes and plates are generally quotable at 1.50c.

Pig Iron—Sellers are hard to find, and the market is up at least $1 on foundry and basic and 50c. on bessemer, producers hoping that prices will advance to what they consider their cost, against the time when they will feel free to sell. We quote the market as not under $20 for bessemer and foundry and $19 for basic, f.o.b. Valley furnaces.

Steel Corporation—The Steel Corporation's unfilled obligations increased by 353,079 tons during March, which, with heavier shipments, indicates bookings at close to capacity, the largest bookings since May, 1920.

Coke

Connellsville—Furnace, $3.50; foundry, $4.25@$4.75.

Conditions in the World's Zinc Industry Improving*

SINCE my last review, quotations of the London Metal Exchange have varied between £27 and £24 per ton, and at time of writing the London market stands at £25 7s. 6d. for spot and £25 10s. for three months. For reasons set out in later paragraphs I consider slab zinc to be cheap at anything below £26 for the next few months.

United Kingdom.—After negotiations between the Board of Trade and the representatives of the British smelters, the former agreed to make 40,000 tons of Australian concentrates available to the British works at a price of 75s. per ton c.i.f. As the grade of the Broken Hill material is 47 per cent Zn, 6 per cent Pb, and 10 oz. Ag, the price mentioned is equivalent to a government subsidy to the British zinc industry and is more than 20s. per ton below the market value of other zinc ores in Europe. As the ocean freight for cargoes has ranged between 45s. and 51s. 3d. per ton, it follows that the Board of Trade has incurred a heavy loss in agreeing to supply the 40,000 tons at the price mentioned. Part of this lot has already been delivered and the remainder is on the water.

Subsequent negotiations between the British smelters and the government have been for the supply over a term of eight years. The terms upon which the Board of Trade are prepared to sign these long-term contracts with British works are highly attractive when compared with the government contract price with the Australian producers and also in comparison with the pre-war selling price of the Broken Hill material. The Board of Trade, however, is only prepared to deal on an f.o.b. Port Pirie, (Australia) basis, and as existing ocean freights are double the pre-war rates, the price concession is at least counterbalanced from the smelters' viewpoint. The first of such long-term contracts has already been signed, and notwithstanding the high freight, Broken Hill material imported under this contract is easily the cheapest source of zinc ore supply.

Several of the British smelters are running at part capacity, but for the time being the aggregate output hardly exceeds 2,000 tons per month. This will expand, however, and I fully expect to see the large plant at Avonmouth brought into operation before the end of the current year. Having regard to the good lead and silver contents of Broken Hill concentrates, it is essential for the British works to install a tabling plant to wash their retort residue, as the resultant washed residue-concentrate is easily salable on satisfactory terms. In my opinion the revenue accruing from the sale of this byproduct will represent the difference between profit and loss to several of the British smelters with low zinc markets.

Belgium.—The Belgian production is on a slightly higher plane than the average of 1921, as it is now in the neighborhood of 9,000 tons per month. Not more than 2,000 tons of this will find its way to the British market, and the rest will go to meet local demand, which is mainly for the rolling mills. The stock of sheet zinc in Belgium, which at one time during the last two years was of such huge dimensions, is now within ordinary limits and is no longer disturbing to the zinc situation.

The Belgium zinc smelters are not waxing rich and have been content to pay their way and make what little profit is possible on rolling. Their average cost of producing zinc is about £26 per ton, as compared with £19 10s. in pre-war days. Today's higher cost is due to the smelters being operated at only half capacity and to high wages and raw materials. Owing to the vagaries of the international exchanges, it is only practicable to make comparisons in terms of English sterling. Thus, today Belgian wages are 20 fr. as compared with 11s. in Britain and 75 marks (actually 1s. at today's exchange, 1,500 M=£1) in Germany. Against this, however, must be set the greatly increased efficiency of Belgian workers compared with the labor employed at British works and at the German and Silesian smelters.

With regard to raw material Belgium is in the same situation as other countries which are entirely dependent upon imported ores. Outside the Vieille Montagne the purchase of ores is in the hands of a coöperative concern of which all the smelters are members. Several large contracts were made when slab zinc was at £40 and over, and naturally with a fall in the metal to below £26 these expensive ores have reacted harshly on the Belgians' producing costs.

Belgium has still many thousands of tons of Australian concentrates to take before it gets to the end of its high-cost contract ores. Coal in Belgium is about 78 fr., or four times the pre-war price of 18 fr., but having regard to the depreciated franc the present cost is equal to 30s. per ton as compared with 25s. in Britain. The Belgian producers emphasize their inability of competing with German smelters with German coal costing only 700 marks (say 10s. per ton). The Belgians are, however, viewing this aspect from an entirely wrong perspective, for though it is true that the official price of German coal is only 10s. a ton, if reckoned at today's exchange, the fact remains that there is a shortage of industrial coal for German industries. Moreover, the German and Silesian smelters find it uneconomical to import zinc ores, and the low-grade local material on which they have to rely makes for costly treatment and poor metallurgical recoveries. The factor which governs the whole situation, however, from a comparison point of view, is the over-all cost of producing a ton of zinc, and this is today £22 in Germany as compared with £26 in Belgium, France, and Britain.

The disability of the Belgian zinc industry as I see it is its future restricted outlet for its metal. It must be remembered that before the war England took 150,000 tons, or 75 per cent of the Belgian production of 200,000 tons. Today the British consumption of zinc is only 45 per cent of 1913, and when normality is restored the English markets will be almost entirely met by the 40,000 tons of electrolytic zinc acquired by the British government from Australia plus the production of the zinc smelters in Britain. Taking a long view of this position, I foresee such marketing difficulties for the Belgian producers as to throw them into the arms of a revived German Zinc Convention.

France.—The French smelters are operating at a capacity merely sufficient to meet domestic requirements, and the output does not exceed 30,000 tons per annum. These smelters in northern France are experiencing the same disabilities as the Belgian works, except that France, being a tariff and consuming country, can always adjust its duty to protect its own industries. Obviously, when Belgium at some future date is fighting for a marketing outlet for its slab zinc, the French smelters will be happier placed and, if pressed, will be granted readjustment of duty on imported metal, notwithstanding that [illegible] interests which control the French works are also directly interested in Belgian zinc smelters.

Germany.—The German situation is unchanged, and the production of zinc at the German works and at the smelters in Silesia now within Polish territory is not more than the present consuming capacity of the country. The outlook at the Silesian works is still unsatisfactory, and production at that centre is on a small scale compared with the rated capacity.

Scandinavia.—The output of zinc in Norway and Sweden is today little more than the requirements of Scandinavian consumers. The electrothermic process has been developed to such a state of perfection that I place it next to the electrolytic process in economy of production, compared with the ordinary distillation methods which have to be employed where cheap hydro-electric power is unobtainable.

Australia.—The small distillation works at Port Pirie remain closed and are unlikely ever again to produce, considering the ability of the same interests to turn out high-grade zinc so much cheaper at the Risdon Electrolytic Works. The first half of the electrolytic plant in Tasmania a time producing 60 tons of 99.95 per cent purity zinc a day, and when the full plant is operating in six months' time the daily output will be 120 tons. As indicated in a previous survey, I have no reason to doubt the ability of the Risdon works, with its cheap hydro-electric power and other natural advantages, to produce zinc for £21 per ton when operating at full capacity, and the company is in an advantageous position, inasmuch as it has sold its entire output up to 45,000 tons per annum to the British government until June, 1930, at a substantial premium over the London market price of good zinc. Moreover, it is protected by possessing a minimum price for its zinc in the government contract, and would be capable of making satisfactory profits if the zinc market necessitated every other zinc smelter in the world closing down.

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*A report by A. J. M. Sharpe, honorary m[illegible] Zinc Institute.

United States.—It is curious, but nevertheless a fact, that the unsold stock of zinc in the United States is the primary reason for the London price of zinc being £1 or £2 lower than it otherwise would be. When the American dollar began to depreciate and certain zinc interests looked to Europe as an outlet for part of their stocks the London metal people were confronted by American selling on an unwilling market. This has been the bogey of all optimistic dealers, who are afraid to back zinc for a rise if the improved sterling exchange in New York should tempt further selling by American holders. Similarly, the bears are unable to operate with any degree of safety with the market price standing below cost of production for fear of being caught short, and it is consequently the stock of United States zinc which is responsible for the absence of professional dealing in the metal on the London Metal Exchange. Though the American stocks are steadily diminishing, the monthly diminution is much smaller than the rate at which European stocks are disappearing, and as will be seen from a later paragraph I estimate the United States' unsold accumulation of zinc to amount to nearly 60 per cent of existing world stocks.

World Stocks of Zinc.—My estimate of virgin zinc stocks on March 31, 1922, is 97,000 tons, made up as follows:

	Metric Tons
United States	57,500
Germany and Polish Silesia	17,500
Britain	7,500
Belgium	3,500
Scandinavia	1,500
France	1,500
Australia, including quantities afloat to Great Britain and Japan	4,000
Other Countries	4,000
Total	97,000

Estimated World Production for 1922.—At the beginning of January I prepared my usual annual estimate of world production of zinc and the details for 1922 were as follows:

	Metric Tons
United States	300,000
Canada	15,000
Belgium	100,000
France	30,000
Poland Germany	125,000
Great Britain	45,000
Austria-Hungary, Jugo-Slavia and Czecho-Slovakia	12,000
Italy	1,000
Holland	3,000
Scandinavia	12,000
Spain	5,000
Australia	25,000
Japan	7,000
Total	680,000

Prophecy is more dangerous today than it has ever been in the metal industry, owing to the collapse in world trade which followed the Armistice boom. The above estimate has been based upon an anticipation of better conditions in the second half of this year, and should the industrial revival exceed expectations, and the world consumption prove greater than my estimated production of 680,000 metric tons, it will be an easy task for the most favorably placed smelters to increase their output accordingly. With one quarter of the year gone, I cannot but feel that I have been ultra-liberal in forecasting a production of 680,000 tons, particularly having regard to existing stocks.

Movements of Metals and Ores in February

Imports and exports of the more important metals and ores during February, as reported by the Department of Commerce, and the figures for February of last year, as finally revised, are as follows:

EXPORTS OF COPPER, LEAD AND ZINC

In Pounds	February, 1921	February 1922
Copper		
Ore, concentrates, matte and regulus (copper contents)	(a)	1,180
Unrefined, black and blister	6,042	
Refined, in ingots and bars	60,147,053	48,676,879
Exported to		
United Kingdom	18,970,135	3,799,420
Belgium	3,444,807	4,466,146
France	10,242,746	10,494,459
Germany	20,725,169	14,302,424
Italy	726,715	3,083,672
Netherlands	1,098,607	2,969,089
Spain	1,125,681	392,818
Composition metal, copper chief value	2,187	1,840
Old and scrap	106,234	245,194
Pipes and tubes	207,017	85,823
Plates and sheets	498,113	1,320,290
Wire, except insulated	1,513,760	447,081
Lead		
Pigs and bars		
Produced from domestic ore	198,155	2,091,358
Produced from foreign ore	2,131,138	7,140,499
Exported to		
France		2,240,972
United Kingdom.	1,574,998	1,572,766
Canada	102,985	78,790
Argentina	224,000	120,878
Brazil		280,141
China	4,076	
Japan	224,051	448,125
Zinc		
Dross		2,976,652
Spelter		
Produced from domestic ore	263,460	593,286
Produced from foreign ore	(a)	(a)
Exported to		
United Kingdom	(b)	131,075
Japan	112,039	224,055
Canada	6,969	10,206
Mexico	118,027	3,892
In sheets and strips	498,225	390,428

IMPORTS

In Pounds, Unless Otherwise Stated

	February, 1921	February, 1922
Antimony ore, contents	149,507	..
Antimony matte, regulus or metal	269,696	1,569,061
Copper		
Ore, contents	4,771,755	4,461,569
Concentrates, contents	5,065,744	
Matte and regulus, contents	743,112	619,928
Imported from		
Spain	5,795	746,799
Canada	81,833	
Mexico	3,319,340	49,807
Cuba	1,620,063	2,214,340
Chile	4,497,516	734,736
Venezuela	....	506,676
Peru	....	218,651
Other countries	1,058,064	610,488
Unrefined, black, blister and converter copper in bars and plates	19,424,907	18,081,802
Lead		
Ore, contents	440,197	1,129,523
Bullion and base bullion	47,350	6,767,282
Imported from		
Canada	239,687	174,818
Mexico	169,944	7,083,782
Chile	18,248	441,051
Other countries	59,668	197,154
Pigs, bars and old	2,000,895	111,963
Manganese oxide and ore, long tons	53,874	7,204
Imported from		
Brazil, long tons	36,450	....
British India, long tons	14,800	... ..
Other countries	2,624	7,204
Tungsten ore, long tons	50	8
Pyrites, long tons	3,600	25,970
Imported from		
Spain, long tons	....	24,970
Other countries	3,600	1,000
Tin ore and oxide, long tons	1,167	2,757
Bars, blocks and pigs	5,269,969	9,294,901
Imported from		
United Kingdon	2,576,894	3,540,382
British Straits Settlements	2,316,937	5,236,649
Hongkong	126,207	40,305
Australia	11,200	40,320
Other countries	238,731	436,945
Zinc		
Ore, contents	2,968,835	63,480
Imported from		
Canada	452,687	28,500
Mexico	2,515,065	......
Other countries	....	34,980
Blocks, or pigs, and old	909,777	11,000

(a) No production. (b) No exports.

COMPANY REPORTS

Calumet & Arizona Mining Co.

A report of operations of the Calumet & Arizona Mining Co. for 1921 states that dividends totaling $1,285,043 were paid in that year. Net deficit was $694,878.81. Production amounted to 17,872,743 lb. of copper, 594,462.7 oz. of silver, and 14,000.6 oz. of gold. Statement of income and expenditures follows:

INCOME		
Total earnings on metals	$3,321,764 85	
Interest	257,784 10	
Other income	97,705 58	
		$3,677,254 53
EXPENDITURES		
Operating expenses, depreciation	$2,432,149 66	
Salaries, office, general expenses	201,014 09	
Freight, refining and marketing	446,715 88	
State and Federal taxes	692,247 35	3,772,126 98
Operating deficit		$94,872.45
Less ore depletion		600,006 36
Net deficit		$694,878 81

Balance sheet follows:

ASSETS		
Mining property account	$29,497,091 00	
Less reserve for ore depletion	7,987,205 96	
		$21,509,885 04
Options		11,000 00
Smelting plant	$3,099,079 39	
Less reserve for depreciation	1,530,475.50	
		1,568,603 89
Sulphuric-acid plant	$998,909 83	
Less reserve for depreciation	416,581.27	
		582,328 56
Other construction	$922,597 85	
Less reserve for depreciation	411,000 00	
		511,597 85
Construction at 85 Branch	$350,102 18	
Less reserve for depreciation	38,500 00	
		311,602 18
Investments (at cost)		
New Cornelia Copper Co. stock (1,229,741 shares)	$4,731,555 12	
Tucson, Cornelia & Gila Bend R.R. stock	425,000 00	
Gadsden Copper Co. stock	664,044.39	
Warren Co. stock	290,000 00	
Cochise County highway bonds	140,000 00	
Liberty Bonds	1,266,900.00	
U. S. Treasury certificates	200,000 00	
Other securities	559,733 54	
		8,277,233 05
Notes and accounts receivable		1,461,591 29
Supplies at mines and smelter		917,339 77
Cash		759,122 76
Metals on hand and in process		3,377,480 28
Items in suspense		141,543 33
Deferred charges to operations		523,404 23
		$39,952,732 23
LIABILITIES		
Capital stock authorized	$6,500,000 00	
Less unissued stock	74,780.00	
Outstanding stock		6,425,220 00
Notes and accounts payable		1,887,769 27
Reserve items		471,537 33
Surplus		31,168,205 63
Earned Surplus, Dec. 31, 1920	$5,096,187 38	
Deficit year 1921	694,878 81	
	$4,401,308.57	
Less dividends paid in 1921	1,285,043 00	
Earned surplus, Dec. 31, 1921	$3,116,265 57	
Paid-in surplus, Dec. 31, 1921	28,051,940.06	
		$39,952,732 23

Copper on hand estimated at 12½c. per lb. Copper on hand Feb. 1, 1922, amounted to 5,881,995 lb., exclusive of copper pledged to Copper Export Association.

Osceola Consolidated Mining Co.

A report of operations of the Osceola Consolidated Mining Co. for 1921 states that no copper was produced during the year. Loss for the year amounted to $426,440.24. On Jan. 1, 1921, 5,533,927 lb. of copper was on hand and on Dec. 31, 1921, 408,263 lb. Balance of current assets Dec. 31, 1920, was $2,796,232.10 and on Dec. 31, 1921, $2,314,003.57.

Ahmeek Mining Co.

A report of operations of Ahmeek Mining Co. for 1921 discloses a loss for the year of $457,035.83, as the following accounts show:

Copper production for the year (Jan. 1 to Mar. 31 only) 6,255,200 lb.

PRODUCTION COSTS		Cents Per Lb.	Total
Mining		7.59	$ 474,[illegible]
Smelting and refining		2.02	126,559 83
Boston office and taxes		.68	42,[illegible]
Depreciation and depletion		4 27	267,127 14
Production, at cost of	6,255,200 lb. at	14.56	$ 910,808 16
On hand Jan. 1, 1921	17,003,646 lb. at	13.00	2,210,473 98
	23,258,846 lb. at	13.42	$3,121,282 14
Sold in year	13,366,746 lb. at	13.00	1,737,676 98
	9,892,100 lb. at	13.99	$1,383,605 16
Add to bring to market value			1,288 84
On hand Dec. 31, 1921	9,892,100 lb. at	14.00	$1,384,894 00

EARNINGS STATEMENT				
Received for copper sold		13,366,746 lb. at	12.86	$1,718,341 58
Cost of copper sold				
Production cost at 13c. per lb.		$1,737,676.98		
Selling and delivery cost at .57c. per lb...		76,008.57	13.57	1,813,685 55
Loss on copper sold			.71	$ 95,343 97
Gain by increase to market value as above				1,288 84
				$ 94,055 13
Maintenance costs (April 1 to Dec. 31)				
Mine		$186,283 71		
Boston office taxes		132,484 57		
Depreciation		21,027 58		
				339,795 86
Loss by sale of Liberty Loan bonds and Government copper		98,704 29		
Miscellaneous credits				
Interest and silver		75,519.45		23,184 84
Loss for year				$457,035 83
Capital assets increased				
Plant: New construction	$6,176 40			
Obsolescence	100 00			
		$6,076 40		
Real estate		1,200 00		
Net increase in capital assets				7,276 40
				$ 464,312.23
Increase in reserves for depreciation and depletion		$288,154 72		
Less decrease by obsolete construction		45 42		288,109 30
Decrease in balance of current assets				$ 176,202.93
Balance of current assets Dec. 31, 1920				3,255,677.97
Balance of current assets Dec. 31, 1921				$3,079,475 04

Engels Copper Mining Co.

The annual report of the Engels Copper Mining Co. for 1921 gives output of copper as 11,500,993 lb., valued at $1,440,319.99; of silver as 168,699 oz., valued at $167,692.22, and of gold as 1,422.7 oz., valued at $27,043.49. The net cost of copper production was 14.69c. per lb. The net receipts from concentrates delivered to and in transit to smelter, together with other earnings, was $1,037,388.97. The total operating expense was $1,088,555.34, leaving an operating deficit of $51,166.37. Reserves for depreciation and liability for compensation, less profit and loss, Dec. 31, 1920, and stock premium bring the total deficit up to $119,616.73 for the year. Capital expenditures for 1921 totaled $275,468.86. Ore reserves total 3,342,118 tons in the Engels and Superior mines. Development footage was 6,687.53 ft. (including diamond drill footage) in the Engels mine and 1,949.53 in the Superior mine. The ore tonnage milled totaled 306,024, averaging 2.224 per cent copper. The mill output was 19,829.9 tons of concentrates, assaying 29 per cent copper.

MINING STOCKS

Week Ended April 8, 1922

Stock	Exch.	High	Low	Last	Last Div.	
COPPER						
Ahmeek	Boston	62	60	62	Sept. '20, Q	$0.50
Alaska-Br. Col.	N. Y. Curb	4¼	[illegible]	[illegible]		
Allouez	Boston	27½	26	27	Mar. '19	1.00
Anaconda	New York	51½	51	[illegible]	Nov. '20, Q	1.00
Arcadian Consol.	Boston	2¼	[illegible]	2¼		
Ariz. Com'l.	Boston	[illegible]	[illegible]	9	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*20	15	18		
Bingham Mines	Boston	15¼	15½	15¾	Sept. '19, Q	0.25
Calumet & Arizona	Boston	61	[illegible]	61	Mar. '22, Q	0.50
Calumet & Hecla	Boston	280	275	275	Jun. '20, Q	5.00
Canada Copper	N. Y. Curb	*24	*21	*24		
Centennial	Boston	12	11	12	Dec. '18, SA	1.00
Cerro de Pasco	New York	36	35¼	36	Mar. '21, Q	0.50
Chile Copper	New York	17½	17	17		
Chino	New York	28	27½	27¾	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*29	*29	*29		
Consol. Arizona	N. Y. Curb	*3	3	*3	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	1½	1¼	1¼		
Copper Range	Boston	45	42½	44	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1½	1¼	1¼		
Davis-Daly	Boston	8	7¼	7	Mar. '20, Q	0.25
East Butte	Boston	11½	10¾	11½	Dec. '19, A	0.50
First National	Boston Curb	*80	*70	80	Feb. '19, SA	0.15
Franklin	Boston	1½	1	1¼		
Gadsden Copper	Boston Curb	†75	†60	*65		
Granby Consol.	New York	27½	26	27	May '19, Q	1.25
Greene-Cananea	New York	29	26¾	29	Nov. '20, Q	0.50
Hancock	Boston	2½	2¼	2¼		
Howe Sound	N. Y. Curb	3¼	3	3¼	Jan. '21, Q	0.05
Inspiration Consol.	New York	41½	40	40¾	Oct. '20, Q	1.00
Iron Cap	Boston Curb	7	7	7	Sept. '20, K	0.25
Isle Royale	Boston	24½	24	24	Sept. '19, SA	0.50
Kennecott	New York	30½	29½	29¾	Dec. '20, Q	0.50
Keweenaw	Boston	1	1½	1½		....
Lake Copper	Boston	3½	3	3½		..
La Salle	Boston	1	1	1		
Magma Copper	N. Y. Curb	29	28½	28½	Jan. '19, Q	0.50
Majestic	Boston Curb	*6	*6	*6		
Mason Valley	Boston	1½	1½	1½		
Mass Consolidated	Boston	2½	2½	2½	Nov. '17, Q	1.00
Miami Copper	New York	29½	27½	29	Feb. '22, Q	0.50
Michigan	Boston	2	2	2		
Mohawk	Boston	59	57	59	Feb. '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	8½	7¾	8		
Nevada Consol.	New York	15½	14½	15½	Sept. '20, Q	0.25
New Cornelia	Boston	18	17	17¾	Feb. '22, K	0.25
North Butte	Boston	13½	12½	12½	Oct. '18, Q	0.25
North Lake	Boston			*10	...	
Ohio Copper	N. Y. Curb	*9	*8	*9		
Old Dominion	Boston	25	24	24½	Dec. '18, Q	1.00
Osceola	Boston	36½	34	36½	June '20, Q	0.50
Phelps Dodge	Open Mar.	†175	†165	.	Apr. '22, Q	1.00
Quincy	Boston	45½	43	45	Mar. '20, Q	1.00
Ray Consolidated	New York	15½	14½	15½	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*2	*2	*2		
St. Mary's Min. Ld.	Boston	46	44½	45	Dec. '21, K	1.00
Seneca Copper	Boston	14½	13½	13¾		
Shannon	Boston	1.25	*85	1.00	Nov. '17, Q	0.25
Shattuck Arizona	New York	8½	8½	8¾	Jan. '20, Q	0.25
South Lake	Boston	†1.00	†60	*80		
Superior & Boston	Boston	1	*90	1		
Tenn. C. & C. cfs.	New York	11¼	11	11	May '18, I	1.00
Tuolumne	Boston	*68	*60	63	May '13	0.10
United Verde Ex.	Boston Curb	28	26½	28	Feb. '22, Q	0.25
Utah Consol.	Boston	2½	1½	2½	Sept. '18,	0.25
Utah Copper	New York	66½	64½	65½	Mar. '22, Q	0.50
Utah Metal & T.	Boston	1½	1¼	1¼	Dec. '17,	0.30
Victoria	Boston	*72	[illegible]	1½		
Winona	Boston	*60	[illegible]	*60		
Wolverine	Boston	13½	12	13		
NICKEL-COPPER						
International Nickel	New York	17½	16¾	17¼	Mar. '19	0.50
International Nickel pfd.	New York	79	79	79	Feb. '22, Q	1.50
LEAD						
National Lead	New York	92½	90	92	Mar. '22, Q	1.50
National Lead pfd.	New York	113	113	113	Mar. '22, Q	1.75
St. Joseph Lead	New York	14	13½	14	Mar. '22, Q	0.25
QUICKSILVER						
New Idria	Boston	1¼	1¼	1¼		
ZINC						
Am. Z. L. & S.	New York	16	13½	14	[illegible]	1.00
Am. Z. L. & S. pfd.	New York	4[illegible]	[illegible]	46	[illegible]	1.50
Butte C. & Z.	New York	[illegible]	[illegible]	[illegible]	[illegible]	0.50
Butte & Superior	New York	27½	26½	26¾	[illegible]	1.25
Callahan Zn.-Ld.	New York	7½	6½	[illegible]	[illegible]	0.50
New Jersey Zn.	N. Y. Curb	145	143	143	[illegible]	2.00
Yellow Pine	Los Angeles	*45	*45	*45	[illegible] '20,	0.03

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, [illegible] Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, [illegible] Commerce; [illegible] Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.	
GOLD						
Alaska Gold	New York	⅜	¼	¼	......	..
Alaska Juneau	New York	1⅛	1	1	...	...
Carson Hill	New York	15¼	15¼	15¼	.	
Cresson Consol. G.	N. Y. Curb	2 1/16	2⅜	2⅜	Jan. '22, Q, X	$0.10
Dome Extension	Toronto	.		*85	...	
Dome Mines	New York	26¼	25¼	25¼	Jan. '22, Q	0.25
Florence Goldfield	N. Y. Curb	*25	*20	*22		
Golden Cycle	Colo. Springs	*72	*72	*72	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*8	*7	7	Dec. '19,	0.05
Hollinger Consol.	Toronto	9.75	9.55	9.65	Mar. '22,	0.05
Homestake Mining	New York	70	69	69	Mar. '22, M	0.25
Kirkland Lake	Toronto	*48½	*44	*45	....	....
Lake Shore	Toronto	2.35	2.25	2.30	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	20.60	19.00	19.60	Jan. '22, K	0.05
Porcupine Crown	Toronto	*30	*26	*26½	July '17,	0.03
Porcupine V. N. T.	Toronto	*31	*27½	*31	....	.
Portland	Colo. Springs	*32	*32	*32	Oct. '20, Q	0.01
Schumacher	Toronto	*57	*53	*53	... . .	
Silver Pick	N. Y. Curb	*21	*16	*16	....	
Teck Hughes	Toronto	*56	*40	*52		
Tom Reed	Los Angeles	*60	*51	*60	Dec. '19,	0.02
United Eastern	N. Y. Curb	1 5/16	1⅝	1½	Jan. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*16	*12	*12	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*8	*4	*4	. ..	...
Yukon Gold	N. Y. Curb	1⅛	1⅛	1⅛	June '18,	0.02½
SILVER						
Batopilas Mining	New York	1⅜	1	1	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*36	*33½	*35	May '20, K	0.03
Coniagas	Toronto			1.00	May '21, Q	0.12½
Crown Reserve	Toronto	*21	*18	*20	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3½	3⅜	3½	Jan. '22, Q	0.12½
La Rose	Toronto	*40	*31	*33	Apr. '18,	0.02
McKinley-Dar.-Sav.	Toronto	*24	*21	*22	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.15	1.00	1.05	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6¼	5¾	6¼	Jan. '22, Q, X	0.30
Ontario Silver	New York	†8	†7	7½	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	.		*12	Jan. '12,	0.10
Temiskaming	Toronto	*40	*34½	*38	Jan. '20, K	0.04
Trethewey	Toronto	*4	*3¾	*3¾	Jan. '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*31	*20	*25	....	....
Cash Boy	N. Y. Curb	*5	*4	*4	....	...
Dolores Esperanza	N. Y. Curb	1½	1¼	1¼	....	...
El Salvador	N. Y. Curb	*5	*4	*4	...	.
Jim Butler	N. Y. Curb	*8	*8	*8	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	....	....	*4	June '16,	0.05
MacNamara M. & M.	N. Y. Curb	*9	*6	*9	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1⅝	1 9/16	1⅝	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*69	*60	*68	....	.
Tonopah Extension	N. Y. Curb	1½	1 7/16	1½	Apr. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1⅞	1¾	1¾	Oct. '21, SA	0.05
West End Consol.	N. Y. Curb	1 3/16	1⅛	1 3/16	Dec. '19, SA	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*6	*6	*6	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	†1.00	†.93	*93	Dec. '20,	0.15
Chief Consol.	Boston Curb	3 11/16	3⅝	3 9/16	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	20	20	20	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†2.50	†1.50		July '20, Q	0.10
Daly-West	Boston	2⅛	1⅞	1⅞	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†3	†2½	2½	Apr. '21, K	0.05
Electric Point	Spokane	*6	*5½	*6	May '20, SA	0.03
Federal M. & S.	New York	11	11	11	Jan. '09,	1.50
Federal M. & S. pfd.	New York	40⅜	38½	40	Mar. '22, Q	1.00
Florence Silver	Spokane	*24½	*24½	*24½	Apr. '19,	0.01½
Grand Central	Salt Lake	*54	*53	*54	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	5⅞	5¼	5¼	Mar. '22, Q	0.15
Iron Blossom Con.	N. Y. Curb	*21	*21	*21	Dec. '21, Q	0.02½
Judge M. & S.	Salt Lake	2.60	2.60	2.60	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*10	*6	*6	June '21, I	0.02
Prince Consol.	Salt Lake	*9	*8	*8¼	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*5	*4	*4	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*10	*9	*10		
South Hecla	Salt Lake	†*60	†*35		Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*17	*15	*17	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*12	*10	*11	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.25	2.25	2.25	Jan. '21, K	0.04
Tintic Standard	Salt Lake	1.97½	1.92½	1.92½	Dec. '21, Q	0.05
Utah Apex	Boston	3⅝	3⅛	3¼	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	..	....	*2	Nov. '17,	0.01
VANADIUM						
Vanadium Corp.	New York	45	39	44¼	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	58	55½	56¼	Jan. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	78½	77½	77½	Jan. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	18⅜	16⅜	18¼	Nov. '19, Q	1.00
Texas Gulf	New York	42	40½	41½	Mar. '22, QX	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	57¾	53½	57¼	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	98½	97⅜	97¼	Mar. '22, Q	1.75
Am. Sm. Sec. pf. A.	New York	91	91	91	Apr. '22, Q	1.50
U. S. Sm. R. & M.	New York	38⅜	36¼	38	Jan. '21, Q	0.50
U. S. Sm. R. & M. pf.	New York	47	46½	47	Jan. '22, Q	0.87½

NEW MACHINERY AND INVENTIONS

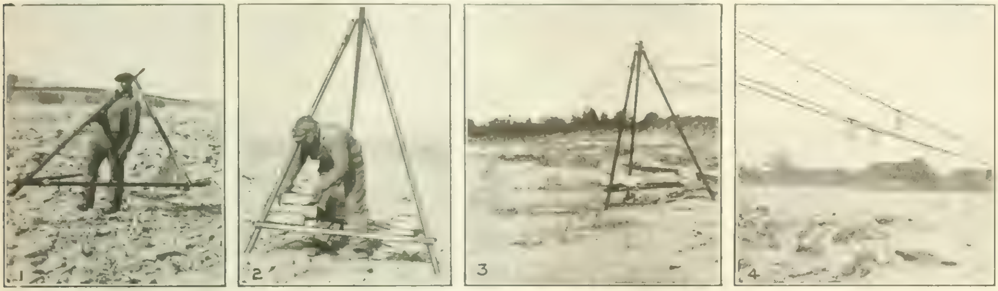
Suspending Temporary Electric Wires in Pit and Quarry

An Ohio stone quarry is making use of portable racks or standards for carrying electric wires used in blasting. The rack is about six feet high, weighs less than one hundred pounds and can easily be handled by one man. Where several are used they are placed from fifty to seventy-five feet apart.

The rack, consisting of three uprights that are braced at the base, is constructed of black iron pipe with a coating of black insulating paint, or of galvanized pipe. At the top the uprights are bolted together so as to form a tripod. Each upright is equipped with a short insulating sleeve and a porcelain knob insulator. The bolts holding these knobs in place are carefully insulated from the upright metal. A ballast plate is fitted on each base angle of the triangle so that boulders or other weights may be used for keeping the rack from being upset or blown over.

Wires as large as No. 4 stranded can be wrapped once around the porcelain knob, thus avoiding the necessity of tie wires.

For the amount of current required by a blast drill hole of 220 or 240 v., the Hubbell weatherproof composition attachment plug has proven satisfactory. Both wires of an attachment plug base are soldered to each of the power wires. Likewise, both poles of an attachment plug "cap" are attached to each wire of the cable leading to the portable electrical machine. The racks are made by the France Foundry & Machine Co., of Toledo, Ohio.



Portable racks for carrying electric wires

1 Carrying rack. 2 Placing standard for use. 3 Wires suspended from racks. 4 Sockets on racks

Mill Wreckage Cleared With "Little Tugger" Derrick

An inexpensive derrick was constructed and successfully used to clear away the debris caused by a fire that partly destroyed the 600-ton mill of the Silver King Coalition Mines Co. at Park City, Utah recently. Two "Little Tugger" hoists were utilized in the construction of the derrick. Originally they were operated in the company's mines and had been purchased for underground usage only.

The following is a description of the derrick and the work. The mast and the boom were made from telegraph poles. The mast is pivoted at the foot and held by guy ropes at the top. The boom is pivoted at the lower end of the mast. A rope is connected with the upper hoist and passes over a sheave at the top of the mast, through a pulley, and another pulley attached to the mast head at the top of the boom. This rope varies the angle of the boom.

The hoisting rope is connected with the lower hoist and passes under a sheave on the mast, over another sheave on the boom, and through two pulleys, one attached to the end of the boom and the other suspended from it. This is the rope which suspends the load.

The derrick is swung by hand, although if a bull-wheel were furnished another "Little Tugger" could do this work also.

The photograph shows the derrick in action. One-half of a Marcy mill has just been lifted clear of the ground.

Salvaging mill wreckage with small hoist

The Hundrieser Rock Drill

The scope of electrically operated, rotating rock-drilling machines has been somewhat extended by the invention of a new rock drill, a short description of which follows:

Most of the drills that have been used for the working of medium hard rocks, such as coal, potash, gypsum, chalk, and slate, comprise two cylindrically arranged uniform edges, whereas the Hundrieser breaking drill, in contradistinction, is shaped as shown in Fig. 1, page 656, with its edges arranged eccentrically, thus insuring a partial breaking of the material to be drilled. About 60 per cent of the boring dust is made up of small grainy fragments, whereas that of standard drills is of a mealy consistency. Owing to this breaking effect, the amount of energy expended for a given length of bore hole is less than in the operation of the usual type of edge, savings up to 50 per cent being obtained. Moreover, the bore hole becomes perfectly cylindrical, with smooth walls, there being no deviation of bore holes.

When using the new type of drill, it is quite essential that any dulled drills should be properly reground. Special wet grinding machines are designed for this purpose, equipped with emery disks of proper shape. Inasmuch as the drill is made of high-grade 16 to 18 per cent tungsten steel, water cooling is of the utmost importance. The following data show the economical advantages to be derived from the use of the new drill:

In a potash mine about 1,052 meters of hard salt were drilled with twenty-four drills of the usual type. During the operation the drills were used up completely, their edges representing a purchasing value of about 800 marks. Fifteen Hundrieser drills were used in drilling 1,826 meters in the same hard salt and only one-third of the drills were worn out, corresponding to an outlay of 475 marks. The total cost in drilling 1,052 meters with the old type of drill amounted to 1,681 marks, whereas the outlay for the new type of drill (despite the greater boring length of 1,852 meters) was only [illegible]00 marks. One meter of bore hole, in using drills with the old type of edge, thus averaged

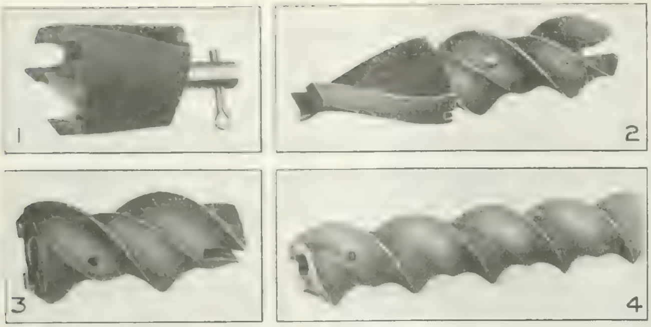


Fig. 1. Cutting edge of Hundrieser drill. Fig. 2. Drill in conjunction with intermediate piece. Fig. 3. Intermediate piece for use in conjunction with Hundrieser drill. Fig. 4. End of boring rod prepared to be fitted direct

a cost of 1.70 marks and with the Hundrieser breaking edge, 0.28 mark. To this should be added the further advantage of about 50 per cent saving in electrical energy. Moreover, the Hundrieser drill insures a higher speed of working. With the old type of drilling edge twenty-three holes of 29.60 m. total boring depth and 45-42 mms. diameter were drilled in five hours and ten minutes, whereas with the Hundrieser drill twenty-three holes of 29.80 m. total depth and 42 mms. diameter were put down in three hours and twenty-five minutes. The drilling time per meter of hole when using the old type of drill averaged ten minutes and thirty seconds, and with the Hundrieser drill the average was seven minutes.

The advantages afforded by the Hundrieser breaking drill can readily be made use of anywhere, as most drilling rods can without difficulty be adapted to the new drilling edge.

Fig. 2 shows the drill in conjunction with an intermediate piece, the latter alone being shown in Fig. 3. The end of a boring rod of sufficient thickness, prepared for a Hundrieser drill to be fitted direct, is represented in Fig. 4.

INDUSTRIAL NOTES

The Combustion Engineering Corporation announces the opening of a new branch office at 1,137 Guardian Building, Cleveland, Ohio. This office will be in charge of Frank Henderson.

The Electric Furnace Co. has moved its general and sales offices from Alliance, Ohio, to Salem, Ohio. By this action all departments of the company will be consolidated at its works, Wilson St. and Pennsylvania Railroad, Salem, Ohio.

The Aztec Gold Mines Co., Baldy, N. M., will remodel its present milling plant and other equipment at an early date, and would be pleased to receive catalogs from manufacturers of crushing, amalgamating, concentrating, cyaniding and flotation machinery. The post-office address of the company is Ute Park, Colfax County, N. M.

The Metals Coating Co. of America, manufacturers and distributors of the Schoop Metal Spraying Process, by means of which metallic coatings of any kind may be sprayed on to any surface, is in full operation at its new plant, 495-497 N. 3d St., Philadelphia, having removed from the company's former Boston, Mass., and Woonsocket, R. I., locations.

In the *Journal-Press* of April 1, on p. 552, our correspondent stated that an installation of rotary car dumpers was being placed at the Odgers mine of the McKinnery Steel Co., Iron Mountain, Mich., and that the work was being done by the "Chicago Car Dumping Equipment Co." The correct name of the latter concern is the Car-Dumper & Equipment Co.

Sandvik Steel, Inc., announces the consolidation of the company's general steel and steel-belt conveyor departments in Suite 2,001, Woolworth Building, 233 Broadway, New York City. The following are the officers of this company: W. D. Thomas, president and general manager; Anders Johnson, vice-president; Garrick M. Spencer, secretary, and Harry Carlson, sales manager.

The Freeport Sulphur Co., of New York and Freeport, Tex., awarded a contract on March 24 to Dwight P. Robinson & Co. for the design and construction of a complete sulphur-mining plant at Hoskins Mound, Tex. Cloyd M. Chapman has been retained by the Freeport Sulphur Co. as consulting engineer. The company now operates a large sulphur mining plant at Freeport, Tex., consisting of four units which were built by Westinghouse, Church, Kerr & Co. (which has been merged into Dwight P. Robinson & Co.) in the period from 1913 to 1918. This plant contains one of the largest installations of oil-burning boilers in the world.

The new plant is one of several industrial undertakings recently awarded to Dwight P. Robinson & Co., and indicates the renewed activity that seems to be generally apparent in industrial construction.

TRADE CATALOGS

Mineral Specimens—George S. Scott, of 20 Nassau St., New York, has issued a twelve page pamphlet which describes the characteristics of 125 mineral specimens included in collections for sale.

Steam Turbines—The Allis-Chalmers Manufacturing Co., of Milwaukee, Wis., has issued Bulletin No. 1,119 on "Steam Turbine and Alternator Units," covering high-pressure condensing units of 1,500 and 1,800 r.p.m.

Industrial Diamonds—J. K. Smit & Zonen, Amsterdam, Holland (U. S. agents, I. C. Van Itallie Co., 90 West St., New York), have issued an attractive fifteen-page pamphlet, which includes information on Brazilian carbons and borts (bortz) used for diamond drilling and other industrial purposes.

Recorders—The Uehling Instrument Co., of Paterson, N. J., has recently issued Bulletin 112, "Uehling CO_2 Equipment." Attention is called to the recently developed Pyro-porus filter, which is efficient in keeping the gas sampling lines clean. Other noteworthy features are the separate recorder for the engineer's office, an indicator for the boiler front continuous (not intermittent) chart record, and dry method of absorption.

Hammer-Weld Pipe—Until now not much hammer-welded steel pipe has been manufactured in this country, in comparison with the established types of welded, cast, riveted, and fabricated pipes. Considering the wide field for this material, and the particular advantages offered, Bulletin No. 13 of the National Tube Co., of Pittsburgh, Pa., will consequently be of interest. Hammer-weld pipe is particularly efficient for water lines, and offers distinct advantages where corrosive tendencies obtain, low friction loss, freedom from leakage, and ease of construction.

Reducing Valves—Most reducing valves, according to the Atlas Valve Co., of Newark, N. J., are needlessly large. Consequently, they are unduly expensive. The whole matter of reducing valve economics is fully covered in a new handbook just issued by the above-named manufacturer. The handbook goes into complete detail on all points that are closely connected with and vital to reducing valves. The flow of steam through pipes is handled in a simple manner. Charts and formulas are entirely eliminated. Handy tables make it possible for the user to determine at a glance just what a given pipe size will do. Also, the tables will enable the user to select the proper size of pipe needed for a given weight of steam per minute. Other features cover: Superheated steam; heavy pipe; pipe fittings; leaders to heating systems; pipe friction allowances and steam velocities. The manufacturers will send a copy upon request.

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JOURNAL-PRESS
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Special Consulting Editors

Volume 113 New York, April 22, 1922 Number 16

A Russian Opportunity

GOLDEN OPPORTUNITIES are scarce these days, so perhaps the one revealed to us by a caller recently may be interesting. Our caller said that ten thousand American engineers and workers would open up at once in Russia—in Siberia—the "greatest industrial region in the world." Volunteers are asked for, to take charge of a mighty territory with every conceivable industry already established, but badly neglected. If you are interested, we will gladly furnish the New York address where you can make application. You must pass a severe examination as to physical fitness; you must have $300, one-third each for transportation, food, and tools; and you must turn this money over to the organization committee. You must pledge yourself to submit to discipline, and in the last analysis to accept as final "the highest Soviet authority in Russia." You pledge yourself "to take into consideration the extreme nervousness of the hungry and exhausted Russian workers and peasants, and to try by all means to avoid friction, jealousy, and misunderstandings, and to attempt by all means to establish friendly and amicable relations." (We are quoting the promotion pamphlet, issued in February, 1922.) The applicant must pledge himself "to work at least two years in Soviet Russia and to pay his own traveling expenses thereto, for clothes for two years, $100 for food, and in addition $100 or more for necessary tools and machinery."

Why are the workers in Russia "hungry and exhausted"? Why are the factories closed and the machines idle, as the pamphlet explains, despite the glorious fact that the Russian Revolution "gave the land to the peasants and the factories to the working man"? The artless promotion literature explains all. "The industrial workmen started production under revolutionary control, and the demands of the revolution called them from the factories." . . . "Some went to the front in charge of the Red Army." . . . "Others became administrators of the government. Less conscious workers returned to the villages to till their acreage of free land. These three movements from the factories continued until at last the factory had to close down for want of skilled proletarian labor." Therefore, ten thousand Americans are wanted at once to reopen the factories.

What will they get? "The workers will receive from their production a satisfactory standard of living. . . . The remaining product (except the customary Soviet taxes) will be used to extend the industrial equipment of the enterprise."

Are you equipped for the enterprise? The organization must have "full-chested, open-air men; men who can do things, while they get their dinner from the river and snap it on the wing; men who can stand lonely nights on the edge of the earth and do it willingly, because of the big thing that stands as a beacon light before them."

"Why go at all?" you may ask. Even this may be found in the promotion pamphlet. Each member "undertakes to work at his or her highest capacity, in order to create the highest form of production, so that they will prove by deeds that the workers are more capable of operating industry than the capitalists."

We have had many illuminating close-ups of Russia, but these extracts from a Soviet pamphlet carry a peculiar conviction.

O foolish and dreamy-eyed children! Where is the merciful Providence that watches over children, drunkards, and fools? They die like sheep in a Wyoming blizzard, back on the Russian steppes, or huddled into the ruined houses of Petrograd and Moscow. The greatest tragedy of all national tragedies is being enacted day by day; yet the vague-eyed Marxian philosopher and foe of capital and profit, with a full New York capitalistic meal beneath his vest, is dreaming of recruiting ten thousand enthusiasts with two years' capital each, whose capital shall prove that capital is unnecessary and money undesirable. He came to us to ask to serve as our correspondent in Russia, for money, and was disappointed at the smallness of our rates of pay.

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Proposed Congressional Action on Trade Associations

THE ENCOURAGEMENT and wise regulation of trade associations, and a stated modification of the so-called anti-trust laws, which we referred to editorially on April 1 as having been under investigation by the Department of Commerce under Mr. Hoover, has been further sought after through the legislative branch, in a resolution introduced on April 3 in the Senate by Senator Edge, of New Jersey, and in the House by Representative McArthur, of Oregon. The resolution provides for the appointment of a committee of three Senators and three Representatives to make a study of the subject and recommend legislation "to define the rights and limitations of co-operative organizations, as distinguished from illicit combinations in restraint of trade."

In commenting on his resolution, Senator Edge said: "These are days of necessary business organization in order to cut overhead and assist in minimizing costs of production and distribution. To accomplish this, co-operation, of course, is essential and necessary. The distinction between monopoly and illegal restraint of trade and co-operation, which should lower costs to the consuming public and thus encourage activity in markets, should be clearly defined, and, in my judgment, can be. Certainly, the present situation is intolerable and must be remedied."

We have several times editorially cited the Government action in aid of the farmers as an example of what should be extended to the miners.

Senator Edge also called attention to the analogy between the necessity for co-operative action by the farmer, already granted by Congress, and that existing in other great industries: "The policy of the present Congress in this direction has been well demonstrated through the legislation already enacted authorizing co-operative marketing by agricultural associations. This legislation received practically the unanimous support of Congress, and if a method can be devised which will give industry a similar opportunity, and still prevent monopoly and restraint of trade, as already prohibited under existing statutes, Congress will certainly be contributing towards the solution of existing economic ills."

The committee suggested, if the proposed resolution shall pass, will make its report to Congress not later than Dec. 4, 1922.

We recommend support of the Edge resolution. We assume it has the support of Mr. Hoover.

The Chamber of Commerce of the United States has also appointed (April 3) a committee to study and report on trade associations, this committee representing various important industries, including agriculture and the coal industry, but, unfortunately, not the other mining industries.

The miners (we refer to them collectively, in the same sense as we denominate those interested in the agricultural industry "the farmers") will be interested in an extract from the bill whereby Congress granted the rights of co-operative action to the farmers, on Feb. 18: "That persons engaged in the production of agricultural products as farmers, planters, ranchmen, dairymen, nut or fruit growers may act together in associations, corporate or otherwise, with or without capital stock, in collectively processing, preparing for market, handling, and marketing in interstate and foreign commerce, such products of persons so engaged. Such associations may have marketing agencies in common; and such associations and their members may make the necessary contracts and agreements to effect such purposes."

It is further provided that the Secretary of Agriculture may restrain associations which use their functions to "unduly enhance" prices, and that he shall have final recourse, if necessary, to the courts, to sustain his decision.

Industrial Information

MR. HOOVER said in Washington, at the meeting with trade association representatives, that if the accumulation and publication of trade statistics were in themselves illegal, then the statistical information published in the newspapers concerning the industries must be abolished, and the industries would have to work on in the dark. "And in this case," he observed, "the United States would be bankrupt in ten years."

Mr. Samuel Untermyer, of New York, a distinguished attorney, made public a letter to Mr. Hoover, which was printed in the papers at the same time as the report of the conference of trade associations with officials of the Department of Commerce. In this letter he took Mr. Hoover to task for his attitude toward the encouragement of trade-association activities, and makes the [illegible] argument that as Mr. Hoover is not a lawyer he is not fitted to deal with the question. We understand that Mr. Hoover had replied to Mr. Untermyer's letter, with the request that no publicity should be given to the letter unless his reply also was printed; but Mr. Untermyer did not, apparently, take note of this fair and sportsmanlike request. But in Mr. Hoover's speech in Washington to the trade-association representatives he observed that the problem of trade associations was not exclusively or even chiefly a legalistic one, but was an economic and industrial problem, and, therefore, within the scope of the duties imposed on the Department of Commerce by its organic act. Well said! Who gave the lawyers universal prescience and an exclusive right to maintain government by their querulous interpretation of obscure, hasty, and often unintelligent legislation? In Russia, in the gigantic experiment there, they scrapped the lawyers and the engineers and the merchants all together: but they have had to come back and beg for the engineer and the merchant to return; but so far they have not yearned a bit to have the lawyer back. In other words, in the category of prime necessities, they have, to say the least, not reached him yet.

Industrial Uses of Zinc

WHAT OF ZINC? Three or four years and more ago almost everyone knew of the campaign to "Make It of Zinc." Now, however, the ruling idea seems to be to make it of copper. Is the zinc campaign still on, and how far has it been carried? What new uses of zinc have been perfected? How do fabricators feel about the zinc situation?

Zinc is a young metal compared to copper and iron. It was not until the eighteenth century that the art of smelting zinc ores was known to Europeans and it was not until the nineteenth century that the metal was used in the arts extensively. Galvanizing was not invented until about 1837. Apparently, no great efforts were made to push the metal until the last decade. In the last few years, however, the American Zinc Institute has instituted an active campaign on behalf of the metal, and several individual companies have done even more than their share to advertise its merits. Chief of these is the New Jersey Zinc Co., and it is possibly owing to the fact that its advertising appropriation has been cut about 75 per cent during the last two years, while that of certain copper interests has been augmented, that the public feels that something must have happened to the zinc campaign.

The principal uses of zinc are for galvanizing, for zinc oxide (used in rubber and paint), and for brass making. These outlets for the metal are well known. They take possibly 80 per cent of the quantity produced. Definite figures are not available, but it is understood are being compiled by the American Bureau of Metal Statistics. The other 15 or 20 per cent goes into varied industries, but a fairly large part of it is rolled into plates and sheets, and it is in the use of these in the building industry that the principal chance for expansion lies.

To the layman, zinc is known chiefly through its use for galvanizing iron to prevent rust. The term "galvanizing," by the way, is unfortunate, for it conveys no hint of the name of the metal actually used. Between "galvanizing" and "spelter" zinc has had to struggle against a peculiar handicap—against aliases which are commonly used to cover up an undesirable career. But now that the public and zinc are becoming better acquainted there seems to be a greater tendency for the metal to come out and be known by its real name. Galvanizing, however, will be hard to replace. We might say zincking or zinc plating, or we might copy an idea from the jeweler's use of "gold filled." This has always seemed illogical to us, however, for one would think a gold-filled article was filled with gold instead of being plated with that metal. Galvanizing will no doubt continue in favor for some time.

Although the use of galvanized pails and other articles demonstrated the value of zinc, we are not at all sure that familarity with galvanized iron has increased the respect in which the non-ferrous metal is held. Galvanizing, particularly in this country, is all too often done down to a price rather than up to a standard. The iron is given an extremely thin coating, and, what is worse, an uneven one, sometimes small spots being entirely missed. As a result, durability is not greatly increased, and the buyer gets the impression that zinc, although rustless, does not wear long. The zinc industry has a real problem in persuading galvanizers to turn out an honest product. The difficulty is, of course, that a poorly galvanized article looks just the same as the best, and unless a manufacturer establishes a reputation and a demand for a certain brand he will have a hard time marketing his somewhat higher priced product.

Increased use of automobiles has greatly enlarged the demand for zinc oxide as a filler to improve the resiliency and durability of automobile tires, for which its only competitor of importance is carbon black. It is also a valuable paint pigment, sharing the field with lead. Should the demand for rouge continue unabated we may come to speak of the "tonnage" going into this field, for the basis of many kinds of rouge is understood to be the common zinc oxide of the medicine shelf!

Brass contains varying percentages of zinc, and the demand from this industry is beginning to be more apparent, owing to the fact that the large tonnages of war scrap are practically exhausted. Some of the copper propaganda will affect zinc favorably in the brass field.

The newest and most interesting outlet for zinc is as a roofing and siding material, and for leaders and eavestroughs. This might be called largely a war development, for during the period of hostilities the zinc-rolling capacity of the country was largely augmented, and when peace came this equipment and experience went begging. However, the New Jersey Zinc Co., the Illinois Zinc Co., the American Zinc Products Co., the Anaconda Copper Mining Co., and others, in co-operation with the American Zinc Institute, determined upon an active campaign of public education to the merits of sheet zinc. They were aided in this by the recent production of a larger proportion of the more desirable electrolytic and high-grade zinc, and by the fact that many Americans had become cognizant of the advantages of zinc as a building material through war-time observation in Europe, where the metal has been used on roofs for nearly a hundred years without replacement.

To succeed, it is not sufficient to make a better mouse trap than one's neighbor, as Emerson suggested. The possible buyer must be taught that it actually is a better trap, how to set it, and the proper kind of cheese to use. Manufacturers of zinc building materials have had to combat not only ignorance and indifference as to the method of application and the efficiency of their product, but have also had to fight against an insidious attitude on the part of jobbers and roofers, inspired by the fact that repair work would not be so necessary or profitable where zinc had been used. However, much progress has been made, and inquiries are being received in a constantly increasing volume. Zinc shingles for houses are as permanent as the house itself, and in the present designs the butt-shingled effect of wood is secured. An oxidized surface of a slate gray color has been perfected which harmonizes well with ordinary forms of construction and finish. To be sure, the colored effects possible with copper cannot be secured, except by painting,, but the cost is only half that of copper; in fact it is little if any more than that demanded for a good wooden shingle.

An objection offered to the use of zinc for eavestroughs and leaders is the high coefficient of expansion—it is about 2.6 times that of iron. This has been solved by the use of corrugations, slip joints, and improved methods of hanging. It only remains to make the buying public understand that old objections no longer hold.

As an industrial sheathing and roofing, corrugated zinc should have a wonderful future. By using a somewhat heavier gage and by making the corrugations deeper, a corrugated sheet has been developed only recently which can be laid on iron purlins spaced at conventional distances, without danger of collapse. By thoroughly painting the purlins before the sheets are laid, or by separating the zinc from the iron by pieces of asbestos, galvanic action is avoided and the roof will last indefinitely. Where corrosive gases are present, as at smelters, refineries, and chemical plants, the advantages of a properly laid corrugated zinc roof and siding should be great, but have hardly been considered as yet. In fact, in the chapter on "Roof Coverings" in Professor Ketchum's authoritative book on "Steel Mill Buildings," 1921 edition, the use of zinc is not even mentioned. However, the following statement does appear: "In 1898, the author saw at the Trail smelter, Trail, B. C., a corrugated steel roof made of No. 22 corrugated steel and painted with oxide of iron paint, that had corroded so rapidly in one year that one could stick his finger through it as easily as through brown paper."

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Remarks by the Editor

COMMENTS on the journalistic "event" of the consolidation of *Engineering and Mining Journal* and *Mining and Scientific Press* continue to drift in from day to day.

The *Arizona Mining Journal* prints a little of the usual rubbish:

> "The unfortunate part is that the Western country is now without a so-called national mining publication, one that is close to its problems; and that the national publication must now be published from New York City and imbued with the New York City idea of the Western mining industry and its general feeling that we are still in an uninhabited and wild country, and that we should be dominated by the financial interests of New York City."

Comment is obvious and therefore unnecessary.

The *Mining Journal*, of London, is owl-like in its ability to draw conclusions, saying, with the British prerogative of passing final judgment on the United States:

> "The development illustrates strongly the centralizing tendencies operating at present in the United States, where the standardization of material is obviously begetting a corresponding tendency in the standardization of ideas."

A Daniel come to judgment—yea, a Daniel!

The *Financial News*, of London, however, helps to give us greater faith in Lloyd George as a Europe-doctor. It is businesslike and kind:

> "The *Mining and Scientific Press* was founded in 1860;

the *Engineering and Mining Journal* in 1866. The papers have been rivals, but they have pursued the same policy in all essentials, and both have been spokesmen for the highest ideals of the mining profession and the best interests of the mining industry."

And the *Iron Age*, of New York, regarded by many as the leading iron and steel journal, takes cognizance of the union in a really critical and able editorial. Referring to the competition of technical journalism with society-subsidized publications, like *Mining and Metallurgy*, it says:

> "Some of the engineering societies, after gaining numerical strength, in part by the help of technical and industrial publications which have been built up on their merits, have thought to capitalize the buying power of their memberships by going into the publishing business. Call it endowment or subsidy or whatever else, this use of the resources of such societies to establish a competitive business was never contemplated in their charter grants. It is a question, moreover, how far membership sanction would be given to these publishing enterprises if they were made the subject of a referendum. What has just taken place in the mining field may start some thinking on aspects of the matter that have not had much attention."

As for *Mining and Metallurgy* itself, its advertising agents, at least, were not slow in striving for a commercial advantage, and of our consolidation they write to engineers under date of March 18:

> "*Mining and Metallurgy* has taken on greatly added importance since the announcement of the consolidation of *Mining and Scientific Press* and *Engineering and Mining Journal*. This, together with the pronounced improvement in the make-up and editorial policy of *Mining and Metallurgy*, and the fact that it is the official organ of the Institute and is owned and published by it, will, we feel certain, cause you to agree that its sphere of usefulness and influence would be greatly enhanced were we to include in it a comprehensive Professional Directory service. The charge for this service will be $36 per annum."

Ha-ha (sardonic laughter)! Here's to the money-making Institute! Why, we publish a professional card fifty-two times for $25 a year, friend Perlmutter? A topsy-turvy world! When the Institute is out after profits, and the *Journal-Press* after increased service at a lower upkeep, where, then, are our old-time notions?

A subscriber in the San Juan (Colorado), writing, not for publication, to the editor, thus comments on the use of the wireless to miners:

> "Your editorial in the issue of Feb. 25 regarding the possible application of wireless to broadcasting *Journal* matter interests me, and I am prompted to write you about it. I have become a 'Radio Fan' myself to some extent, and perhaps my observations will be of some interest.
>
> "I have placed in my home a first-class receiving set, Westinghouse make, and have taken an agency for the stuff as a side line during dull times and for the purpose of familiarizing myself with the possibilities, for I believe this will soon become a valuable adjunct to mining operations.
>
> "My experience is probably typical of what would be that of the average individual in a mining district. I have not been at it long enough to determine many things, but I have learned the essentials. Nightly, I receive the day's news from Denver, a day ahead of our papers; I get the day's market reports and quotations; a great deal of music is broadcasted, some of it first-class music by regular artists. I do this with ease and in comfort—simply sit down in my home at a neat little table and outfit, turn the dial, and 'listen in.' It is marvelously simple and a fascinating study—offers plenty of scope for the man with the experimenting turn of mind, yet is compact and ready-made for the man who doesn't want to experiment. You can readily understand what an appeal this has for the dweller in a mining camp. I receive also other stations, but less satisfactorily; I receive innumerable telegraph stations, and their messages will become of much interest when I have learned to receive—understand—telegraph signals. As the thing progresses, I will get more and more things of interest, and from still other stations."

Somehow or other, by a kind of wireless telepathy, this puts us back in San Juan.

Our special European correspondent, Mr. Jacques Negru, mining engineer and graduate of the University of Liège, now in Europe after years of professional work in the United States, has sent us an interesting diary. What he says about his own native people is illuminating:

> "The first impression one gets of the Belgians, judging from the appearance and actions of the people, is that they have become quite sober and do not show the same vivacity as before the war. They move about slowly, talk calmly, and are very simply dressed. There was scarcely any conversation in the compartments on the train. How very different from before the war! There are few automobiles on the street and practically no trucks. Flemish horses are still on the job."

The second of our series of marketing articles appears in this number. This article, by Charles Hardy, deals with the problem of marketing tungsten. It is a subject we should all know about. Mining schools should include the knowledge of marketing in their curricula.

Then in the field of non-metallic mining is the second article on the asbestos district of Quebec. This district is far and away the most important source of the world's asbestos, so we are naturally much interested in it; and this article deals with the mining, milling, and preparation of the mineral.

An article by Sydney Ball, on the copper metallurgy of the Central African natives, is of curious interest. The metallurgist, it appears, was rated even more highly in Darkest Africa than he is in our own land. Incidentally, community action and trade associations are outlined in their tribal customs. That certain mineral sulphides are storehouses of electric energy which may become of commercial value is shown by experiments described by G. N. Libby.

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Engineers' Reports on Mines

THERE ARE conservative, ultra-conservative and timid mining engineers as well as careless, free-thinking, and courageous engineers. Their reports on mining properties vary accordingly. This is equally true of all branches of engineering. It is also true of business men. The ultra-conservative balance with the ultra-positive; the courageous with the timid. It is good for any industry to have this balance, as the average is probably the representative of the initiative which advances the industry in question.

Mining projects are accepted or rejected for a variety of reasons which are more or less not publicly expressed. Unless all of the facts are known, unless the specific instructions given to an engineer by his client are exposed, judgment of a report and of the engineer cannot be equitably made. No one can say that he played "safe" nor "ten-times safe."

The Functions of Institutes—II

By T. A. Rickard

IN a preceding article on this subject I ended with a compliment to the Institution of Mining and Metallurgy, stating that its success was due largely to the fact that the British mining profession was concentrated in London. Indeed, this geographic factor enters largely into the success of a national professional society. The wide extent of the United States and of Canada is one reason why the American and Canadian institutes have succeeded less well in serving the mining profession. The distance of most of the members from headquarters renders representation difficult. Those in control of the Institute have tried to obtain representative management by means of selecting directors from the various Local Sections, but the plan has broken down for the simple reason that engineers living at a distance from New York have neither the time nor the money to go thither to attend the directors' meetings. In consequence of their failure to attend, the control has passed into the hand of a small group of directors—six or eight—living in New York or in its environs; and they have acted for the whole board of 24 directors. Thus a coterie has exercised control, not necessarily because they have striven to obtain it, but by the logic of circumstance and also perhaps on account of the fact that they have given the Institute the financial backing that it has needed more than once during the last year or two. Thus the Institute has passed into the control of "a self-perpetuating oligarchy", as Mr. Spurr has phrased it in his presidential address before the Mining and Metallurgical Society. A sagacious leader of the profession, Mr. Philip N. Moore, has suggested that representation for the Local Sections at a distance be obtained by nominating persons resident in New York to serve for them on the board of directors. This is a palliative only, for those who live in New York soon lose touch with the West. The difficulty is geographic. The remedy is to develop regional—not local—Sections, and diminish the centralization in New York.

In discussing this subject, I assume that the principal functions of such a society are to promote the solidarity of the profession, to develop the idealism of public service, to further acquaintance and goodwill among its members, and to do these things by means of meetings and discussions. The publication of technical articles or papers or essays is incidental to the performance of its major social function. Whatever the conditions thirty years ago, it is easy nowadays for an engineer to find other means of publishing his writings, so as to reach the profession or the public. As for the discussions at the meetings, it is safe to say that they are less valuable than the conversations between members before and after the formal meetings. This is a phase of their social activities that is not sufficiently appreciated. The value of the printed discussions, on the other hand, is over-rated, because much that appears in them comes from persons with a bias. This is especially true of some of the controversies over the relative merits of proprietary devices and patented machines, concerning which a lot of rubbish has been printed in the Transactions of the American Institute, simply because there has been nobody sufficiently courageous (and sufficiently aware of the commercial ties of the speakers or writers) to apply the blue pencil vigorously. During recent years the meetings of the Institute have been utilized systematically by the representatives of manufacturers. I do not blame them; they are to be congratulated on their skill in using such occasions for the purpose of publicity; but, it may well be asked, how did they become members? They are not mining engineers, metallurgists, or geologists, and they do not pretend to be what they are not, although some of them were recruited from the ranks of the profession. The Transactions contain many papers on 'The Jones machine, by Jones', and 'The Smith process, by Smith', but the worst lapses are similar propaganda, in pseudo-literary form, with no acknowledgment of the business or commercial link between the subject of the paper and the writer of it. At some of our meetings the machinery agents have given the dominant tone, socially pleasant enough, but utterly stultifying to the dignity—that is, the scientific trustworthiness—of the technical discussion. However, despite the warnings of experience—particularly the experience of others, which is the easiest and cheapest kind of experience—the Canadian Institute is hungering for an expansion of its membership and a spreading of its activities, so as to become bigger—just as if mere bigness were not the curse of the modern world! Mr. Mackenzie is not content with enrolling the promoters and secretaries of mining companies; he desires the Canadian Institute "to expand logically along industrial lines", which he explains thus: "We must secure many more members from amongst the business men who have invested their money or are directing the investments of others, prospectors, salaried employees, and public-spirited citizens—and, in fact, take in all reputable persons who wish to identify themselves with us". Well, that is exactly what the American Institute has done from time to time, followed by spasms of selectiveness, as various presidents have been in temporary ascendancy. The result is a mob, not a technical society. It has been assumed that increase of membership would assure financial resourcefulness, whereas, of course, the increase of members has led usually to an expansion of the staff at headquarters, to the deputizing of duties, to swollen publications, to the careless use of money, and to the decay of vitality that follows spurious growth. Those connected with the periodical press know that an increase in the number of subscribers entails actual loss unless the new subscribers are of the same kind as those on whose support the paper has been built. Mere expansion is worse than futile unless it be in the right direction; that is, in the direction that leads to the fulfilment of the essential purpose for which the institute or the technical journal exists. It is not toward that kind of useful expansion that the Canadian Institute is heading; it will become, as the American Institute has become, a nondescript organization of all those connected with the mining industry; in short, a Mining Congress.

DISCUSSION

The Problem of Depletion

Solution Seemingly No Nearer in Spite of Space Devoted to Subject in Internal Revenue Regulations for 1922

REGULATION 62 of the Bureau of Internal Revenue contains what is supposed to be the last word on depletion. Is the problem any nearer solution than it was three years ago?

> "Art. 206. *Determination of fair market value of mineral property other than oil and gas.* . . . The value sought should be that established assuming a transfer between a willing seller and a willing buyer as of that particular date. . . . Valuations by analytic appraisal methods such as the per cent value method are not entitled to great weight: (1) If the value of a mineral deposit can be determined upon the basis of cost or replacement value, (2) if the knowledge of the presence of the mineral has not greatly enhanced the value of the mineral property, (3) if the removal of the mineral does not materially reduce the value of the property from which it is taken, or (4) if the profits arising from the exploitation of the mineral deposits are wholly or in great part due to the manufacturing or marketing ability of the taxpayer. . . ."

Can anyone imagine an instance where the buyer of a mine was unwilling?

The cost of most mines is represented upon the books of the company by a charge to property account, and a corresponding credit to capital stock, or probably the vendor accepted a cash payment and the balance in stock having a par value of say $5, which went on to the New York Curb at $1.75 and then went down to 37½c. and stayed there. What did the mine cost the company? If it paid all cash, it's plain sailing, unless the company afterward "discover" the presence of mineral greatly enhancing the value of the property.

Depletion was supposed to be (notice I say "was") a deduction from income allowed by the Government for the purpose of reimbursing the owner for the cost of the property. If, therefore, a property was purchased for $200,000 on the assumption that it contained enough ore to pay a profit on the purchase price, (the cost of development and equipment having been taken into consideration as a future charge against ore extracted, in figuring the possible profit), and it is afterward found that the mine contains more or higher-grade ore than was expected, does this discovery increase the original cost of the mine? Depreciation is a deduction allowed from income, of an amount sufficient to replace equipment or plant when it is worn out. It must be figured on cost, not on value. It might have cost considerably less than it would have later, but the taxpayer is not allowed to take advantage of the enhanced value. It would be a peculiar sort of mine which would not be reduced in value by the removal of its contents.

If a mine is being profitably worked, because of good and efficient management, that fact puts another phase on the question of valuation. Who is to decide this point? Based on experience as to recovery cost and selling price, "the number of units recoverable in marketable form multiplied by the difference between the selling price and the operating cost per unit gives the total expected operating profit. The value of each mineral deposit is then the total expected operating profit from that deposit reduced to a present value as of the basic date . . ."

Records and data are no criteria as to what will be in, say, ten years from now. Several of the larger mines have from twenty-five to fifty years' ore in sight. Who knows what the average selling price of copper is going to be during the next twenty-five or fifty years or how much costs will be reduced and recoveries increased by improved mining and milling methods? The whole trouble over depletion arose over the wording of the law.

If a property was acquired after March 1, 1913, the basis for depletion charges is the *cost* of the mines, mills, and other holdings. If prior to that date, the fair market *value* on that date. No one has ever been able to figure the value on March 1, 1913, of a mine acquired and worked prior to that date. The law contemplated an allowance to return to the owner in years subsequent to March 1, 1913, that part of the cost of the mine applicable to those years when purchased prior to March 1, 1913. But it didn't say so in words anybody could understand. In years prior to 1913 no one had ever seen a depletion account on mining books. Some lawyer Congressman had it in his head without doubt, but could not say it. He wanted to say that the Government would not be responsible for that part of the cost of a mine applying to any period prior to March 1, 1913. He knew that, if the cost was credited with something represented by the ore taken out prior to that date, the balance on March 1, 1913, would be what the Government would allow to be deducted, but he said "*value*," and consequently mines were all worth on March 1, 1913, more than they cost, notwithstanding development work had been charged off against ore as mined.

If each separate mining company is to be allowed to do the guessing, and these guesses become a source of controversy with the Internal Revenue Bureau, which maintains a special division called National Resources for the purpose of making contra guesses, why not let the Government do all the guessing and furnish a factor to be used for fixing depletion in the mining of each mineral and also the production of oil and gas, this factor to be changed each year as production costs and selling prices increase or decrease? This would save the Government millions of dollars in the Natural Resources Division of the Internal Revenue Bureau and cut down the income of a lot of high-brow accountants who are reveling in the intricacies of the present law.

Two good men in the Natural Resources Division can in a month compile all the guesses made for three years on depletion per pound or per ounce of the different metals, per barrel of oil, per 1,000 ft. of gas, timber and other things, and strike an average. Reduce that about 25 per cent and hand the results out to be used as the standard factors for 1922. Fire several hundred employees and cut down expenses, which the taxpayers are paying. Cut out the bunk and get down to results.

Washington, D. C. C. B. Holmes.

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Cheap Copper

A rearrangement of prices has been going on throughout the world since the autumn of 1920. This rearrangement was bound to come after the Armistice, when the artificial high level of prices brought about by the Great War collapsed, and with it the policy of production without regard to cost. The metal industry has suffered perhaps more than any other while this painful and necessary process has been going on, and most of the big copper mines have been obliged to shut down while the large stocks of that metal produced for war purposes and at high cost were absorbed by the peace-time industries.

Copper has reached a price now that will allow the mines with the lowest costs to start up, and if worked at their maximum capacity—which is, of course, also the most efficient—to make a profit, though small. Here is where an important point of policy, and one which will have a profound and far-reaching bearing on the future of the metal industry, comes in. What would serve the interests of the industry best? That those producers with the lowest costs should resume operations at once, or wait until the now diminishing stocks of copper are absorbed completely so as to cause an artificial high price that will allow the high-cost producers to make a profit also? I believe that the second policy would be detrimental, not to say suicidal, to the best interests of the industry as a whole, and for many reasons.

Let us take, for the sake of simplicity, the copper industry as an example. What can be said with regard to copper will apply equally well to the other metals. Our civilization is becoming every day increasingly dependant upon the metals. Of these, none has become so necessary of late years as copper.

The scarcity of copper and copper alloys during the war caused inferior substitutes to be employed in their place, and though the first cost of these substitutes is much lower than the cost of the nobler metal, over long periods of time they become much dearer because of their necessary periodical renewal. Nothing like cheap copper, besides the necessary campaign of educating the public, would make the red metal regain the lost ground. Not only would this be regained but new fields would be conquered and new uses be found for copper. All this is dependent, every one will admit, on cheap copper. Cheap copper, *the cheapest copper possible*, would permit the maximum and most efficient working of the mines at all times, because a steady and sure demand would be created and the industry would not be subjected to alternating periods of inflation and depression, or at least these would not be so frequent.

There is nothing like maximum production and low prices to insure maximum efficiency. I know that a close adherence to this policy of cheap metals would mean that the high-cost mines would be sacrificed and that the profits to the low-cost producers would not be so large as with high prices, but though the profits would be smaller they would be more constant. Steady though smaller profits would place the industry on a surer basis than large fluctuating ones, and would make mining, at least base-metal mining, more of an investment than a gamble, as the dividends would come more steadily.

To prop up the high-cost properties by causing a high artificial price through restricted production would be a wrong policy. It is a well-known fact that there is nothing so conducive to inefficiency as high prices and large margin of profits. Let us remember what happened during the war. Under the stimulus of high prices *production at any cost* became the motto, and nobody troubled about *the cost of production*. High prices make for inefficiency, as they tend to level up costs, not by lowering those of the inefficient but by raising those of the efficient. The struggle for efficiency and low costs comes about when the margin of profits begins to disappear. If it is necessary to sacrifice the marginal copper mines, let them be sacrificed, for the sacrifice will redound to the benefit of the industry as a whole.

Let us take two widely different industries and compare what happened to each of them under the opposing policies of their directors at the close of the war. The nitrate industry tried to maintain Chilean *salitre* at the high price it reached during the war, and to effect this purpose the Association of Producers fixed the price without regard to the state of the world's markets. What have been the consequences? The industry is today practically dead and nearly all the *oficinas* are idle. This means, of course, that the investors are not getting dividends for the capital invested. The Chilean government is not getting, either, any export duties from the nitrate. Result? That the American dollar is worth 10 chilean pesos and the pound sterling 45, in comparison with 3 and 15, respectively, when the export of *salitre* was at its height. Also, Chile is experiencing the worst financial crisis that the country has ever had to meet.

The Chilean nitrate industry offers the best example of what a monopoly can do for an industry. As *salitre* always had a good market until recently, no matter at what price it was sold, for it had no competitors, there was no incentive to cheap production, and the technical methods of beneficiation remained stationary, with less than a 60 per cent recovery, a worse condition than that existing in any other great industry in the world. There has been practically no progress for forty-five years.

Markedly different to this story is what happened to Mr. Ford's enterprise. Mr. Ford saw that if he wanted to sell automobiles to a much poorer world he would have to sell them at the same, or, better still, at a lower price than when money was more plentiful than it is now. He realized that a low price, the lowest price possible, was necessary to obtain large sales, and that these were the only means of keeping his plants working at maximum capacity and resultant high efficiency. Low prices and maximum capacity are interdependent. The one cannot exist without the other. The result has been that Mr. Ford's enterprise has been adversely affected by the world crisis to a less degree than any other great industry.

Cheap copper would enable the industry to work at maximum capacity for long periods of time. Steady production with a maximum output would create and develop that efficiency which would increase with time, and the cost of production would tend to decrease rather than to increase. Steady employment to the labor force would produce contentment and would induce in the workers a desire to remain where they could obtain constant employment. They would also be content to work for smaller wages than in an industry where dismissal might come at any time and where they would be forced to save up for bad times.

Of course, there always remains the danger of overproduction and the collapse of the market through this cause, but I do not think that the danger would be great in the case of copper, as this metal, offered at a reasonable price, is bound to be used in the future in a greatly increasing number of industries. F. **Benitz.**

Santiago, Chile.

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The Element of Chance in Drilling Alluvial

The statements made by Wilbur H. Grant in his paper on "The Valuation of Placer Deposits," which was published in the *Engineering and Mining Journal* of Feb. 25, 1922, are of so startling a nature that they demand close investigation before they can be accepted. Present methods of testing placer ground are roundly condemned, and a call is made for eight times the number of holes per unit of area customarily put down in average ground. This attitude evidently arises in great measure from the comparison he institutes between the usual close spacing of cuts in lode sampling, and the wide spacing between holes in drilling alluvial. He states, "As the amount of material in a drill hole sample is only a small part of the whole placer deposit, no great number of improvements in the refinements of the mechanical details of sampling and computation would have nearly as great an effect on the final results as has the irregular occurrence of the valuable mineral in the gravel. Consequently, the deliberate or accidental location of holes has vastly more influence on the valuation of the deposit than all the other forty-nine or more variables put together." Again, "The accuracy will increase as the ratio of the quantity of the sample to the amount of material in the deposit increases." This last statement is certainly not true to any material extent as it stands. If "number of samples" were substituted for "quantity of the sample" it might be tolerated.

As pointed out by Eugene H. Dawson in the same issue of the *Journal*, drilling, in an established field, resembles the exploration and development practiced in lode mining, and its cost is a legitimate part of the cost of dredge operation, but much drilling is more to be compared with wildcatting for oil, and the investor is going to be chary of investing in the business if he is told beforehand that unless the prospective area is closely drilled at considerable expense the results will be utterly untrustworthy.

There is an extensive mathematical literature on the laws of chance, of error, and of probable deviations from the truth in a series of observations, but this relates only to cases where a definite magnitude is observed, the measurement of which is subject to small unavoidable errors. It is possible, for example, to calculate the largest probable number of instances of deviation from the mean (evens) in matching a large number of nickels. There is also a theory of sampling, showing the limits within which error will probably be confined by taking a sufficiently large bulk of a sample from material whose particles are of a given average size, and it is perhaps worth while to point out that this bulk does not in the least depend on the total bulk of the material which is being sampled. But nothing of the kind appears to be applicable in the present case, where we are concerned with the determination of a mean value by the measurement of a large number of independent values which will be found to differ widely among themselves.

The determination of the average value of an alluvial deposit by drilling may be compared to the determination of the mean elevation of a block of territory by a series of arbitrarily placed spot levels. Similarly, it may be compared to the determination of the mean elevation along a section line by leveling, but where the observer receives no guidance from the actual character of the ground as he views it, but spots his rod at more or less regular distances. Such a section may be either practically horizontal, a fairly regular steep or gentle undulating slope, or wildly irregular in gradient and elevation, with a number of irregularly distributed high and low points of different elevations among themselves. The three categories into which Mr. Grant divides alluvial deposits may thus be represented. Anyone can draw such a section for himself, determine its mean elevation carefully by reading off closely spaced ordinates, and then see what means he obtains by wider spacing of the ordinates, placing these at regular intervals, but starting at a different point each time. I strongly recommend anyone interested to do this. It will restore confidence, should this have been shaken by recent revelations. It is surprising how difficult it is to draw a sufficiently jagged section, if it is of reasonable length, to obtain any serious deviation from the average.

Mr. Grant's alarmist view seems to be altogether due to his belief that the ratio of the volume of the sample to the volume of the material sampled is a criterion of accuracy in alluvial sampling. Such is actually not the case at all.

In computing values, although the practice of different engineers varies according to individual idiosyncrasies, the basic assumption always made is that the values at points intermediate between those where the samples are actually taken vary regularly between those points, and inaccurate results, or discrepancies between drilling and dredging results, where they are not due to the dredge itself, or to actual errors in individual samples, or to a consistent error throughout, as would arise from the adoption of an incorrect factor, are due to this assumption being incorrect. Nobody supposes that it is literally true, of course; what is assumed is, that in a sufficiently large number of point-to-point cases those where a plus error is introduced in consequence of this assumption will be balanced by those into which a minus error is introduced, and the efficiency of close drilling lies not in the fact that it produces finally a larger bulk of samples, but that the probability of serious departure from the rule of regular variation from point to point will be less as the holes are closer together; and, further, that as a larger number of these point-to-point cases are taken together, the law of averages will work out so that there will not be any great excess of the one case over the other. This is about the only place where the mathematical law of averages operates at all in relation to alluvial sampling.

The law of averages is usually stated thus:

1. Plus and minus errors are equally likely.
2. Large errors are less common than small ones.
3. Very large errors do not occur.

London, England. R. T. **Hancock.**

Inheritance and Industrial Unrest

Touching upon the problem of the present unrest, it is rather strange that more prominence has not been given to the abolition of inherited wealth as a cure, and the simplest cure, for most of the existing differences between capital and labor. The gradual abolition of the privilege of inheritance would solve most of the world's present difficulties without interfering with the ordinary functions of the governments and without seriously interfering with present industrial institutions. The industries of the world are tending toward greater consolidation, and not toward disintegration; toward co-operation, and not toward competition. There is no objection to that. The difficulty comes in the distribution of the earnings. In considering this problem a fundamental distinction must be made between earned wealth and unearned wealth.

It can readily be shown that from 50 to 75 per cent of the earnings of the heads of poor families goes to support and to increase the unearned fortunes of the rich. This burden is getting hard to bear, and is the fundamental cause of the present unrest, when it is considered that fully 80 per cent of the people of the United States may be classified as poor.

Socialism has been given a great deal of consideration, but socialism leads to communism, for, if it is desirable to socialize some industries, there would be no stopping place until all industries were socialized, and this, in effect, would be communism. Whether communism is desirable or not is another matter.

The bonus system has been given a great deal of consideration, but the bonus system will not meet the conditions, and, in the end, would lead to communism; for if labor is entitled to a part of the earnings, aside from its wages, it will be seen that it can demand more and more, until finally it can demand all the earnings.

Government regulation has also been given a great deal of prominence, in the discussions between capital and labor. Manifestly, again, if one industry can and should be regulated by the government, all can and should be so regulated. We would then have government by regulation instead of government by representation. This would perpetuate, and not eradicate, the present evil. In the end, it would no doubt lead to government ownership—that is to say, socialism.

It would seem as if the present tendency of solving the problem of unrest is toward a mild form of socialism, either as represented by the socialists themselves, by an enlargement of the bonus system, or by an enlargement of government regulation. It is believed that neither of these remedies offers the best way out of the difficulty. The one remedy which would meet all the essential conditions is the gradual abolition of the privilege of inheritance. This could be done without much shock to existing institutions. It would be in line with American ideas and American ideals.

The Declaration of Independence, which has always been the basis of American liberty, says: "We hold these truths to be self-evident, that all men are created equal; that they are endowed by their Creator with certain unalienable rights." Surely, no one would say that men are created equal, when the children of the poor are born into the world free of any crime save that of the poverty of their parents, yet sentenced to pay a large portion of their life's earnings to other children, simply because the ancestors of the other children had acquired wealth. If any one doubts the evils of inherited wealth, let him ask why one child should inherit undeserved poverty and another undeserved wealth, and if he did not know in advance which child was his he would do some thinking. Inheritance is an offence against society; it is an offence against the inherited; it is an offence against the disinherited. It is also an offence against American traditions.

Lincoln, in one of his speeches, said: "But it has so happened in all ages of the world that some have labored and others have without labor enjoyed a large portion of the fruits. This is wrong and should not continue. To secure to each laborer the whole product of his labor, or as nearly as possible, is a worthy object of any good government." In this connection it might be well to ask how, or when, or where, did an heir labor for a dollar which he inherited. He gets without giving; he reaps without sowing.

Jefferson, who was certainly the greatest statesman and one of the greatest patriots that America has yet produced, says: "These are axioms so self-evident that no explanation can make them plainer: That our Creator made the earth for the use of the living and not of the dead; that those who exist not can have no use nor right in it; no authority or power over it; that one generation of men cannot foreclose or burden its use to another, which comes to it in their own right and by the same divine beneficence. . . . Habit alone confounds civil practice with natural rights."

Blackstone says: "There is no foundation in nature or in natural law why a set of words upon parchment should convey the dominion of land: why the son should have the right to exclude his fellow creatures from a determinate spot of ground because his father had done so before him."

In a court decision rendered in Pennsylvania, it was said: "There is no provision of our Constitution or that of the United States, which secures the right of any one, whether kindred or not, to take property by inheritance. Descent is a creature of the statute and not a natural right."

Carnegie says, in his "Gospel of Wealth," that: "The Almighty Dollar bequeathed to children is an almighty curse." The late William K. Vanderbilt said, in 1905: "Inherited wealth is a big handicap to happiness. It is as certain death to ambition as cocaine is to morality." Only within the last few weeks, Henry Ford remarked: "It would be said that people bought these (railroad) stocks for the financial protection of their families, their children. Protection from what? From the necessity of earning their living. Their children would be better off if they had to finance themselves."

The abolition of inheritance would largely, if not entirely, automatically solve the problem of the present social, industrial, and political unrest. With the abolition of inherited wealth, every one would get all, or nearly all, that he earned, and there would be no cause then for strikes or labor agitation. There would be capital, as now, but no permanent capitalistic class. The differences between capital and labor would die a natural death, the same as did the conflict between plebian and patrician with the abolition of inherited nobility, and the same as did the conflict between the North and the South when inherited slavery was abolished. The abolition of inheritance would not involve any injustice to anyone. It would be in the nature of restitution, and not of confiscation.

Denver, Col. **William E. Greenawalt.**

Marketing Tungsten Ores

Domestic Production Now Dormant—Tungsten Used Industrially in Alloys, Pigments and for Lamp Filaments—Markets Are Hamburg, London and New York—World's Consumption Estimated To Be 15,000 Tons of Ore

By Charles Hardy

TUNGSTEN seems to have been known for many years, but its use on any large scale began only about fifty years ago. It was used by the sword makers of Damascus in the Middle Ages, as most of the swords of that time which have been examined show a certain percentage of tungsten in their composition.

Tungsten, known also as wolframite, an older name, is first mentioned in literature toward the latter part of the sixteenth century in the works of Lazarus Ercker. Wolframite was then known only as a compound which interfered with the reduction of tin ores, with which it is generally associated. It was not realized that this detrimental impurity contained a new element. The discovery of tungstic acid as a new compound was made by Karl Wilhelm Scheele in 1781. The compound of tungstic acid and calcium known as scheelite was named after him. A Spaniard named Elhuyar, in 1786, was probably the first to utilize tungsten with steel. The amount of tungsten used until the middle of the nineteenth century was inconsequential, and all the work done up to that time must be classified as experimental.

In a publication which appeared in London in 1807, Frederick Accum states that tungsten "is not employed yet, but promises real utility, on account of its coloring properties, as a basis for pigment, since the compounds, it is said, form with vegetable coloring matters and afford colors so permanent as not to be acted on by the most concentrated oxigenated muriatic acid, a great enemy of vegetable colors." Of the tungsten compounds, the same authority says, "The salts are very little known."

About the year 1860, efforts were made to utilize tungsten in the manufacture of rails, and at Terrenoire, France, rails containing 5 per cent of tungsten were manufactured. The high prices quoted in those days for tungsten ores prevented its immediate application on a large scale. In a book issued by Heinrick Leiser, reference is made to the price in 1860, 1,400 marks, or the equivalent of approximately $150 per unit. A British patent by Oxland, covering the manufacture of sodium tungstate, and the process of converting the ore into sodium tungstate before reducing it, gave the industry considerable impetus. At the Paris International Exhibition in 1900, the first utilization of tungsten in the tool and high-speed steel industry was shown, by exhibits principally on the part of the Bethlehem Steel Co. (the so-called Taylor White steel). Closely following the application to high-speed and tool steel, tungsten was employed in the manufacture of lamps, with which the names of Dr. Just and Dr. Hans Kuzel will always be associated.

Tungsten is used in a variety of products. Its principal application is in the high-speed tool industry. It also finds regular uses in the following trades: As a metal—in the electric lamp industry; in replacing platinum for contact points in the automotive and telegraph industries (wireless apparatus); in dentistry to replace platinum pins; in phonograph needles; in shell steel, and in chemistry to replace a number of platinum chemical apparatus. As ferro tungsten—for making alloy steel, magnetic steel, and other similar products. Tungsten is also used in the manufacture of non-ferrous alloys, as it alloys with most other metals. Tungsten compounds are used in the manufacture of colors. In combination with barium a white color is produced; with nickel a light green; with chromium a dark green; with cobalt a blue, and used as tungstic acid alone, a yellowish color is formed. Tungsten is further used for impregnation and as a mordant in the cloth industry. Stellite is an alloy of cobalt, chromium, and tungsten, and other alloys have been made of copper, nickel, and tungsten. Platinoid is 60 per cent copper, 25 per cent zinc, 12 to 14 per cent nickel, and 1 to 2 per cent tungsten. Sideraphit is a composition of iron, nickel, aluminum, copper and tungsten. Other alloys of tungsten are also known. Scheelite has been used to a considerable extent in X-ray technique.

TUNGSTEN ORE USERS IN THE UNITED STATES

During the war the following works, in the United States, were consuming tungsten ore, and though a number of these are not at this moment operating, owing to the general commercial condition, with a revival of trade most of them should again resume activity:

The Crucible Steel Co. of America	Pittsburgh, Pa.
Primos Chemical Co., (*a*)	Primos, Pa.
Firth Sterling Steel Co.	McKeesport, Pa.
Latrobe Electric Steel Co.	Latrobe, Pa.
Vanadium Alloy Steel Co.	Latrobe, Pa.
Hudson Reduction Co.	Latrobe, Pa.
Penn Electric Smelting Co.	Philadelphia, Pa
E. J. Levino & Co.	Philadelphia, Pa.
Electric Reduction Co., (*b*)	Washington, Pa.
Fansteel Corporation	Chicago, Ill.
H. L. Hollis	Chicago, Ill.
Tungsten Products Co., (*a*)	Baltimore, Md.
General Electric Co. National Lamp Works	Cleveland, Ohio
General Electric Co.	Schenectady, N. Y.
Ludlow Steel Co.	Albany, N. Y.
Atlas Crucible Steel Co.	Syracuse, N. Y.
Electro Metallurgical Co.	Niagara Falls, N. Y
Metal & Thermit Co.	New York
Chemical Products Co.	Washington, D. C
Black Mountain Co.	Boulder, Col.
Tungsten Products Co., (*c*)	Boulder, Col.

(*a*) Gone out of business.
(*b*) Now operating under title of Molybdenum Corporation of America.
(*c*) Now operating under title of Radium Co. of Colorado.

GEOGRAPHICAL DISTRIBUTION OF TUNGSTEN ORES

Prior to the war the important sources of tungsten ores were Burma, Australia, New Zealand, North America, South America, Portugal, and Siam, each of which produced more than 750 tons per annum. During the war the developments caused by the large demand and the stimulation of the high prices shifted the production centers considerably, and China, which prior to 1914 was not known as a producer of tungsten ore, became the largest producer in the world.

Tungsten is found widely distributed all through the world. Scandinavia, Russia, Germany, Austria, France, Spain, England, Canada, Alaska, Mexico, Bolivia, Peru, Argentina, South Africa, and the Straits Settlement all contributed during the war toward the huge production of approximately 32,000 tons.

Marketing Points—Until 1914, the best marketing point for tungsten ore was Hamburg, as Germany reduced most of the tungsten ore mined in the world to either the metal or ferrotungsten. Though 50 per cent of the ore at that time was found in the British colonies, and a like proportion, if not more, was consumed by the British steel industry, the German industry had control of the conversion of the ores. During the war the marketing of tungsten ore shifted, and, in addition to Hamburg, London and New York are now important marketing centers for tungsten ores.

Consumption—The production of tungsten ore has practically kept pace with the consumption of tungsten, and any increased production has been absorbed by the new uses discovered for tungsten. The world's annual production from 1898 to the present is given in Table 1 and in Fig. 1. In 1917, a production of 25,523 tons was reached. This tonnage was actually consumed.

It was anticipated, had the war continued, that a total of 25,000 tons per annum would not be equal to the requirements, and all governments urgently put forth special effort to increase their production. The sudden ending of the war, however, cut down the consumption considerably. The highest production ever reached, in 1918, was 32,000 tons, followed by the production of 20,000 tons in 1919 and 11,000 tons in 1920. This was more than the industry, disorganized by the signing of the Armistice and the consequent withdrawal of the war demand, could possibly absorb. The accumulation of ore here as well as in Europe had made it impossible to gage accurately the present position, and now the world's consumption of tungsten ore is estimated not to exceed a total of 15,000 tons per annum.

Requirements as to Content and Purity—Tungsten is found as tungstic oxide in combination with other elements. The principal minerals are:

Wolframite (Fe,MnO)WO_3, tungstate of iron and manganese.
Ferberite (FeO WO_3), iron tungstate
Hübnerite (MnO,WO_3), manganese tungstate
Scheelite (CaO,WO_3), calcium tungstate
Powellite Ca(MoW)O_4
Tungstite (WO_3 H_2O)
Stolzite ($PbWO_4$)
Rospite ($PbWO_4$) (different crystallization)
Cuprotungstite ($CuWO_4$ $2H_2O$)
Ferritungstite (Fe_2O_3 WO_3 $6H_2O$)
Tungstenite (WS_2)

Tungsten ores are generally grouped into two classes: (1) Wolframite—in general, includes the black ores. (2) Scheelite—includes tungstic acid in combination with lime.

Tungsten ores vary considerably, and hardly any two mines produce like ores. Though in general tungsten ores are marketed on the basis of 60 or 65 per cent tungstic acid (WO_3) and better, the trade likes to buy a known product of a given mine or ores upon which the analysis is guaranteed.

Ores are generally classified according to the type of reduction applied by the buyer. The manufacturers of tungsten salts or lamps can use different grades. The reduction of tungsten ores may be divided into three classes: (1) Chemically, as in the manufacture of sodium tungstate and reduction to metallic tungsten powder or the making of yellow tungstic oxide for pigment or other purposes. (2) By the electric furnace, with ferrotungsten as a product. (3) By the Thermit process.

In the chemical process, most of the impurities objectionable in other processes, such as tin, copper, phosphorus, arsenic, sulphur, and manganese, are eliminated, and a buyer applying chemical treatment can use almost any ore. In the manufacture of ferrotungsten by the electric furnace, it is essential to have an ore as free as possible from impurities, as, in the process of fusing, the impurities would enter into the finished product. A desirable quality of ore for this class of buyer should be one containing more than 65 per cent tungstic acid and not more than 0.05 per cent each of tin, copper, phosphorus, arsenic, and sulphur. In the Thermit process the highest quality ore, free from impurities, is wanted.

The quality requirements called for in groups (2) and (3) make it impossible to sell certain ores, or incumbent upon the producer to subject the ore to special treatment—magnetic separation for the elimination of tin, copper, lead, and other impurities; or where an excess of phosphorus is present, the dephosphorization process by acid treatment is employed; sulphur and arsenic are eliminated by roasting. Typical analyses are given in Table 2.

The coarseness or fineness of the material is immaterial to any user. Tungsten ores reach the trade from a fist-size down to a fine powder. The former is generally the result of hand sorting, and the fine powder the product of table concentration or electromagnetic separation.

Wolframite, ferberite, and hübnernite all show the same physical characteristics. All three are subject to electromagnetic treatment. The presence of tin, copper, antimony, arsenic, phosphorus, bismuth, and sulphur reduce the value of the ore. No definite scale exists by means of which to adjust the price, because of impurities. The price is fixed by the individual negotiation between buyer and seller.

No definite ruling exists governing the quantities sold, although in this country buyers prefer to purchase in carload lots. Material shipped from an American mine can easily be handled in this way, but the foreign ores reach New York in quantities varying from a few bags to fifty tons.

Penalties and Premiums—No accepted practice has been evolved covering the premiums or penalties. At one time a premium was paid for material running over 65 per cent tungstic acid. However, as the available stocks are exceedingly heavy, sufficiently high-grade material can now be had without buyers having to pay a premium.

The ore is weighed and sampled at the buyer's works if sold before arrival; otherwise, the sampling is done, at port of arrival, by quartering or by automatic samplers. The general tendency on the part of the samplers has been to sample lumpy ore by taking approximately a 30 per cent sample of the material; fine concentrate by taking about 10 per cent. The final sample is reduced to approximately 10 to 15 lb. and taken by the chemist for analysis. Weighing is generally done in drafts of six bags.

Analyses for tungsten and the impurities are made from these samples. In most countries the analyses of certain recognized chemists are accepted by buyers and sellers as final. Only in rare instances is the assay determined by two chemists, and in such event the mean of the two assays is the basis for settlement. The tolerance is one-half of 1 per cent. If the difference is larger a referee assay is made. This is averaged with the one nearest to it, and the mean of the two is accepted for the final settlement.

Transportation Requirements—Tungsten ore shipped in double bags. The size of the bags varies between 200 to 224 lb. per bag. Bags are generally returnable to sellers.

Value Computation—The accepted measure used in computation of the value is the so-called unit. One unit equals 1 per cent. In the United States, the short ton is generally adopted as the basis for calculation, and one unit is, therefore, equivalent to 20 lb. of tungstic acid (WO_3). In England and the British colonies, the English ton is the basis; in France and Germany the metric ton. A unit is equivalent to 22.4 lb. in the former, and 22.08 lb. tungstic acid in the latter countries.

Terms of Settlement—Domestic ores are shipped to the buyer's works. A preliminary invoice calling for payment of 90 per cent is attached to the documents. Foreign ores are paid for at the rate of 75 per cent of the preliminary invoice against documents, and in both transactions final settlement is made immediately upon determination of weights and analysis by a mutually approved chemist. Between the importer and the foreign shipper, the method of settlement is also on the basis of 75 per cent advanced against the documents. In many transactions a credit is obtained for this amount.

Marketing Problems and Conditions Influencing Prices—Tungsten ores should be cleaned by concentration to as high above 60 per cent as possible. The higher the percentage of tungstic acid in the concentrates the smaller the losses in the production of ferrotungsten. Hence, buyers can afford to pay the top market price for a high concentrate.

Tin, bismuth, copper, lead, antimony, and iron are generally eliminated by electromagnetic separation, which is best done at the mine itself. There are in the United States, England, Germany, and France works which clean concentrates by magnetic separation on toll. The average cost of such separation is from $30 to $35 per ton. If sulphur is present, roasting of the ore is advisable. During this roasting arsenic and phosphorus are generally eliminated or considerably reduced. The dephosphorization alone has been successfully achieved by treatment with diluted sulphuric or muriatic acid under injection of live steam during the process. If tin, copper, lead, and bismuth are present in sufficient quantities, a further concentration of the tailings for the recovery of these impurities is advisable. Usually, any ore showing tin, copper, or bismuth in excess of 1 per cent will pay for this procedure.

TABLE I—THE WORLD'S APPROXIMATE PRODUCTION OF TUNGSTEN ORES AND PRICES FOR EACH YEAR

Year	Quantity, Short Tons	Price per Unit in Dollars	Year	Quantity, Short Tons	Price per Unit in Dollars
1895	193		1909	6,200	$8.00
1896	152		1910	8,000	11.00
1897	285		1911	8,200	7.75
1898	800	$17.50	1912	8,650	8.25
1899	[illegible]	20.50	1913	8,800	7.75
1900	2,900	14.00	1914	8,000	7.25
1901	650	7.50	1915	[illegible]	30.00
1902	650	7.50	1916	21,000	40.75
1903	1,300	8.75	1917	25,500	21.85
1904	4,200	15.00	1918	32,000	22.50
1905	5,800	13.50	1919	20,000	9.50
1906	4,350	10.25	1920	11,000	7.00
1907	6,100	13.50	1921	6,000(a)	3.00
1908	4,500	10.25			

(a) Estimated

Imports and Exports—The imports of tungsten ores totaled 1,441 tons, of a valuation of $276,757, for the year 1921. This compares with 1,740 tons imported in 1920 and 8,400 tons in 1919. Of the 1,441 tons imported in 1921, China's share is more than 75 per cent.

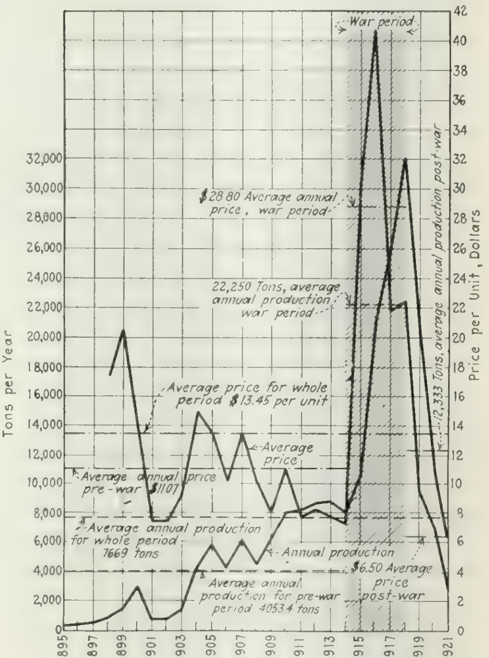


Fig. 1. Prices and world production of tungsten ores

During the whole of 1921, the maximum price for tungsten did not exceed $3 per unit, and it will readily be seen that no other country but China could produce in quantities at this level.

The influence of imports upon the price of tungsten ores in the United States market is naturally great. The importation of Chinese ores has brought the mining of tungsten ore in the United States to an entire stop. Chinese ores are produced by surface mining at a low cost, and of late probably 70 per cent of the total importations originated in China. The tungsten mines of the United States, and those of Argentina, Chile, Bolivia, Peru, Portugal, and Spain are reported closed

TABLE II—ANALYSIS OF SCHEELITE AND WOLFRAMITE IN PER CENT

	Tungstic Acid WO_3	Copper	Tin	Phorphorus	Sulphur	Manganese	Lime	Magnesia	Iron
Bolivian scheelite	63.79	0.03	Tr.	0.071				..	.
[illegible] (a)	71.[illegible]	0.02	Tr.	0.079				.	.
[illegible]	66.56	0.27	1.68	0.068		0.24			..
[illegible]	67.10	0.05	Tr.	0.036				.	
[illegible] scheelite	63.72			0.020	0.80				
[illegible] wolframite (b)	64.23		0.44—0.66			5.19	1.10	3.16	8.55
[illegible] wolframite	67.65	0.02	Tr.	0.014		0.94		.	.
[illegible] wolframite	65.[illegible]1	0.02	0.48			1.71	.	.	..
[illegible] wolframite (c)	64.50	0.07	..		Tr.			..	....
[illegible] wolframite	67.26		0.79	0.037	0.15	5.74	0.61		12.98
[illegible] concentrates (d)	[illegible]3.23	0.97	0.45			1.01	1.21	7.16	
[illegible]	[illegible].50			0.040	0.09	0.15	0.30	Tr.	..

(a) Arsenic 0.06 per cent. (b) Silica [illegible]; alumina 5.5 per cent. (c) Bismuth 1.5 per cent, (d) Silica 3.21; Alumina 2.31 per cent down, and importations from these countries during 1920 and 1921 represent to a large extent the shipment of unsold accumulations at the mines, as the ruling prices during the last two years have been insufficient to make commercially possible the mining of new ore. The production of China is now governing the world's markets.

The prices given in dollars, do not necessarily represent the dollar price actually paid, as the market in the United States for tungsten was limited, and the above prices represent the English or German quotation per English or metric ton unit converted into United States currency at normal exchange.

For the years of the war it is impossible to give a world's quotation. In Allied as well as enemy countries no free market existed; the prices were entirely controlled by government regulations. Therefore, the prices quoted in the United States in these years are given.

Peruvian Copper Mines To Be Developed By A. S. & R. Subsidiary

The Northern Peru Mining & Smelting Co., a subsidiary of the American Smelting & Refining Co., holds a three-year option, dating from April 16, 1921, on the Quiruvilca copper mines, and also has an option on the adjoining Almiranta copper deposits. In addition, it has a working agreement with respect to the Milluchaqui silver mines—the property of Vicente Gonzales Orbegoso, according to *Commerce Reports*. The Quiruvilca mines are about eighty miles east of Salaverry, in the Department of La Libertad, and fifty miles from Menocucho, the present terminus of the Trujillo Railway. They lie at an altitude of 12,000 ft. and can be reached by automobile and mule from Trujillo. The copper mines have been operated by the Quiruvilca Mining Co. for about ten years, producing about 2,000 tons of ore annually. The Milluchaqui mines are about halfway between Quiruvilca and Trujillo and produce a high-grade, siliceous silver-gold ore. There is a good vein of anthracite coal at Calluyacan, about five miles from Quiruvilca, which can be used for smelting purposes. Another vein of still better coal is found at Canibamba, which may be used as fuel for general purposes. The new company purposes to build a hydro-electric plant at Motil (twelve miles southwest of Quiruvilca) or at some other suitable point. This plant is to be capable of generating 2,000 hp. A smelter will also be erected if developments warrant such construction. If the Chuquicara branch of the Chimbote-Recuay line is extended as now planned it will run only 15 km. from this property. It is possible that the company will build a line to Trujillo.

Seventeen Plants Produced Potash Salts During 1921

More than 18,200 tons of crude potash salts, containing 7,618 tons of K_2O, were produced in the United States during 1921 from domestic sources, according to the Geological Survey. This potash was produced at seventeen plants, and about 79.5 per cent of it was extracted from natural brines. The total production from domestic material was less in 1921 than in any other year since 1915. Twenty-one plants made sales amounting to 8,907 tons of crude material, containing 3,895 tons of K_2O, valued at point of shipment at $383,218, and twenty-four plants reported stocks on hand amounting to 26,461 tons of crude material, containing 10,348 short tons of K_2O. The domestic potash produced in 1921 was made from natural brines, dusts from cement mills and blast furnaces, and wastes from molasses distilleries and from sugar refineries that employ the Steffens process. No production has been reported from alunite, silicate rocks, kelp, or wood ashes. The only plants that reported continuous operation during the year were several that produce potash from the dusts of cement mills and blast furnaces. The inactivity of the fertilizer market and the low price of foreign potash are given as reasons for non-production.

Mica Industry During 1921 Was Below Normal

Preliminary figures showing the quantity and value of mica sold in the United States during 1921, as reported by the Geological Survey, give a total of 3,854 tons, valued at $174,838. Of this quantity 371 tons, valued at $117,989, was sheet mica; the rest was scrap. These figures are obtained from reports received by the Survey from 97 per cent of those engaged in the business. The production was made by eight states: North Carolina, New Hampshire, Virginia, New Mexico, Georgia, South Dakota, Colorado, and Wisconsin, named in order of total value of mica sold from greatest to least. The total quantity of uncut sheet mica in 1921 shows a decrease of about 56 per cent, and the value a decrease of about 78 per cent; scrap mica showed decreases of about 39 per cent in quantity and of about 66 per cent in value, as compared with 1920. The most notable decrease is shown by North Carolina, where sales of uncut sheet mica dropped about 79 per cent in quantity and about 87 per cent in value in 1921, as compared with 1920. On the other hand, New Hampshire shows an increase in output of sheet mica of about 73 per cent in quantity, but a decrease of about 25 per cent in value. The increase in quantity is due to the larger production of mica of small size, such as punch and washer mica, which has had the effect of lowering the average price per pound of sheet mica in New Hampshire from 29c. in 1920 to 13c. in 1921. The average price per pound of all sheet mica sold in the United States in 1921 was 16c., as compared with 32c. in 1920, and the average value per ton of scrap mica fell from $29 in 1920 to $16 in 1921.

The consumption of mica in the United States depends largely on the available quantity of foreign mica, the importations of which showed a notable decrease. The cut mica and splittings imported for consumption—the splittings form the greater part of the imports—fell in value from $2,011,434 in 1920 to $758,521 in 1921. The unmanufactured mica, consisting essentially of uncut trimmed sheets, dropped in quantity from 1,298,537 lb. in 1920 to 328,444 lb. in 1921, and in value from $1,177,943 in 1920 to $331,219 in 1921.

A Correction

In the *Journal* of March 11 we published an article by Walter Stalder, "The Ciervo Anticlinal Bow Oil Field of California." The title as submitted by Mr. Stalder was "The Prospective Ciervo Anticlinal Bow Oil Field." In view of the fact that this district has not yet come in as an oil field, the latter title is to be preferred, and we desire to make the correction accordingly.

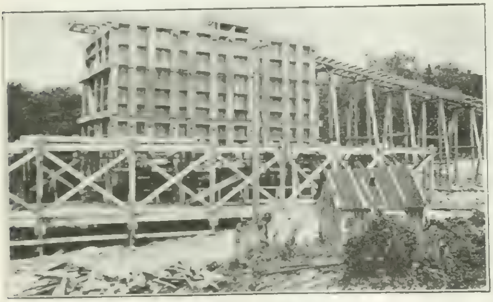
Asbestos Mining and Milling in Quebec—II

Modern Underground Mining Methods Now Being Introduced — No General Standardization of Milled Product — Simple Crushing, Screening and Suction Used To Separate and Grade Asbestos — Detailed Costs of the Various Operations

By Walter A. RuKeyser

THE SEARCH for crude asbestos and the operation of hand-cobbing begin immediately after the rock is block-holed. The first or rough cobbing rids the veins of asbestos of most of the adhering gangue. The final cobbing is done by girls, usually, in suitably designed sheds on the surface, and cleans the veins of any remaining rock particles and partially "opens" the asbestos. In one of the mines, the run-of-mine rock, with the refuse from the rough cobbing, is run over slowly moving conveyor belts for hand-picking. The product is sorted as to length and quality and bagged for shipment, the bags weighing 100 lb. net and the material running about 40 cu.ft. per ton of 2,000 lb.

After the sorting of the crude on the floor of the pit or benches, the rock which constitutes the mill feed is shoveled—usually by hand—into the boxes, or skips, of the cableways. It has been found impracticable to use mechanical means for loading these boxes, primarily because of the fact that a steam (or electric) shovel could not be kept busy enough—there being of necessity many working places, which may be on the benches of several levels. In the Thetford and Black Lake districts, at least, suitable grades for the egress of the shovels could not be maintained. In addition, there are the extremely irksome winter conditions, which would severely handicap movement of the shovel or loader. I know of no property in the district where a small loader or mucker such as is employed underground in metal mines has been used experimentally, although I think such a device might possibly find application under favorable conditions.



Loading terminal for an aerial tramway

Cranes Effective in Handling Waste and Rock

Steam and electric cranes are used in two or three operations in the district to sort and handle the boxes of waste and mill rock. In this connection it must be remembered that the asbestos-bearing rock occurs in zones separated possibly by granite or, more often, by barren serpentine. This must all be mined. Thus a large proportion of "dead" rock results, usually about 25 per cent of the total and running as high as 40 to 60 per cent, which must be sent to the dump.

Usually both waste and mill feed are hoisted to the surface by means of cableways. However, at the Bell mine, a crane is used to load narrow-gage dump cars, and these are assembled into trains and hauled by means of a hoist through an inclined tunnel to the mill bins or waste-rock dump. This incline system has practically replaced the cable derricks. The lower third of this incline is situated in a pillar of rock left between two pits which are now connected by a main opening. The tunnel is about 1,200 ft. long and reaches the surface near the crusher house.

At Black Lake, the Black Lake Asbestos & Chrome Co. is using a crane to make up the trains of waste and mill rock on the floor of the company's main or No. 9 pit. Cableways are used to lower the boxes from the upper benches. This main pit is now connected by a 45-deg. raise to the floor of a smaller and more shallow working, Pit No. 6, and it is the intention to mill down from this pit, all of the rock being taken out through No. 9. A tunnel approximately 200 ft. long runs through the pillar, separating the two workings at the level of the tracks of the main pit. This is sufficiently large in cross-section to allow the crane to enter and to swing its boom when necessary to sort both classes of rock. Fifteen-ton steam locomotives run the trains to the wet-rock bin feeding the crushers and to the waste dump, both objectives being about 1,500 ft. from the face of the pit.

The topography of the Black Lake mine, coupled with the large amount of available surface area, has permitted the placing of the company's mill below the level of the pit floor.

Large Cableways Have Been Extensively Developed

Typical Thetford open-pit mining has probably been most highly developed at the King mine of the Asbestos Corporation of Canada, a reorganization of the old Amalgamated Asbestos Co. The operations at this mine disclose a high degree of progressiveness and show careful planning. The hydraulic stripping operations already described were begun by this company after an extensive diamond-drilling campaign, totaling 20,000 ft., that was awarded by contract to the Sudbury Diamond Drilling Co., which has had five drills in continuous operation since May, 1920. As much as 90 ft. of $\frac{7}{8}$-in. core was recovered per day by one drill, and I am told that reserves of milling rock sufficient for thirty years' mill operation at the present rate of output have been blocked out.

The King mine, Lot 26, Range 5, Thetford, is the largest producer of the group, and the open pit has reached a depth of over 300 ft. At the surface it measures approximately 900 x 500 ft., and this width is increasing continually. Five powerful cable derricks now replace thirteen small ones by which the rock was formerly hoisted and conveyed to hoppers at the surface. These hoppers loaded into 36-in. gage cars, which were assembled into trains and hauled by steam locomotives to the bins or to the waste-rock dump, 4,000 ft.

distant. The five large cableways have enabled the mine to more than double its daily hoisting capacity, which must be approximately 3,000 tons in twenty-four hours at a maximum.

All the steam locomotives, both for the rock yard (which feeds the primary crushers) and for the dump, have been replaced by Canadian General Electric locomotives of the trolley type. The electrification involved one contract for equipment alone totaling over $110,000. It is said this step was taken primarily to eliminate the uncertainty of the coal supply, especially in winter, when railroad transportation from the United States may be seriously disrupted. However, a greater over-all efficiency and lowering of operating costs was probably the main reason for making the change, hydro-electric power being supplied to the mines of the district both by the Shawinigan Power Co. and the St. Francis Power Co., at rates averaging about $40 per horsepower-year on large new contracts. Fuel is now used only for the driers.

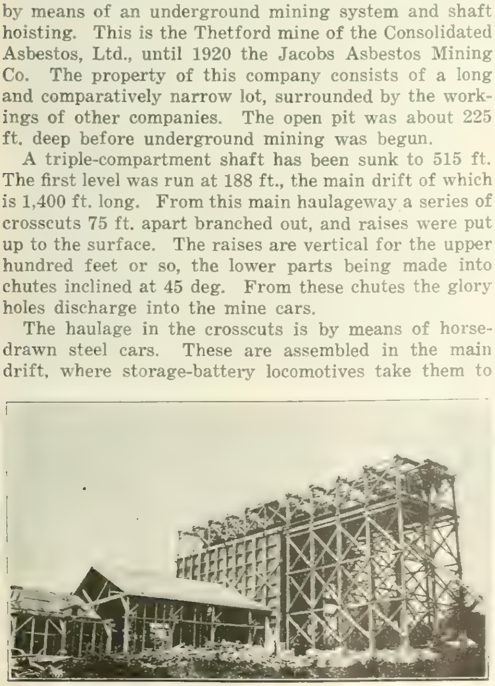
25,000-Ton Dry-Rock Bin

To facilitate continuous mill operation during the winter months, and to increase the flexibility of the system, a large concrete storage bin has been erected for the crushed and dried rock. The rock enters along a distributing conveyor from above and is drawn off to another conveyor through hand-operated arc gates at the bottom. This conveyor runs through a tunnel surrounded by "dead" ore. The sides of the bin are sloped at the angle of repose of the rock.

Although considerable underground exploratory work has been done in the district by several of the mines, only one property is really turning out its entire output by means of an underground mining system and shaft hoisting. This is the Thetford mine of the Consolidated Asbestos, Ltd., until 1920 the Jacobs Asbestos Mining Co. The property of this company consists of a long and comparatively narrow lot, surrounded by the workings of other companies. The open pit was about 225 ft. deep before underground mining was begun.

A triple-compartment shaft has been sunk to 515 ft. The first level was run at 188 ft., the main drift of which is 1,400 ft. long. From this main haulageway a series of crosscuts 75 ft. apart branched out, and raises were put up to the surface. The raises are vertical for the upper hundred feet or so, the lower parts being made into chutes inclined at 45 deg. From these chutes the glory holes discharge into the mine cars.

The haulage in the crosscuts is by means of horse-drawn steel cars. These are assembled in the main drift, where storage-battery locomotives take them to the loading pocket at the shaft station. The charging set for the locomotives is underground.


Discharge terminal for an aerial tramway

Collector used in many mills

A second level 175 ft. below the first has been driven, and by means of this the rock milled down from the former open pit is handled.

The shaft is vertical and timbered throughout, the headframe being of steel. The two skips are each of 2½-ton capacity and the hoisting plant has a capacity of 2,000 tons per day.

During 1920 a large loading pocket at the second level was completed and also a 160,000-gal. sump. The entire mine drains into this, drainage from the first level being effected through a series of 6-in. shot-drill holes. The cabled derricks are no longer used for hoisting rock, but only as accessories to fill the mine cars at the bottom of the pit for haulage through the first level. A part of the mine tonnage is hauled to the mill through a 20-deg. incline 1,015 ft. long from the surface to the bottom of the open pit. However, four-fifths of the total tonnage comes from the glory-hole operations and is shaft-hoisted. It is the intention eventually to use the incline only for a manway.

The rock after being hoisted to the surface is passed over a slow-moving picking belt for a further sorting out of the crude.

The "Combined" Method of Working as Practiced at Black Lake

The fact that the most productive asbestos-bearing ground rises steeply away from the railroad at Black Lake has permitted keeping the mine workings either at the level of the mill bins or above it. The topography thus lends itself to the driving of tunnels to the farthest-removed pits; or, as with the Asbestos Corporation's workings, has permitted the joining up of a scattered series of old workings by means of a main haulageway. These old pits were formerly under separate control, but, having been acquired by the corporation, are now consolidated into one extended system. The individual pits are being prepared for glory holing, and eventually the mine will be worked entirely by this method. A main haulageway, or tunnel, has been driven under the separate pits, thus connecting them underground. A branch tunnel has been driven to the south to a point under the Standard pit, a distance of 2,038 ft. At various points raises have been driven to the surface or to the bottom of old pits, so that the rock can be milled down for electric haulage to the mill in five-ton cars.

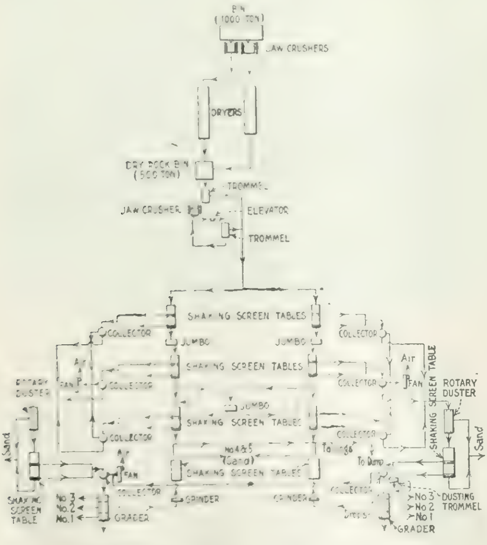
The rock is crushed by 36 x 42-in. jaw crusher to 5 in., being then further reduced to 2½ in. through three 15 x 20 in. crushers of the same type. After drying, the rock is conveyed to a 25,000-ton bin similar to the one at the King mine.

The Canadian Johns-Manville Co., operating the Jeffrey mine, at Asbestos, near Danville, has now entirely eliminated cableways for rock hoisting. The country is of flat topography, and therefore the mine has been developed by means of four steam shovels operating on wide benches. The shovels load into standard-gage cars on the benches and in the bottom of the pit. Steam locomotives of 30 and 38 tons' weight haul the trains up maximum grades of 3 per cent to the mills, three in number, which have a combined capacity of 3,000 tons per day.

The problem at Danville differs from that at Thetford in that there is ample working space for the laying out of the grades and that the crude is more narrowly confined to high-grade zones.

PRACTICALLY ALL SLIP-FIBER PROPERTIES WORKED BY STEAM SHOVELS

On the slip-fiber deposits steam shovels have found excellent application, owing to the fact that no crude has to be sorted before the rock goes to the mill. Thus, at East Broughton all the mines use this method, the shovels loading usually into 36-in. gage contractors' side-dump cars. The cars may be jogged back and forth between the working face and a crusher installation in the pit itself, as at the Quebec Asbestos Corporation mine, or hoisted out of the pit up an incline to the crusher bins, as at Asbestos Mines, Ltd., which has a 4,800-ft. aerial tramway of the Trenton-Bleichert type connecting the mine with the mill, having an hourly capacity of 50 tons. Its loading terminal bin has a rock capacity of 500 tons, the discharge bin holding 1,000. The loading terminal is 60 ft. above the discharge, and only 5 h.p. is required for the operation of the system.



Typical flow sheet of a slip-fiber mill

At the Federal mine of the Consolidated Asbestos Co. the rock was formerly brought from the pit crushers to the surface on a 24-in. belt conveyor running through an 18 deg. inclined drift, but this method has been discontinued, and the cars are hoisted along an outside incline to the crushers installed on the surface. Much difficulty had been experienced with flooding and freezing, especially during spring thaws. The pit is about 300 ft. wide by 1,100 ft. long, and is worked in a single bench 125 to 150 ft. high. Both the foot and hanging walls dip at an angle of 67 deg. Two forty-ton shovels, both of the railroad type, supply the mill with its requirement of 1,000 tons per day.

ADVANTAGES OF CATERPILLAR SHOVEL

At East Broughton the caterpillar shovel has been found most successful, being free from all track troubles and expense. One Harris shovel (Canadian made), usually with a 1¼-cu.yd. dipper, has been able to supply the mills from 600 to 1,000 tons per twenty hours. Hydro-electric power is used by nearly every mine in the district, and in almost every operation there is a direct railroad siding from the Quebec Central main line.

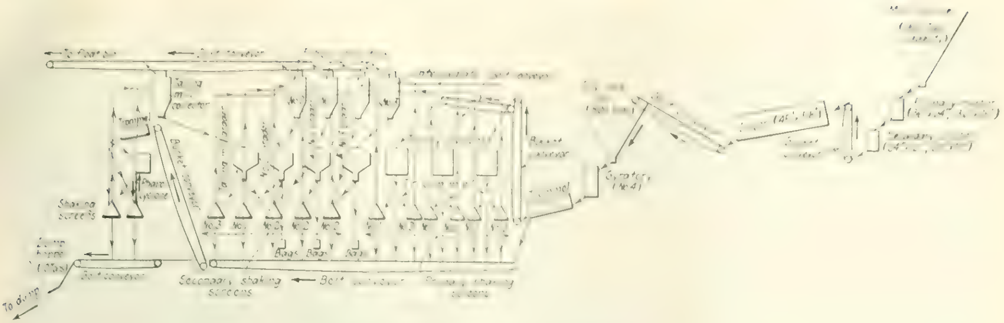
There is still considerable controversy in the district as to whether the advantages of underground mining systems outweigh the increased cost and disadvantages. The supporters of open-pit methods claim for their system that no skilled labor is required, no timber used, which some maintain contaminates the mill feed; no expensive shafts, stations, pockets and underground haulage must be driven and maintained, and a better separation of the crude is practicable. On the other hand, the supporters of underground methods maintain that twelve months' continuity of operations is possible in underground work; that a simplicity and centralization of hoisting is effected, eliminating signal boys and several hoistmen; that there is no waste of men's time in watching boxes overhead; and that a minimum of shoveling is necessary. However, in the Quebec district at least, the consensus of opinion is that open-pit methods are cheapest and best for shallow depths. The controversy starts only at that point.

NO STANDARDIZATION IN GRADING MILLED PRODUCT

Before describing the milling methods practiced in the Quebec industry it is necessary to explain the complexity of the grading problem. The various companies have arbitrarily adopted specific grades and designations for their products, the crude alone approaching a state of standardization. But even the two grades of crude vary in price according to the percentage of the longer fiber in each, which is particularly true of the milled fibers. Thus there are more than fifty classifications of the mill products.

The following method has been adopted throughout not only the Quebec mines but also by the manufacturers of finished product for testing asbestos. The standard testing machine is, as far as I know, made only by the two local foundries at Thetford. It is a shaking screen of four trays, fitting on top of each other, the screens being 24 x 14 x 4 in. The top or No. 1 tray is fitted with a screen bottom of 2 mesh, No. 11 wire; No. 2 screen is 4 mesh, No. 17 wire, and No. 3 is 10 mesh, No. 18 wire. The bottom forms a solid pan. The nest of screens is fastened to a frame and given a horizontal throw of 1½ in. The shaft, fitted with an eccentric, is made to revolve at 300 r.p.m.

To make a test, one pound (16 oz.) of fiber is placed on the top screen and run for exactly two minutes. The fiber retained on each screen is weighed separately,



Typical flow sheet of a cross-fiber mill

and the number of ounces from each tray read in succession, the total, of course, adding up to make 16 oz. Thus, for example, if a sample of asbestos yielded a test reading 0-8-5-3, that grading would signify that 0 oz. had been retained on the top or 2 mesh screen, 8 oz. on the 4 mesh, 5 oz. on the 10, and the "drops" (or "pan"), that is, the minus 10-mesh screen, had reserved 3 oz.

The following table shows the average test of milled products for various purposes:

ASBESTOS TESTS

Purpose	Thetford	Black Lake	East Broughton	Peak Price per Ton
Long spinning fiber. .	1½ 9¼ 4¼–1	3½ 8½ 2½ 1½	1½ 9 4½ 1	$800
Medium spinning fiber......	0–8–6–2	0–8–6–2	0–8–6–2	350
Magnesia pipe covering and compressed sheet. .		0–7-5–4	0 5 8–3	200
Shingle stocks...... . .	0–1½-9½–5 0–0–11–5	0–4–8–4 0-3-9-4	0 1½ 9½ 5	125
Paper and millboard. .	0–0–10–6		0–0–11 5 0–0–10–6	80
Cement and roofing....	0–0–5 11		0–0–5·11	40
"Sands," either of dark pulpy nature; short clean fiber or sandy. (For cement and flooring.)............ ..	(a)	(a)	(a)	

(a) No test.

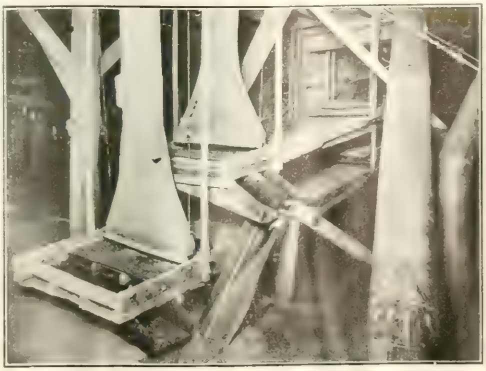
The problem of milling consists not only in recovering as much of the fiber from the rock as possible, but also with as great an average fiber length as is consistent with economy. Owing to the great difference in market price between the better mill grades and the poorer in general, the processes which have been evolved attempt to remove the fiber from the rock as early as possible during the treatment. Types of machines have been developed or applied with every attempt to spare the fiber from unnecessarily rough treatment, yet at the same time sufficiently breaking the rock which incloses it.

Crushing in Stages by Straight Impact

Concentration of asbestos by milling consists broadly in coarse crushing, drying, recrushing in stages, each step being followed by screening, during which air suction effects the separation of the fiber from the rock gangue; collection of the fiber, cleaning of adhering dust and rock particles by rescreening, grading, and, finally, bagging for shipment. This typical process is much the same today as when established in 1889 by Earle C. Bacon for the Scottish-Canadian Asbestos Co. (now defunct). The changes that have been made are essentially those of arrangement of the units in the flow sheet and of mechanical detail. The non-technical operator has always inclined in that district toward a *laissez-faire* attitude. Finally, it must be pointed out that the question of milling efficiency, per cent of recovery, and the like are largely indeterminate problems. Exact chemical determination of mill feed and tailings is not possible. There is no means of accurate analysis to check the results of the mill run. The matter has resolved itself to the present time in weighing the rock going to the mill and the production of fiber resulting. It is because of this last fact that modifications of practice throughout the district are the dictates of individual taste or judgment rather than conclusions based on accurate comparative data.

As the asbestos is deposited along lines of weakness in the rock, it follows that breaking by straight impact would be the ideal condition. The "squeeze" of the primary jaw or gyratory crusher is thus not harmful to the fiber, and the problem becomes of importance only in the later reduction. So it is that coarse crushers reduce the rock as much as possible, and the fiber liberated during this stage is separated from the rock before treatment by fine crushers.

In a typical milling operation, rock from the mine is dumped into a hopper or bin which feeds the primary crushers. Too often, the bin is of limited capacity, and any delay at the working face is reflected in mill operations. It must not be forgotten, however, that storage of wet serpentine is extremely difficult, if not impossible, under the Quebec winter conditions. For example, in January, 1920, the temperature at no time went above zero, and often hovered for days at 10 to 20 deg. below, reaching a minimum temperature of —48 deg. F. As



Courtesy of Asbestos Crude & Fiber Corporation

Shaking screen tables

soon as the run-of-mine rock hit the plates of an unheated bin, the entire mass would freeze solid. Only by continual barring down, bulldozing with powder, and by never allowing the flow of the rock to cease could the bins be kept open. The frozen fines in particular would tend to form a cementing medium binding the large blocks. Under such conditions operators have considered it advisable to provide large dry-rock storage wherever feasible, and in an extreme instance (the Asbestos Corporation) 25,000 tons' storage has been provided. This is sufficient for a fortnight run of the mill.

PRIMARY CRUSHING USUALLY BY JAW TYPE MACHINES

Coarse breaking is usually done by jaw crushers, because the better-sized product of the gyratory type machines is not a distinct advantage. The two primary machines at the King mine are 72 x 32-in. Blake type jaw crushers of a capacity of 100 tons per hour. At the Johns-Manville Co.'s mine the jaws of the primary crusher have an opening of 60 x 84 in. to take steam-shovel material direct. This is a Traylor crusher 19 ft. 7½ in. long, 11 ft. high, and 18 ft. 1½ in. wide, weighs 500,000 lb. and delivers 3,000 tons per eight-hour day of 10-in. product. Owing to the slippery nature of the serpentine, it was necessary to have an acute angle of nip—viz., 18 deg.

From the coarse crushers, of which there may be two, or even as many as three, series, possibly of jaw and gyratories combined, the rock is conveyed or elevated to the drier. Drying is an extremely important operation, the milling efficacy largely depending upon how well this is done. Too little drying hinders recovery and fiberization; too much injures the fiber. Hence, earlier operators used the indirect heat type of drier; for in that way it was thought that danger of "scorching" (partly dehydrating) the fiber was eliminated. The direct-heat drier, with its greater thermal efficiency, is now used almost everywhere; and one or two mines even employ the combined direct and indirect heat type in which the hottest gases pass around the shell of the drier and the last amount of heat is given up to the rock during the return of the gases of combustion through the shell. Although standard Vulcan, Ruggles-Cole and American Process driers are to be found, it is more usual in the district for shells to be made up by some Canadian foundry, and the castings and drives are purchased or made locally.

With the exception of the practice of the Asbestos Corporation, the horizontal rotary-shell drier, with a firebox at one end and a dust chamber at the other, is generally used. The speed at which the shell is revolved, its length and diameter, inclination from the horizontal, and whether or not a forced draft is to be used under the firebox are considerations which must be worked out for each individual application, depending upon the rock to be dried and the capacity required. The same factors determine whether or not there shall be baffles and whether the rock is to be passed concurrent or countercurrent to the gases of combustion. The Asbestos Corporation uses the stationary, vertical-tower drier patterned after the Edison type, in which the rock is dropped from the top and encounters a series of crossed-rod baffles in its downward passage against the uprising gases. From the drier discharge the rock is usually conveyed to dry-rock bins, where storage for at least two days' mill run is usual.

It is considered best practice to begin taking off the fiber immediately. The dried rock is therefore passed through trommels, and the fines, containing the liberated asbestos, are passed over shaking-screen tables. These may be 6 ft. in width by as much as 20 ft. long, and may consist of one, two or three decks covered with suitable screening, and shaken by means of an eccentric at, say, 300 r.p.m. Suction hoods made by the mill's tinsmith are suspended at the discharge end of the tables or of each plateau of the table. The hood runs the width of the screen and has an opening of about 4 in. It is connected by means of piping to conical-bottomed collectors, and the entire system is put under suction. Formerly, the material was made to pass directly through high-speed suction fans, this resulting in a needless tearing of the fiber. The shaking tables are not primarily for screening purposes. They rather serve as a means by which the feed can be spread out sufficiently for the suction to separate the asbestos from the heavier rock particles, and their oscillatory motion results in a "bedding" of the material. The particles which pass through the screen cloth (usually of from 8 to 12 mesh) are barren of commercial fiber and go to waste.

The regulation of the screening and suction affords one of the most interesting fields for experimentation in asbestos milling. I have never seen any record of accurate data showing the results of varying the inclination, the dimensions, the rate of vibration of the tables, nor the relation of rate of feed to them with a variation in the suction. Roughly speaking, the table as used in the average installation must have a capacity of twenty tons an hour, treating rock of average fiber content, and when a moderate suction (8 in. of water) is applied at the hoods.

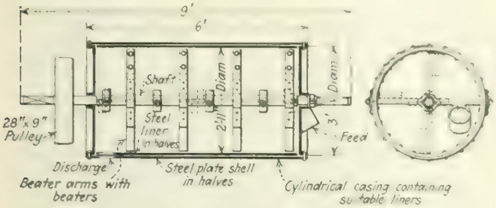
FINAL CRUSHING EITHER BY "CYCLONES" OR "JUMBOS"

The secondary crusher may be in closed circuit with a rotary screen or trommel, the undersize from which goes to a second screen table. A further separation of fiber is effected in the same manner as before noted. The oversize is then passed to fine crushers, machines which have been specially developed in this district for asbestos milling, the older "Cyclone" and the recently more popular "Jumbo." Rolls have been tried and are occasionally used, but, owing to the matting of the resultant discharge, they have not found great favor in the asbestos mill. These machines are particularly inefficient on the talcose rock of the slip-fiber deposits.

As pointed out, the desired effect in the reduction of the asbestos-bearing rock is one of straight impact and disintegration permitting the freeing of the fiber and at the same time "fluffing" it. A minimum of grinding or shear action is desired. With this in mind the Laurie "Cyclone" was first evolved, with later modifications by Pharo at the Beaver mine and Torrey at Black Lake. The "Cyclone" consists essentially of two cast-steel impellers shaped like a ship's screw, weighing approximately 1,000 lb. each and made to revolve at a high speed (2,000-2,200 r.p.m.) in an inclosed chamber lined with manganese-steel plates to withstand the impact of the rock hurled against it. If a lesser action is desired the impellers may be made to revolve in the same direction, but in the usual practice they are rotated in opposite direction to each other. It is claimed by many that the "Cyclone" produces a great amount of attrition, injuring the fiber; is of low capacity, wasteful of power, and necessitates frequent and costly repairs.

The impellers must often be changed every two days, owing to the high speed at which they are revolved, and must be balanced on their shafts with extreme care.

The above considerations led to the development of the "Jumbo," a machine, better mechanically, which has for some time replaced the "Cyclone" on the Broughton rock. Within the past two years much experimentation has been done using the "Jumbo" on the harder Thetford and Black Lake rocks, and the machine is finding a great deal of favor with some operators who have discarded the "Cyclone." The "Jumbo" is really a modification of the ordinary pulverizer, consisting primarily of a horizontal shaft fitted with a series of arms, these in turn carrying "beaters." The whole is caused to revolve at from 400 to 800 r.p.m. (as the nature of the rock dictates) in a cylindrical casing lined with suitable plates. The rock, fed from above at one end, is made to pass through the machine by a deflection of the beaters, and drops out at the other end. Here again is a great field for scientific test-work, as a variation in the speed, the length, number, spacing and type of beaters causes a great difference in the results obtained by the machine.



Sketch of "Jumbo"

Fiber Is Carried by Suction to Collectors

From the succession of "Jumbos," "Cyclones," or combinations of both, the crushed serpentine and asbestos is spread over respective screen tables and the fiber again lifted from the rock gangue by suction. This is done as many times as necessary to effect the limit of economical separation from the rock. All the fiber is sent to collectors, which usually consist of galvanized sheet iron forming cylinders 6 ft. in diameter by 6 or 7 ft. high, terminated at the bottom by a truncated cone with a height also of 6 or 7 ft. These collectors are fitted with suitable baffles, which prevent the fiber from being exhausted into the atmosphere and thus lost.

From the collectors the fiber drops to a series of rotary or shaking-table screens, where all adhering dust and rock particles are removed from it. After this cleaning it passes through the graders. These consist of hexagonal or octagonal screens, which are slowly revolved, sometimes with a bumping motion, about a shaft which is slightly inclined to the horizontal. The graders are divided into sections fitted with screens closely approximating those used on the standard testing machine already described. The products from the graders go to their respective bins and are bagged in 100-lb. lots, either by hand or by semi-mechanical devices.

Waste serpentine is sent to a dump over belt conveyors, or, where this is not possible, by trams. Many of the dumps now contain three to five million tons.

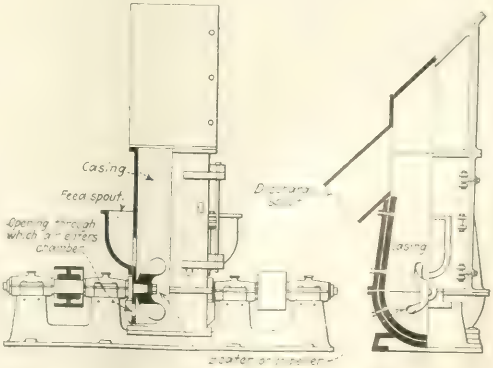
The accompanying flow sheets are typical, the one of cross-fiber milling at Thetford, the other of slip-fiber practice at Broughton.

One large mill in the district recently attempted to replace both "Cyclones" and "Jumbos" by reduction-type gyratory crushers breaking to about 1 in. However, the results could not have been successful, for the "Cyclones" have been put back into the flow sheet. Another plant at Black Lake has installed a swing-hammer mill manufactured by the K-B Pulverizer Co., with extremely satisfactory results. I understand that one of these machines is doing the work of three "Cyclones," with a great saving in repairs and power. The same plant has been experimenting with a new type of stationary screen, which requires no power and no replacement of any screen surface. This, too, has proved successful, and is based upon an entirely new principle.

The Asbestos Corporation has recently been running an extensive series of tests with the Mitchell vibrating screen, and one of these screens has likewise been installed by the Quebec Asbestos Corporation at East Broughton. To avoid duplication of data and to obtain comparative results, the Asbestos Mines, Ltd., installed a Tyler Hum-mer electric screen. It is still too early to state definite conclusions, but these machines will probably have their best, if not their only, application in the secondary process of cleaning the fiber and possibly in grading. For this purpose, tests so far made indicate that the vibrating screen, at least, has a capacity four or five times greater than the old shaking screen table.

Department of Mines at Ottawa Doing Extensive Testing

I have had the privilege for the last several months of consulting with the Department of Mines at Ottawa on some extensive asbestos milling test work which is being conducted under the direction of W. B. Timm. Several possible, and in some cases radically different, courses of action were laid out. The first involved dry milling, breaking as far as possible, say, to 1 in., in the jaw crushers; then sending the product to Hardinge mills. It was found that by applying suction direct to the mill the asbestos might be separated and removed without undue attrition. Mr. Timm has just completed a comprehensive and scientifically prepared report on this first test, but this is not yet generally available. The conical pebble mill has already been used in the district for regrinding the tailings for the preparation of a special product used for plaster and cement purposes.



Sketch of Laurie "Cyclone"

Another interesting possibility in asbestos milling is the application of wet-grinding methods, even wet concentration by tables or flotation. The advantages, elimination of the dust evil, drying required only for the product, and not for the entire mill-feed; lesser cost of grinding, and protective action on the fiber, might prove so important in any successful method that they could easily revolutionize this phase of the industry.

It is the intention of the Department of Mines, Canada, to publish the results of all this work as soon as completed.

SIX TO SEVEN PER CENT AVERAGE EXTRACTION FOR THE DISTRICT

Statistics prepared by the Department of Mines of Quebec show that before the Great War the value of the rock in the ground was below $1.50 per ton; recently it has been $4 per ton or over. The per cent of fiber extraction has averaged between 6 and 7. The average value per ton of the product increased from $35.90 in 1910 to $81.89 in 1920. The percentage of No. 1 crude decreased consistently from about 0.1 per cent in 1910 to about 0.033 per cent in 1920. That is, to obtain the same amount of crude, three times as much rock has had to be mined and hoisted. Thus, the 3,000,000 tons resulted in twice as much crude No. 2 and practically three times as much mill product. This shows that the rock mined in 1920 is not nearly as good as that handled in 1910, and that the mills therefore must have made considerable increase in recovery to maintain the proportion of mill stock. Rock mined was about 20 per cent greater than that milled in 1910; about 16 per cent in 1920. This average includes figures from East Broughton, where all the rock mined is milled. In 1920 there were reports of shipments by seventeen companies operating twenty-one mines. Prospecting and develoment was being conducted by nine other properties.

COSTS

The following represent average results from an 800-ton per day mill working on slip-fiber rock mined by steam shovels from a pit 150 ft. deep. The figures are for the year 1919:

Value of ore milled, per ton	$2.60
Total expenses per ton mined and milled	$1.65
Recovery of fiber, excluding "asbestic" per cent	4.81
Average selling price of fiber, per ton	$60.60
Average operating expense (only), per ton	$38.00

The operating expenses include mining, milling, cost of bags and bagging, shipping, power and mine office charges, but not head office, sales, and other overhead. A typical report on cross-fiber operations gives the following:

Total tons mined (March, 1921), per shift	1,001
Rock to mill, per cent	65.5
Power coal used per day, tons	10.470
Average cable-derricks used	9.6
Average payroll, per shift:	
Miscellaneous employees	13
Transportation	11
Teams	16
Machine shop and repairs	17
Mill bagging and loading	37
Miners	108
[illegible]	21
Total men	223

The figures show a production of about 4.5 tons per man for every man on the work and about 8⅓ tons for every man in the mine.

The cost per ton delivered to mill or rock dump for derrick mining averages $1.017; the cost per ton, by crane handling, $0.576, and by crane and derrick, $0.850.

Underground development work produced rock at $1.895 per ton in crosscutting and $2.080 in tunneling. The total cost is proportioned as follows:

	Per cent.
Labor, mining	72.5
Supplies, mining	13.7
Labor, transportation	4.4
Supplies, transportation	2.5
Power	2.9
Insurance and miscellaneous	4.0
	100.0

At East Broughton, mining by steam shovel and milling is being done for $0.80 a ton.

At Black Lake a typical daily average might be expressed by the following:

Value fiber per ton of rock mined	$2.51
Value crude and fiber per ton mined	$3.43
Total operating and mine expenses per ton rock mined and milled	$1.48
Average value fiber per ton	$329.75
Expenses (mine) per ton fiber	$147.24

The cost of milling, bagging, loading, and mine overhead thus is about 45 to 50c. per ton milled and correspondingly less per ton mined. The above costs are for March, 1921, when operating conditions were perhaps at their worst and wages and supplies at the peak.

EXPLORATION AND CONSTRUCTION COSTS

Diamond drilling in 1921 was contracted for at from $3 to $3.75 per ft., the latter being for a 1,000-ft. contract with 1¼-in. core recovery. Counting seven set-ups, the work averaged 25 ft. per day of twenty hours, all the holes being inclined. A maximum of 91 ft. was made in one day. The crew consisted of two runners at $6 per ten hours, two helpers at $4.50, and a foreman at $300 per month. Five and one-half carats of carbons were used.

Calyx shot drilling for a 4⅝-in. hole averaged $0.94 per ft. on a 212-ft. hole inclined 15 deg. from the vertical. The average progress was 11 ft. 1 in. per shift. The average cost for seven holes, all inclined, totaling 1,426 ft., was $1.28 per ft. in 1919, including all moves, and $1.15 per ft. excluding moving. Twelve shot-bits were used, at an average cost of $0.0791 per ft.

Exploratory drifting in serpentine can be done as cheaply as $6 per ft.; shafts down to 150 ft. about $15 per ft., with stull timbering only. Permanent work of large cross-section requires timbering.

APPROXIMATE COST OF AN 800-TON PER DAY PLANT

The following is a recapitulation of the estimated cost of replacement of a complete plant to handle 800 tons per twenty hours for steam-shovel mining the slip-fiber deposits:

Construction	$85,000
Tramways and railroad	5,000
Machinery (complete)	135,000
Machine foundations	4,000
Motors	45,000
Chutes and spouting	1,500
Auxiliary cableway	10,000
Locomotives and cars	12,000
Steam shovels	60,000
Shafting, pulleys, belting	15,000
Steam, water and air pipe	7,000
Dust collector system	11,000
Lighting and power wiring	12,000
Office equipment	1,500
Teams, stable equipment	2,000
Tools and miscellaneous	10,000
Total	$326,000

This is at the rate of a trifle over $400 per ton daily capacity. Of this total amount, the mill and contents represents approximately $95,000, the driers, $22,000, the bins, $21,000 and the crushers, $21,000.

A 4,800-ft. Trenton-Bleichert fifty-ton per hour aërial tramway with two large bins, complete, installed, cost less than $50,000 at peak prices.

In 1920, general pit labor cost from 35c. to 42½c. per hour, against 17½c. in 1915 and 12½c. in 1914. Mill and drier men received from 37½c. to 45c. per hour, and steam-shovel runners up to 55c. at the peak. Carpenters, blacksmiths, and the like commanded 45c. and 50c. An average wage of about 42½c. was the prevailing rate for all classes of labor in 1920.

In mentioning this phase of the subject it is necessary to point out that a condition exists in this district different possibly from that in any other in the world and comparable in a way only to Mexico. Unions, in the ordinary sense of the word, do not exist. The men are practically all French-Canadians, and, except in unusual instances, do not speak or understand English. The bringing in of skilled imported or foreign labor creates hostile feeling. The available resident help is for the most part unskilled men who leave the mines to farm in the spring and harvest, and who possibly leave for the "bush" to cut lumber or pulp wood in the winter.

The Church is necessarily all-powerful in the district, the local curé acting as labor leader, moral advisor, and mentor in general. Any attempt upon the part of the mine managements to vest in themselves these powers, in whole or in part, is not encouraged. In one or two instances which have come under my personal attention the village priest has asked that the company abolish a proposed plan of outside education and amusement. The men are extremely wary of any innovation, and to establish even such a benefit as group insurance, the curé was called upon to give his sanction and explain the move to the men. Often, high Church dignitaries visit the respective mines, establish shrines in the workings, and invoke the blessing of God on the operation.

The men are for the most part loyal, although committed to everything that is usual and customary to them. It is therefore extremely difficult to introduce new methods. It is usual for the lesser executives to be mustered from the French-Canadians, but the operating heads are almost without exception English, Canadian, or American. During the war many of the men enrolled under the American flag.

The individual nearly always owns his own home and farm; there is practically no floating population. These homes are nearly always scrupulously clean. The schools and hospitals are under the direction of the Church. The extensive size of the average family prevents any tendency toward a Red philosophy, and the men are consistent, if not too efficient, workers. Owing to the great number of religious and state holidays, and the all prevailing "high-wine" (a white whiskey with a 150 per cent "kick"), 250 working days is a high average for the year.

GREAT PROGRESS MADE WITH "SAFETY-FIRST" WORK

The above-stated facts have, of course, not affected the attempts of the various mine managements to promote the safety and welfare of the men wherever possible. The shaft and tunnel for the circulation of the men at the King mine is an example of this progressive attitude. All mines and mills take the usual, and in many instances unusual, precautions to promote safety. Thus, the Johns-Manville Co. has procured the services of an efficiency and safety engineer. Meetings are held and lectures on "Safety First" given. The company has organized a hospital in charge of a trained staff.

A further example of welfare work is the building of thirty-five modern cottages during the summer of 1920 by the Bennet-Martin Co. at the company's Vimy Ridge mine. This property is about six miles off the main line of the railway and has established a thoroughly up-to-date community. I understand that twenty-five more cottages were built during the past year. The houses, which are of extremely neat appearance, have a concrete foundation, and are of frame construction, with double sheathing, a layer of building paper covered over by asbestos board, and are roofed with asbestos shingles.

Many of the mines have well-run boarding houses, and all-in-all there is a well-established feeling of contentment among the labor of the district.

It has been the purpose of this article to show that the present technology of the Quebec asbestos deposits is the direct result of their geology coupled with a former lack of capital in the hands of small, individual owners who were themselves the operating heads. The modern and future tendency is constantly being based upon refinements of technique.

More especially in the milling department will there be a tendency toward the evolution of radically new methods, for the present state of the industry bespeaks possession of the means for experimentation and costly test work. The mining methods, although to a large degree dependent upon factors which permit of no change, will possibly in the future be laid out upon a more extensive scale, resulting from the further amalgamation of companies. Finally, there is being attracted yearly to the district a type of highly trained technical operator who is sure to effect the adoption of the principles of best practice from outside fields.

Spanish Metallurgical Situation in 1921

Mining reviews and the technical press generally agree that 1921 was a year of crisis for the Spanish metallurgical industries. Although all industries in the kingdom felt the effects of the world-wide depression, mining and metallurgy suffered the most severely, according to Charles H. Cunningham, commercial attaché at Madrid. This crisis is a part of the inevitable readjustment following the enormous increase in prices of the preceding years. Producers faced the necessity of lowering costs to stimulate the market for their output, demand having fallen off sharply as a result of the high prices asked; but labor troubles and employees' requests for higher wages prevented the reduction of production costs, and losses to the producers followed, resulting in the closing down of many mines.

Toward the end of 1921 the situation improved somewhat, and several of the plants have reopened. One Spanish journal, in reviewing the year, says:

"The coal and iron industries have suffered most in Spain, as they have in other countries, being interdependent and having many other industries contingent upon them also. Furthermore, there have been serious crises in the lead, copper, and zinc industries.

"Lead mining also has passed through a crisis. In Linares, La Carolina, Cordoba, and Cartagena many of the workers have been discharged and only the more important industries have been exploited, and these with little profit. Prices for both ore and metal declined, particularly during April, May, and June, but by the end of 1921 quotations were again in the neighborhood of those with which the year started, being different from coal and iron in this respect.

"The exportation of pyrites from Huelva has also been paralyzed and the number of workers cut down considerably. Exports (in metric tons of 2,204.6 lb.) of copper ore containing less than 2½ per cent of copper during the first ten months of 1920 and 1921 amounted to 236,223 tons and 193,714 tons respectively."

Mineral Sulphides As a Source of Electric Energy

Laboratory Experiments Show That a Cell of the Bunsen Type Can Be Used With Pyrite as an Anode in an Alkaline Solution—Possibilities of Economy Over Existing Methods of Generating Power Suggested

By G. N. Libby

THAT MINERAL SULPHIDES may function both as attackable and unattackable electrodes in electrolytic cells has been demonstrated by a number of investigators, the work of R. C. Wells, as discussed in Bulletin No. 240 of the U. S. Geological Survey, being especially noteworthy. To show further that they may be a source of electric energy of commercial value, and to stimulate interest in the solution of the chemico-mechanical problem, is the object of this paper.

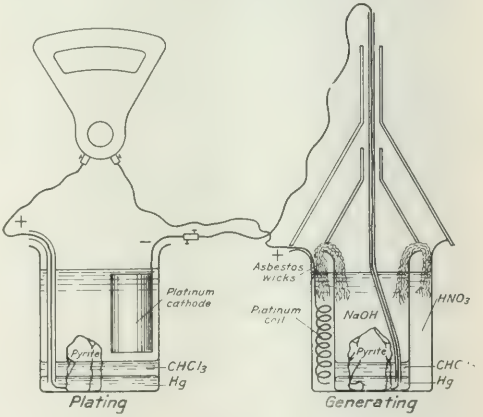
COMPARATIVE HEATS OF OXIDATION

Substance	Product	Components	Calories Total	Calories Per kg	Electrical Equivalent Kw-hr. per kg $= \frac{\text{kg-cal}}{863}$
C	CO	C+O	29.3	2440	2.83
C	CO_2	CO+O	73.9	6160	7.14
C	CO_2	$C+O_2$	103.2	8600	9.55
S	SO_2	$S+O_2$	77.6	2420	2.80
S	SO_3	SO_2+O	71.7	2240	2.60
S	SO_3	$S+O_3$	141.1	4410	5.10
Fe	$Fe(OH)_2$	$Fe+O+H_2O$	68.9	1210	1.41
FeS	$FeSO_4$	$FeS+O_4$	210.9	2390	2.77
FeS_2	$FeSO_4,H_2SO_4$	$FeS_2+O_7+H_2O$	352.0	2930	3.40
Zn	$Zn(OH)_2$	$Zn+O+H_2O$	83.5	1273	1.48
ZnS	$ZnSO_4$	$ZnS+O_4$	265.0	2345	2.73
Pb	PbO	Pb+O	30.8	244	0.28
PbS	$PbSO_4$	$PbS+O_4$	195.0	815	0.945

In the accompanying table are tabulated the heats of oxidation of carbon, sulphur, the commoner mineral sulphides, and their metals. It will be noted that, weight for weight at maximum oxidation, sulphur has about half the value of carbon and that the electrical equivalent of this heat is 5.1 kw.-hr. per kilogram of sulphur. Unfortunately, sulphur is such a poor conductor of electricity that its use as an attackable electrode does not seem encouraging. However, in combination with the common metals, lead, copper, and iron, it exists in the form of mineral sulphides, which are fairly good conductors, and which, as will be shown, may function as readily oxidizable electrodes liberating energy chiefly as electricity. Among these mineral sulphides galena is by far the best conductor, but, owing to its high molecular weight, equal amounts develop only about one-fourth the energy value of pyrite, which in turn is equal to about one-third its weight of carbon.

Carbon burned under boilers can yield only about one-third of its energy in the form of electricity, so that it is patent that pyrite and carbon are theoretically equivalent for power purposes if the heat of oxidation of pyrite can be changed directly into electrical energy, and practically so if the cost of conversion is the same. The power-house cost of changing the heat energy of coal into electricity is well known. No data are available upon which to base the cost of operating electrolytic cells of the type and size that the problem demands. However, it is known that, for instance, in the cyanide process, where large tonnages of ore are treated, the cost for agitation, filtration, handling, and so on, which are the prime factors in electrolytic-cell operation, is almost unbelievably small, being at the Homestake mine about 70c. per ton. Possibly the most important point to be considered is the fact that quantities of copper pyrite are daily oxidized in metallurgical plants, resulting for the most part only in the discharge of sulphurous gases into the air, which, owing to the possibility of producing damage, have been the cause of costly litigation.

The cost for oxidation by roasting could be credited to any system that would produce equivalent results in recovering the metal from the ore. With pyrite, then, it is not so much a question of comparing it with coal, for here we have a substance that is essentially a waste product, which is already mined and delivered, and which must be oxidized. In doing this there is an available credit on account of the saving in treatment. Normally in the Butte district, Montana, about 4,000 tons of copper pyrite is oxidized daily in the production of copper. The energy capable of being generated by this pyrite, if there were no loss, is equal to



Electrolytic cell showing pyrite as anode

$$3{,}490 \times 4{,}000 = 13{,}960{,}000 \text{ kw.-hr.}$$

or $$\frac{13{,}900{,}000}{24} = 580{,}000 \text{ continuous kw.}$$

This is worth, if we compare it with the best coal-burning practice,

$$580{,}000 \times \$20 = \$11{,}600{,}000 \text{ per year}$$

or $$\frac{11{,}600{,}000}{365} = \$31{,}600 \text{ per day}$$

or $$\frac{31{,}600}{4{,}000} = \$7.90 \text{ per ton of copper pyrite.}$$

The proportion of this value that would be realized would, of course, depend on cell efficiency, which might be anywhere from 50 to 90 per cent. Of course, just as coal cannot compete with water-power as a source of electricity when cheap development is available, even if the coal is obtained for nothing, so one can never hope to compete with it by cell-oxidation of sulphides; but it will be noted that owners of water-power value their electrical energy not by what it costs them but by its value in competition with coal.

MODEL LABORATORY CELL DEVELOPED

Seeing, then, that there appeared to be some economic hope for a cell in which mineral sulphide could be oxidized, it was warrantable to attempt the construction of a laboratory model. After a number of preliminary experiments it was noted that these sulphides oxidized rapidly in an alkaline solution; acting, in fact, as zinc would do in the same solution, but with a lower electromotive force. Perhaps nitric acid is the most efficient depolarizing liquid known, producing, by the cell action, nitrogen dioxide (NO_2), which is readily oxidized again to nitric acid; so that, theoretically at least, by proper oxidation and absorption of the gases from a cell of the Bunsen type, nearly all the acid can be recovered and used again, the atmospheric oxygen being the only substance consumed.

A modification of a cell of this type, shown to the right of the sketch, is easily assembled. In a tall 300-c.c. beaker was placed a smaller 200-c.c. beaker. Into the small inner beaker enough mercury was poured to cover the bottom to a depth of about ¼ in. An insulating layer of chloroform of about the same depth was then added. The small piece of pyrite, about 1-in. cube, placed in the beaker made good electrical contact to the chloroform-covered mercury. A strong solution of alkali was then poured in till it nearly filled the beaker. Strong nitric acid was added to the outer beaker to the same height as the alkaline solution, and the two solutions were connected by about thirty ¼-in. asbestos wicks. A platinum wire served as the acid electrode, but carbon, iron, or aluminum might have been used. A copper wire protected by a glass tube and inserted into the mercury gave an electrical connection to the pyrite. The cell as constructed consisted of platinum, nitric acid, a diaphragm, caustic soda, and pyrite, the mercury being almost completely insulated by the chloroform. This cell, on closing, gave 1.15 volts and 0.3 ampere, with no diminution of current until the ferric hydrate resulting from the action was sufficient to cause an increase in resistance, when, of course, a diminution was noted. The ability of pyrite to depolarize or oxidize in an alkaline solution was shown by an experiment in which a current of two amperes was sent through such a system with a pyrite anode surface of about two square inches, with little or no evolution of oxygen at its surface.

The current that can be taken from such a cell depends on the internal resistance, which is principally due to the asbestos-wick diaphragm and the electrode coating. The solubility of ferric hydrate in sodium-potassium tartrate and other organic substances is well known; if added to the anode solution it keeps the ferric hydrate in solution and thus gives a means of eliminating this resistance due to coating. The deposit, when it becomes sufficient to interfere with cell action, is loosely attached and consequently is easily dislodged by the slightest washing motion. The cell in principle is not new, being merely an adaptation of a well-known form of cell of the Bunsen type, but the use of a mineral sulphide as an oxidizing electrode in such a combination, so far as I know, is new.

The reaction at the cathode in the nitric-acid compartment is fairly well established, the product of reduction being principally nitrogen dioxide (NO_2), which may be converted by air and moisture back to the original nitric acid. At the anode, however, two reactions occur; first, the oxidation of the sulphide to sulphate, then the reaction between the sulphate and the alkali, with the formation of ferric hydrate. Consequently, at the anode, alkali as well as sulphide is consumed. To replace such an alkali as caustic soda would be economically impossible, but fortunately a cheap and abundant source of alkali is available in the form of calcium hydrate. This may be used directly in the cell, which might involve the formation of calcium-sulphate incrustations, which would produce insulation. In that event an indirect method probably could be developed.

POSSIBILITIES OF PYRITE AS A GENERATOR OF ELECTRICITY

The design of the laboratory cell described cannot, of course, be adopted on a large scale, but it serves to demonstrate the fact that certain mineral sulphides can be oxidized, giving up their oxidizing energy in the form of electricity. It is interesting to note that as a source of electricity, pyrite has about twice the value of zinc, weight for weight; that the quantity of electricity generated by the oxidation of the sulphur of the sulphide is much more than enough to precipitate its metal from the sulphate formed. It may be possible to oxidize the sulphide in one cell (right figure in sketch), generating electricity; and in another cell (left figure in sketch) to use this energy to electroplate the metal from the solution that resulted from the action in the first cell. The reason for this excess energy of oxidation over that needed for metal deposition is evident when it is realized that when oxidizing pyrite (FeS_2) seven atoms of oxygen are required, whereas when reducing FeO to Fe only one atom of oxygen is taken away.

In this paper it has been pointed out that certain mineral sulphides are a possible source of electrical energy. Pyrite seems to be particularly promising for the purpose, especially in view of the fact that it is now oxidized metallurgically in enormous quantities, the result of which is often wasted. A simple laboratory cell has been described which demonstrates the possibility of oxidizing mineral sulphides, with the production of electrical energy. Perhaps the only new matter herein developed is the fact that mineral sulphides such as pyrite oxidize readily as an anode in an alkaline solution.

Tasmanian Mineral Production

The following table, compiled by the Acting Secretary for Mines, shows the quantity and value of mineral products for the State of Tasmania during the year 1921:

Mineral	Quantity	Value
		£
Gold, oz.	[illegible]	24,395
Silver, oz.	[illegible]	57,576
Lead, tons	[illegible]	32,241
Copper, tons	[illegible]	467,163
Tin, tons	790.395	130,257
Coal, tons	66,476	63,446
Wolfram, tons	10.34	676
Bismuth, tons	[illegible]	21
Shale, tons	[illegible]	1,506
Iron pyrites, tons	[illegible]	2,579
Scheelite, tons		
Osmiridium, oz.	[illegible]	42,935
Asbestos, tons		...
Zinc, tons		...
[illegible], tons		
[illegible], tons		56
Total	....	£822,851

Copper Smelting by Central African Natives

By Sydney H. Ball

IRON ORE is common in Central Africa, and in consequence the smelter of iron ore and the smith is an important individual in many Bantu villages. But copper is more prized than iron among the natives, and copper smelting has been carried on for centuries, not only in the Katanga, Southeastern Belgian Congo, but also at Bembe, Portuguese West Africa, and at M'Boko, Songo, and Mindouli, French Congo. At these latter two points lead was also smelted.

Although the Union Minière du Haut Katange is now one of the world's largest copper producers, its total production to date only recently surpassed that laboriously produced by the natives. T. W. T. Atherton estimated that the natives smelted at least 100,000 tons of copper, requiring the mining of over 1,000,000 tons of ore and waste. The natives sunk numerous pits and excavated open cuts in their search for copper, and these antiguas in part explain the rapidity with which the copper belt was delimited by the early white prospectors. One of these native open cuts is 720 ft. long, 30 ft. deep and 480 ft. wide at one end, tapering to a point at the other.

The earliest reference to the copper mines was by the Portuguese half-caste traders, P. J. Baptista and Amaro José, who crossed Africa from Loando to Tete in 1802. At Chamuginga Mussenda, a village in the copper belt, they state that the natives "dig the copper; in the midst of this country is where they make the bars." The ore smelted was undoubtedly high-grade malachite and other oxidized ores.

In the December issue of *Congo*, a Belgian review devoted to Colonial affairs, a high government official, F. Ladame, publishes the results of his researches into native mining and smelting methods (pp. 685 to 691). The following résumé of the article may add to the knowledge of primitive mining processes:

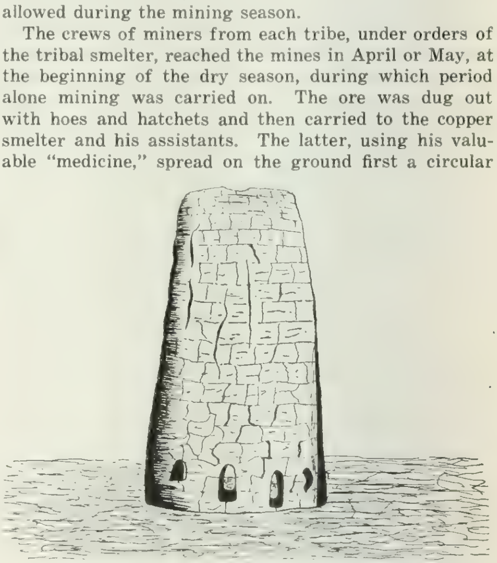
The natives no longer exploit the mines, and M. Ladame believes that in the main part of the copper belt no work has been carried on by the natives since the white man knew the Katanga, as is evidenced by trees growing in the pits. In the vicinity of Elisabethville, the last generation of miners has passed away, and the oldest blacks say the secret of smelting has been lost. M. Ladame suggests that the loss of the art was due to internecine wars early in the nineteenth century. In the southern part of the Katanga, however, smelting was carried on in Commandant Lemaire's time, about thirty years ago. The furnace used is shown in the figure, which is sketched from a photograph taken by Lemaire in 1898.

The natives worked not one mine but many mines. In contradistinction to the jealously guarded ownership of hunting preserves and fishing grounds, the copper mines do not appear to have been the exclusive property of any tribe.

The tribal copper metallurgist, like the smith of today, was a man of importance in the community. Each tribe appears to have had a hereditary caste of copper smelters. Their names still linger in the tribal legends, and several of the copper mines still bear the name of the copper metallurgist who smelted its ores (for example, Kipoie, near Sofumango).

The metallurgist alone had the "secret" or the "medicine" necessary to render the ore amenable to treatment. Not only was superstition attached to the art of copper smelting, but the hills from which the ore was obtained were held in awe. No women were permitted at the mines, nor was association of the sexes allowed during the mining season.

The crews of miners from each tribe, under orders of the tribal smelter, reached the mines in April or May, at the beginning of the dry season, during which period alone mining was carried on. The ore was dug out with hoes and hatchets and then carried to the copper smelter and his assistants. The latter, using his valuable "medicine," spread on the ground first a circular layer of charcoal about 1½ ft. in diameter; on this were placed successive layers of ore and charcoal, each bed decreasing slightly in diameter. As the pile rose, it was enwalled with clay 1 to 1½ in. thick. When the pile had become almost 3 ft. high, the top was also sealed with clay and the sugar-loaf-shaped mass was then pierced at the base. Into the holes the nozzles of bellows were placed, these bellows being worked up and down by thin wooden wands. In three or four hours, copper began to trickle through the holes and after the copper buttons had cooled, they were cleaned of slag.



Copper-smelting furnace constructed by natives. Height approximately 10 ft.

These copper slugs were then collected, resmelted, and cast either into disks, rectangular sheets, or St. Andrew's crosses. Twenty per cent of the product belonged to the copper metallurgist, 40 per cent to the village chief of the miners, 20 per cent to the miners and 20 per cent to the tribal chief.

The village coppersmiths fabricated the metal into thin wrist rings, pins, lance points, hatchets, rifle balls, and bells. Legend states that thin wire twisted into bracelets or anklets were first made by the Bayeke workmen who arrived in the Katanga region early in the nineteenth century. In much of Central Africa copper was one of the most important forms of exchange and was particularly valued by tribes residing at a distance from the mines.

USEFUL OPERATING IDEAS

Coreing Devices for Rotary Drilling In Oil Fields

Various Types of Barrel Designed That Make It Possible To Take a Core of Sand Readily

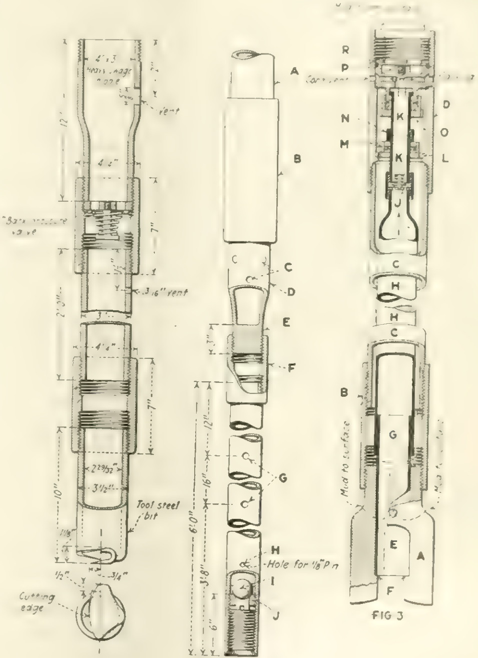
VARIOUS coreing devices used in rotary drilling are described by R. E. Collom in Bulletin 201 of the U. S. Bureau of Mines. A common objection to most forms of rotary core barrels used is that the hole must be underreamed after drilling a core, with the exception of the attachment with the fishtail bit mentioned below. With most core barrels it is difficult to take a core of sand.

One coreing device used in soft formations has the core barrel in the center of a fishtail bit, this being made so as to have a 1½-in. hollow tube, or the barrel, running up the center. The 1½-in. opening in the shank of the bit is threaded, and pipe is screwed into it of sufficient length to take the amount of core desired. The opening is slightly larger at the top than at the bottom, being thus tapered to catch and hold the core when the drill pipe is pulled out. The hole is held to standard gage when this device is used, and the drilling is done as with the ordinary fishtail bit. The sample, however, is not kept in its original state, and the length of sample does not give the thickness of the formation drilled.

The core barrel shown in Fig. 1, which is extensively used, is made by cutting a lip and bending and blacksmithing it over the bottom of a piece of pipe. It cuts like an ordinary post-hole auger. In pulling out, the lip holds the sample in the barrel, the sample coming out as cuttings. This device is said to be preferred by the Gulf Production Co.

A coreing device used in Holland by the Roxana Petroleum Co. has a shoe, of complicated design, which is screwed on the 6-in. drill stem. The core barrel can be of 4-in. pipe and long enough to take the amount of core desired. The barrel is made up of 1-ft. lengths of flush-joint pipe, the bottom length being screwed into a steel shoe through which watercourses run. Cast steel cutting teeth fit into slots in the bottom of the shoe and can be replaced when worn out, thus avoiding the necessity of blacksmithing. Small springs on the inside of the shoe keep the core from falling out when it is taken. An ordinary back-pressure valve on top of the core barrel allows the mud and water in the barrel to be forced out as the core moves up the barrel, and prevents the drill mud from entering the top of the core barrel. A drawback to this core barrel is that different numbers of teeth must be used for drilling different materials. In using 1-ft. lengths of flush-joint pipe these can be unscrewed and the core pushed out.

In Fig. 2 a coreing device used by the Rio Bravo Oil Co., of Texas, for coreing in soft formations is shown. The hole has to be reamed to size after its use. *A* is the drill stem; *B*, a 4 x 14-in. drill collar; *C*, half-inch holes for mud circulation; *D*, a 2½ x 4 x 17-in. swaged nipple; *E*, a 3-in. solid end; *F*, a 2½ x 6½-in. heavy collar; *G*, ½-in. holes for escape of air; *H*, ⅛-in. round-iron pin to prevent ball going up ahead of sample; *I*, 2-in. steel ball; *J*, removable seat valve for emptying sample; and *K*, cutting edge.



Three devices for taking cores in drilling oil wells

An ordinary piece of pipe in the bottom of which is cut a small V-shaped notch is used by A. R. Gamble in the Gulf Coast country. This is lowered into the hole and rotated on bottom. It has been found that this core barrel makes a core just as fast as any other style in use and will work in fairly hard formations. The barrel is rotated until the amount of hole desired has been made (cores from 8 to 10 ft. long are commonly taken). The swivel is then unscrewed on the derrick floor and a double-handful of small pieces of cast iron of about the same size as one's fingernail is dropped into the drill stem. The swivel is then screwed back on and the pump started, and as soon as these pieces of cast iron have reached bottom the drill stem is raised a few inches and lowered slowly. After this operation is repeated a few times the tools are pulled out. The pieces of cast iron become lodged between the barrel and the [illegible] and hold the core in the barrel. In using this type of core barrel, it is necessary to ream the hole before drilling ahead. The time required to remove and unscrew drill pipe and set it together again for a fresh run, and the necessity of underreaming, are the principal objections to the use of the core barrel.

A tool combining a vented core barrel, for relief of pressure, with a fishtail bit, is shown in Fig. 3. It has been operated successfully, taking cores of both soft and hard formations. As much as 16 to 18 ft. of hole has been made on one run, given 12 to 14 ft. of core, in pieces, with a maximum length of 18 in. *A* is an ordinary 11-in. fishtail bit with 6-in. shank bored out to 4-in. pipe; *B* is a 6-in. drill coupling; *C* a 6-in. drill pipe. *D* is a special drill coupling that supports and swivels the core barrel and is provided with vent holes to equalize the pressure on the core. *E* is a piece of 4-in. pipe forming the lower end of the core barrel. It is held from dropping through the bit by the offset *F* in the bit *A;* and from pushing up, by the ring *G*. *H* is the main core barrel made of a joint of $4\frac{1}{2}$-in. pipe, swaged to $2\frac{1}{2}$ in. at the top, and on this is attached a $2\frac{1}{2}$-in. coupling. *J* is a back pressure pipe; *K* the swivel pipe; *L* a perforated annular ring that supports the core barrel. *M* is a ball-bearing supported on *L*, carrying the coupling attached to the swivel pipe, thus supporting the core barrel. *O* is a packing box; *P* is the head through which the core barrel is vented to the ascending fluid; *R* is a perforated follower to hold *P* in place.

Okell drilling equipment follows closely the rotary practice of drilling with a fishtail bit. When hard formations are met a core barrel is substituted for the fishtail bit, and it is claimed that the core barrel not only drills faster than cable tools in similar formation, but also takes a true sample of the rock.

The Okell core barrel is used to drill and take cores from all solid rocks, from the hardest to those that are soft enough to be scratched with any dull tool. The core barrel is a plain piece of pipe, with one or more diagonal grooves cut in the ends of the barrel at an angle of approximately 45 deg. with the vertical axis. This feature is patented.

Small fragments of steel are used as an abrasive with this core barrel. The angular slot—revolving in a direction so that the top end is always in the lead—continually carries the fragments of steel from the sides of the hole to the cutting end of the core barrel. When extracted, the cores show perfect angles of dip, but do not show what the direction of the dip is at the point of taking.

Types of Cages and Skips

The mine cage is a light steel platform attached to a steel frame. Shoes engaging with the guides are attached to the frame and prevent any lateral displacement. From one to four decks or platforms are used on a single cage. Large capacity and deep hoisting require from two to four decks. Each deck is equipped with tracks for the car, car hooks, or a yoke swivel on one side to engage the car and prevent it from being displaced, and overhead bars which serve as handholds or for the lashing of timbers.

Gates are necessary where cages are used for handling men, and these are generally arranged as to be easily removed when the cage is to be used for ore hoisting. Removable decks are a feature of cage construction where long timbers or stulls are used. Conspicuous on most cages in Western mines are safety catches which are designed to prevent the cage from falling in the event of rope failure. These catches are advocated by most mining engineers, although they are conspicuously absent in some important mining districts. At best they can be looked upon only as an auxiliary safeguard. Proper use of ropes and thorough rope inspection are the best protection against accidents, with their attendant expense and delays.

The tilting single-deck cage is used in some collieries. By its use the load of coal is dumped at the landing chute and the cage is returned to the level. It avoids unloading the cars and, where single-deck cages are in use, it effects a decided economy. A special type of end-dumping car is required, and as a rule a larger car, capable of carrying from one to two tons, is necessary. Where smaller cars are required by the mining conditions the tilting-deck cage possesses little practical advantage.

Cages are the most common shaft vehicle employed. In collieries the coal is brought to the surface in cars on cages, but in metal mines, even where skips are employed, the cage is necessary for handling both supplies and men. The cage and skip are sometimes used as a combined vehicle. Under other conditions where skips are used auxiliary cages are employed in separate compartments. The carrying capacity of the cage varies between wide limits and depends primarily upon the dimensions of the shaft compartment and the number of decks to the cage. In Western mines the load is a $\frac{3}{4}$-ton car to the deck (compartment dimensions usually 4.5 x 5 ft.). In coal mines, where larger shaft compartments are the rule, two cars, each carrying from one-half a ton to two tons, are hoisted on each deck. The size of the mine car determines the deck load. The weight of the cage ranges from 1,200 to 1,500 lb. per deck.

Skips are used in incline and vertical shafts in metal mines. They are only occasionally used in coal mines, on account of the dust and breaking of coal caused by the double handling. They are loaded from chutes communicating with shaft pockets and are automatically discharged by the wheels striking a curved runway, which tilts the skip over until the angle is sufficient to discharge the contents. They range in capacity from one to eleven tons, three to five tons being commonly used in mines of moderate output. The ratio of the weight of the load and the weight of the skip ranges from 1 to 2.5, an average figure being 1.5.

In incline hoisting, special man cars are generally used in mines employing 100 or more men per shift. These are arranged so that twenty or more men can be handled per trip without crowding or discomfort, as is often the condition at small mines where no special provisions are made. In deep mines served by vertical shafts special man cages are employed. These are substituted for the skips at the beginning of the shift and are removed as soon as the men are down. In mines of small output the cages used for hoisting ore cars also answer for lowering the workers.

Square or round tanks constructed of steel are used in dewatering, either as an auxiliary to the pumps or for main drainage. They are usually arranged to discharge like a skip, and are provided with bottom or side inlet valves which automatically open and close as the skip is lowered into and raised from the water in the sump. Bailing tanks are made with from 500 to 2,000-gal. capacity.

THE PETROLEUM INDUSTRY

Analytical Distillation of Shale Oils*

BY MARTIN J. GAVIN

THE oil-shale studies of the Bureau of Mines, conducted in co-operation with the State of Colorado and the University of Utah, have for their primary purpose the determination of retorting and refining conditions most favorable for obtaining the highest yields of most satisfactory products. Typical oil shales are retorted in carefully controlled retorts of different types; the conditions are varied in successive runs. As a rule, it is easy to determine when the highest absolute yield of oil has been obtained from a given shale, but it is an altogether different problem to ascertain the relative qualities of different shale oils.

ANALYTICAL DISTILLATION IS USED TO COMPARE OILS

Thus far the Bureau of Mines has found no more satisfactory method for determining the relative qualities of different shale oils than the analytical distillation method, developed by the Bureau, for petroleum. Certain minor modifications of this method have been found necessary, owing to the peculiar nature of shale oil.

The method used by the Bureau of Mines for examining petroleum and the interpretation of data obtained with it are briefly described below,[1] followed by remarks that indicate the manner in which the method of examining shale oils differs from that used for petroleum.

Each sample was subjected to laboratory tests that yielded the following information:

1. The specific gravity at 60 deg. F. and the corresponding Baumé gravity (based on the modulus 140).
2. The percentage of sulphur. This was determined by burning a weighed quantity of oil in a calorimeter bomb, precipitating the sulphate formed as barium sulphate, filtering, igniting, and weighing.
3. The percentage of water.
4. Distillation at atmospheric pressure with data for the percentages distilling within 25 deg. C. limits up to 275 deg. C. and the specific and Baumé gravities of the fractions.
5. Vacuum distillation at a reduced pressure of 40 mm. "absolute," of the residuum from the "air distillation," with data for the percentages distilling between 25 deg. C. limits up to 300 deg. C. and for the specific and Baumé gravities, Saybolt Universal viscosities (at 100 deg. F.) and Fahrenheit cloud tests of the distillation fractions.
6. Conradson carbon residue percentages of the residuums from the combined "air" and "vacuum" distillations.

The methods employed by the Bureau of Mines for the distillation analysis of crude petroleum have not been developed with the idea of obtaining figures that parallel the results of actual refinery practice. It is believed that, although the most satisfactory use of the figures involves a comparison, there is also a need for some method of "rough-and-ready" interpretation in terms of commercial products. The authors have, therefore, offered the following classification, which, even if it has no other justification, is convenient because it permits discussion in terms of "given names" rather than the determining physical or chemical properties of distillation fractions:

1. The sum of all fractions distilling at atmospheric pressure below 200 deg. C. is reported as gasoline and naphtha.
2. The sum of all fractions distilling at atmospheric pressure between 200 deg. C. and 275 deg. C. is reported as kerosene.
3. The sum of all vacuum distillation fractions having Saybolt viscosities at 100 deg. F. of less than 50 sec. is reported as gas oil.
4. The sum of all vacuum distillation fractions having Saybolt viscosities at 100 deg. F. between the inclusive limits of 50 and 99 sec. is reported as light lubricating distillate.
5. The sum of all vacuum distillation fractions having Saybolt viscosities at 100 deg. F. between 100 and 99 sec. inclusive is reported as medium lubricating distillate.
6. The sum of all vacuum distillation fractions having Saybolt viscosities at 100 deg. F. of 200 sec. or more is reported as viscous lubricating distillate.
7. Conradson carbon residue tests were made on residuums from the "air" and "vacuum" distillation and the resulting percentages, termed "carbon residue of residuum," are regarded as an index of the asphalt content of the crudes and their suitability for yielding steam cylinder stock when refined.

ANALYTICAL DATA MORE COMPLETE

Until recently, the Bureau of Mines has not, except in rare instances, determined sulphur content. However, all crude shale oils now being examined are analyzed for sulphur. It has been found that nearly all shale oils contain rather large percentages of sulphur, the average of those thus far examined being about 0.60 per cent. Also, until recently, Conradson carbon residue tests have not been made on shale-oil residuums. Recent work indicates that the carbon residues of nearly all shale-oil residuums are relatively high, some being over 18 per cent, indicating, as is to be expected, that shale oils usually are not suitable for yielding steam-cylinder stocks.

On account of the high content of solid paraffin wax in many crude shale oils, and shale-oil fractions, it has been found somewhat inconvenient to determine viscosities at 100 deg. F. or 130 deg. F.

TAKING CLOUD POINT IMPRACTICABLE

The dark color of many of the vacuum fractions and of the crude oils themselves makes the taking of the cloud point impossible. Consequently, on these fractions and on the crude a "setting point" test is made. This method also is of value in that it follows the method used by Scotch shale operators and by them is used as an index of the amount of solid paraffin wax recoverable from the oil. The procedure is to freeze a drop of the oil on the tip of the cooled bulb of a thermometer, then to invert the thermometer, and while rotating it about

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*Abstracted from *Reports of Investigations*, U. S. Bureau of Mines.

[1] Dean, E. W., *Reports of Investigations*, Serial No. 2,202. Bureau of Mines.

a vertical axis to permit the temperature to rise at a definite rate, until the drop melts and flows down the bar. Unless the oil is of an exceedingly tarry or asphaltic nature, the settling point can be sharply and accurately determined. In addition to the tests described above, shale-oil fractions resulting from the distillation at atmospheric pressure are combined, and an unsaturation test is made on the combined fraction.

A word of caution should be spoken regarding the interpretation of vacuum fractions resulting from analytical distillations of shale oils. It will be noted that many of the oils yield vacuum fractions that appear to have properties satisfactory for the production of lubricating oils. However, little is known as to how these fractions would stand refining, or how satisfactory for commercial use the refined lubricating oils would be. The high-carbon residues of the shale oils examined in more recent work of the Bureau would strongly indicate that the production of satisfactory lubricants from many shale oils would present a most difficult problem.

THE EVALUATION OF SHALE OILS

Attempts to evaluate shale oils, even for comparative purposes in the laboratory, involve both technical and economic considerations. From a technical standpoint one must consider and determine what possible products can be reasonably expected from shale oils. From the economic side there must be considered which of these possible products will be in greatest demand, and how cheaply they can be placed on the market. During the last several years the petroleum products in greatest demand have been motor fuels, illuminating oils, lubricants, and fuel oils. It seems likely that, first of all, shale oil will be used as a source of motor fuel, and secondly, possibly as a source of fuel oil. Other products will probably be of secondary importance, and it has been finally decided that shale oils may reasonably be evaluated on the basis of the amount and quality of motor fuel they will produce.

An analytical distillation can indicate the relative amount of motor fuel of a given volatility to be obtained from different oils, but it is necessary to be somewhat arbitrary in selecting the range of volatility of the motor fuel, or, in other words, its "end point." In making analytical distillations of petroleum and shale oil, it is the practice of the Bureau of Mines to stop the atmospheric pressure distillation when the vapor temperature in the neck of the fractionating column reaches 275 deg. C. The combined fractions distilling up to this temperature are considered, for purposes of comparison, as representing all the gasoline, crude naphtha, and crude kerosene.

No definite prediction can be made as to the future end point for motor fuel, and accordingly it has been found most satisfactory for purpose of comparison to classify shale oils on the basis of relative percentages distilling up to 275 deg. C. vapor temperature. This distillate is generally spoken of as "tops."

Another point to which attention must be directed is the suitability for refining of this crude motor fuel fraction. Probably this can most conveniently be studied by determining the percentage of "unsaturation" of this fraction.

DEFINITION OF "UNSATURATES"

For the purpose of this discussion the term "unsaturates" or "unsaturated hydrocarbons" is taken to mean that part of the oil soluble in concentrated sulphuric acid under the conditions of the test above noted. If used with this understanding, unsaturates probably includes the diolefins and part, but by no means all, of the olefins. Just what part percentage of unsaturation will play in the refining of shale oil is not well known at present. Certainly, under commercial practice the refining loss of any distillate will be much less than the absolute unsaturation percentage. However, it is likely that the relative refining losses will be approximately proportional to the respective percentages of unsaturated hydrocarbons in the oils under consideration.

It is difficult to determine accurately by the usual test with sulphuric acid the percentage of unsaturated hydrocarbons in a crude shale oil. The acid tars produced under this treatment are usually markedly viscous and difficult to separate from the oil. On the other hand, it is relatively simple to determine this unsaturation percentage in the tops and to secure on this product closely agreeing results on successive unsaturation tests. Therefore, and again tentatively, the Bureau of Mines compares the qualities of shale oils on the basis of relative percentages of unsaturates in the tops from the oils.

Knowing the amount of tops yielded by the crude oil and the quantity of the tops as indicated by its percentage of unsaturates (also, its percentage of saturated hydrocarbons, as this is obtained by subtracting percentages of unsaturates from 100), an index number tentatively evaluating the shale oil may be calculated. If percentage of tops from a shale oil be multiplied by the percentage of saturated hydrocarbons in the tops, the product is a good numerical index of the value of the oil. If the possible oil yield of the shale has been determined by a standard method, the crude oil yield of the shale, calculated to gallons per ton, multiplied by this index number, gives another number which can be used as an index of the value of the shale, disregarding, of course, certain economic considerations.

THE METHOD IS NECESSARILY ARBITRARY

It should be repeated that this system of classification does not take into consideration the value of the oil other than as a producer of motor fuel, although, as noted, a high yield of motor fuel fraction coupled with low percentage of unsaturates in this fraction is reflected in the quality of the other fractions from the oil. Likewise, it does not take into consideration the absolute volatility range of the motor-fuel fraction, or the percentage of sulphur in the oil. These matters require further study, and perhaps the method will require revision when these factors are properly taken into account.

An application of the method described above may be given. Consider two shales, one yielding fifty and the other thirty-five gallons of crude oil to the ton. The oil from the first yields 38 per cent of tops containing 55 per cent of unsaturates (45 per cent saturated), and the other 35 per cent of tops contain 40 per cent of unsaturates (60 per cent saturated). First evaluating the oils:

Relative value of oil from shale No. 1 = 38 × 45 = 17.10
Relative value of oil from shale No. 2 = 35 × 60 = 21.00

If the shales themselves are to be evaluated, the numbers obtained as above are multiplied by the respective crude-oil yields of the two shales:

Relative value of shale No. 1 = 17.10 × 50 = 855
Relative value of shale No. 2 = 21.00 × 35 = 735

BY THE WAY

Whence Came It?

"Are we ready for the shale-oil industry?" asks J. B. Jenson in the *Salt Lake Mining Review*. We are—let her come. But we confess to being a trifle startled by the title of "shaloilogist" which our contemporary in all seriousness bestows on Mr. Jenson. This caught us entirely unprepared. Who fathered this etymological freak and who gave it birth?

The Law's Delay

Butte & Superior's accounting hearing, recently set for April 11 but again deferred, has been so often postponed that it seems to have somewhat the nature of a movable event, like Easter, and one has difficulty in keeping track of it. Repeated postponement and delay are characteristics of legal actions. In the meantime, John Ballot, president of the plaintiff company, dies. Who dares say who of those now active on either side of this famous suit will be alive when the lawyers are finally done with their maneuvering? There is some talk of the case being settled by compromise. We hope so. Dickens wrote a volume on Jarndyce and Jarndyce, a typical chancery case, stretched over generations, and which brought nothing but evil and despair to any of the litigants. Finally the trial came to a sudden halt because the estate, originally large, had been entirely absorbed in costs and fees and there were no more bones for the lawyers to pick.

Better Work Possible

We advise a course in advertising, or something of the kind, for those who prepare the literature used in fake promotions. Some of this is "smooth" and so cleverly written as to deceive even the intelligent, if they be unwary. But by far the most is crude, the work of tyros, and violates all the principles of good advertising. Much of it is difficult to read. A prospectus at hand sprawls over four foolscap pages printed mainly in caps, hard for the eye to grasp and making use of black-face type where emphasis is sought. It violates all our ideas of what's what in promotion literature. It must drive easy money away. We know we could do it much better, if we tried. But we shall not try. We are too busy nowadays.

An Amateur Promotion

A striking bit of stupidity is to be found in the "preliminary prospectus" of the Two-in-One Gold Mines, Ltd., which owns property in the Porcupine district, Ontario. Its authorized capital is $5,000,000 in 5,000,000 shares of $1 par value, for which it is seeking purchasers at 50c. per share. The property consists of eight claims which are on the "same latitudinal line as the great Dome and Hollinger" for which reason, it is said, "they should embrace the same dikes and ledges," since they are only a mile or so away. Much is said of "ore measures" and of the great variety of gold-bearing veins found on the claims and elsewhere in the district, but nothing at all of the value of the ore already found. The salesman who left the prospectus with us said that there was considerable $2 ore on the surface, and he was optimistic that values would improve with depth.

Apparently no development work has been done, for none is mentioned. Instead, the prospectus says, "the results of development are indicated by the official reports of the other mines in the Porcupine area . . . The environment of these 'Two-in-One' properties indicates that they will soon be one of the largest gold producers. . . . The locations of the properties and the success of the mines in the same area furnish *proofs* of rapid and continuous production at a minimum of cost and with every prospect of large profits to the stockholders. This should appeal strongly to the conservative investor."

Selling stock in a company on the strength of the proximity of its holdings to those of known producers is nothing new, but usually the promoter talks convincingly, oftentimes inventing his facts as needs be, as he goes along, especially if the properties are a mile or more apart. The writer of this prospectus invents nothing, but has a facility of jumping to conclusions and making asinine deductions, which we suspect he believes himself. Apparently he can visualize the future as readily as Conan Doyle can the hereafter, even to the extent of creating imaginary reserves in stopes in ground as yet undrilled.

West and East

A friend recently remarked, àpropos of the *Journal-Press* merger, that he never expected such a consolidation, for, as Kipling said,

"East is East and West is West, and never the twain shall meet."

He was reminded, however, that the complete verse runs as follows:

"Oh, East is East and West is West, and never the twain shall meet,
Till Earth and Sky stand presently at God's great Judgment Seat;
But there is neither East nor West, Border nor Breed nor Birth
When two strong men stand face to face, though they come from the ends of the earth."

The Elimination of Waste

"I see w'ere they 'ave been makin' a gert fuss baout this 'ere waste in h'industry; savin' 'ere, stoppin' there, an' tryin' to 'old daown tha cost o' h'everything an' speed tha h'output," said Cap'n Dick. "If they don't 'arp too much h'on one thing, or some things—savin' h'at tha spigot an' wastin' h'at tha bung'ole, so to speak—h'ought to do a 'eap o' good, seems to me. Never will do, any'ow, to work h'out like Jan Tregillis' trainin'. Jan started h'in, w'en 'ee firs' come h'over 'ere, workin' at one o' there 'ere h'open pits. 'Ad no h'other work to put 'im to, so super gives 'im a job workin' in tha shop, h'oilin' h'engines. Tha foreman wuz a savin' chap, an' wuz mighty set h'on tha Safety First h'idea too. So h'each day 'ee'd tell h'all tha men to take good care o' theyselves, an' h'in particular 'ee'd tell Jan to make no squandering o' tha h'oil an' waste. Persistent beggar, 'ee wuz, an' Jan wuz a good listener. Come one day w'en they needed a fireman h'on one o' tha h'engines h'in tha pit, an' Jan wuz given tha job. So tha pit boss sez to 'ee, by way o' tryin' 'im h'out, ''Ere, you, supposin' naow you're h'in tha h'engine, runnin' roun' a curve, an' thee sees one o' tha h'other h'engines commin' full speed towards thee. W'ot's thee goin' to do?' 'Dam-me,' sez Jan, 'Simple nuff. I'll grab tha h'oil can an' tha bloody waste, an' jump.' "

SOCIETIES, ADDRESSES, AND REPORTS

Northwest Mining Association Urges Unity in Blue-Sky Laws

The Northwest Mining Association has officially endorsed a suggestion made by J. F. Callbreath, secretary of the American Mining Congress, which is to the effect that a meeting of Western mining interests be held at Salt Lake City or some other central Western point, with the object of arriving at a concerted basis of action looking to the simplification and unification of state legislation with regard to "blue-sky" laws. The association has also passed the following resolution, copies of which have been forwarded to all Washington, Idaho and Oregon Senators:

"Whereas, The Senate Finance Committee is reported to have removed cyanide from the free list, with the recommendation that it be subject to an import tariff of 10 per cent ad valorem; now, therefore, be it,

"Resolved, by the Northwest Mining Association, of Spokane, Wash., this the sixth of April, 1922, that in its opinion the proposed import tax would act as a serious handicap to the precious metal mining industry of the West, already suffering from excessive costs in every direction. And be it further,

"Resolved, that copies of this resolution be forwarded to members of the Senate Finance Committee and to Senators Jones and Poindexter, with the urgent request that they use their influence toward retention of this essential compound upon the free list."

F. A. E. S. to Make Survey of Industry

A survey of American industry to ascertain "what steps have been taken to smooth out the business cycle" has been started by the American Engineering Council of the Federated American Engineering Societies. Each of the thirty member societies of the federation will participate in the survey, which is undertaken at the request of Secretary of Commerce Hoover.

Each member organization, headed by Dean Mortimer E. Cooley, will be engaged in the task of covering the industries in its locality.

Secretary Hoover had previously presented to the executive board of the American Engineering Council, through the executive secretary, L. W. Wallace, the question of a proposed investigation of intermittent unemployment and cyclical depressions as an outcome of the work of President Harding's conference on unemployment.

"The largest area of waste lies in the periods of slack production and unemployment due to the ebb and flow of economic tides between booms and slumps," said Mr. Hoover. It was Mr. Hoover's plan that parts of the investigation which he suggested fall in the same general field as that explored by the Waste Committee, especially those of the long-range plan of the construction and maintenance work of the industries.

The survey of industry which has just been started will come up for discussion at the next meeting of the council's executive board in Pittsburgh early in May. It represents an extension of the program of public service initiated by the engineers of the nation while Mr. Hoover was president of the federation and which is being carried on under the direction of his successor, Dean Cooley, aided by a group of prominent engineers, educators, and economists representing practically every industrial centre.

Sulphuric Acid Plant at Anaconda

The Montana Society of Engineers met in Helena on April 6, 7 and 8. A paper, "The New Sulphuric-Acid Plant at Anaconda," was presented by E. S. Larison, and detailed the progress made by the Anaconda in its series of experiments to lessen the cost of the manufacture of sulphuric acid and reducing the factory area required for its production. The Anaconda's engineering department has conducted successful research in this direction, the objective of which is the use of sulphuric acid in connection with the manufacture of fertilizer or phosphate rock, two tons of acid being required in the treatment of one ton of phosphate rock, and with the accomplishment of the object assured the Anaconda has gone forward with its fertilizer development plans on a broad scale, particularly in the development of its phosphate deposits near Soda Springs, Idaho.

Utah Oil Possibilities Discussed

The bi-monthly meeting of the Rocky Mountain Association of Petroleum Geologists was held at the Albany Hotel, Denver, Col., on April 13. The feature of the meeting was a paper by Max Ball on the petroleum possibilities of the Tertiary of the Uinta Basin, Utah.

San Francisco Section, A. I. M. E

The San Francisco Section of the A. I. M. E. held its regular monthly meeting on April 11. Newton Cleveland presented a paper on "Gold Dredging in California."

Utah University Offers Research Fellowships

Announcement of fellowships in mining and metallurgical research offered by the University of Utah for the year 1922-1923 has been made by Dr. Joseph F. Merrill, director of the School of Mines and Engineering. Invitation for application for the fellowships is extended to qualified men, college graduates who have had a good training in chemistry and metallurgy. The applications will be received up to May 15, 1922, addressed to Professor Merrill at the University.

The fellowships have an annual value of $720, and as the Department of Mining and Metallurgy is maintained in connection with the Utah Station of the Bureau of Mines and is a department of co-operative research, the holders of the fellowships will be subject to the rules governing employees of the Bureau of Mines, and will report for duty about July 1, 1922. They must also register as students of the University of Utah and become candidates for the degree of Master of Science, unless this or an equivalent degree has been previously earned. The fellows are appointed for one year, but the appointments may be renewed, and they pay no laboratory fees.

California Dredge Operators Meet

The California Dredge Operators held their monthly meeting in San Francisco on April 7. More than forty dredge superintendents and others were present. Charles M. Romanowitz, presented a paper an the design of gold dredge buckets, which reviewed the history of the subject in an interesting manner. D. H. Young, of the American Manganese Steel Co., discussed the practical difficulties involved in the foundry work upon manganese steel buckets. He pointed out the mechanical troubles and explained the manner in which they are being eliminated. E. C. Parker, who recently returned from Siberia, informally discussed placer mining districts upon the Amur River, in the Far-Eastern republic.

Joint Meeting Denver Sections A. I. M. E. and A. I. E. E.

Dean Fulton of the Missouri School of Mines addressed a joint meeting of the Denver Section of the American Institute of Electrical Engineers and the Colorado Section of the American Institute of Mining and Metallurgical Engineers on April 14, on the subject of the "Electro-Thermic Process of Dry Distillation of Zinc from Complex Ores."

MEN YOU SHOULD KNOW ABOUT

James P. Porteus has gone to Lawrence, Kan.

G. C. Bateman, of the La Rose mine, at Cobalt, has left on a trip to Los Angeles.

C. N. Miller, of San Francisco, has been inspecting properties in the Lordsburg, N. M., district.

L. M. Kniffin has returned to Fierro, N. M., as manager of the Hanover Bessemer Iron & Copper Co.

R. L. Lloyd, of the Dwight & Lloyd Sintering Co., New York, sailed on April 15 for a three months' trip to Europe.

H. G. Young, of Montreal, has completed an examination of Ontario Kirkland mines for Montreal Kirkland interests.

A. Burt, manager of the Kirkland Lake Proprietary, has arrived from London to inspect the company's property.

John W. Prout, manager of the Central Copper Co., of Dos Cabezas, Ariz., is making a trip to New York and Danville, Pa.

H. T. Reifel, former superintendent of the La Rue mine, Nashwauk, Minn., has accepted a position with the United States Railroad Administration.

Horace Pomeroy is now manager of construction of the hydro-electric dam for the Georgia Railway & Power Co. on the Tugalo River, Georgia.

A. W. Newberry left New York on April 17 for a four months' stay in Nevada, where he will be occupied in reopening a silver mining property.

Walter G. Perkins and **Preston K. Horner** have established their office as consulting mining and metallurgical engineers at 62 London Wall, London, E. C. 2.

Charles L. Harrington has purchased the engineering office of **W. A. Funk** in Idaho Springs, Col., and will conduct a general engineering business as related to mining.

Kuno Dorr, general manager of the American Smelting & Refining Co.'s plants in Colorado, returned to Denver on April 10, from a visit to the New York offices.

F. C. Lincoln, of the University of Nevada, at Reno, recently visited San Francisco to confer with the officials of the Berkeley Station of the U. S. Bureau of Mines.

Gordon R. Campbell, president of the Calumet & Arizona Mining Co., is making a tour of inspection of the company's properties at Ajo and Warren, Ariz., and Lordsburg, N. M.

William H. Bard, for the last four years with the engineering staff of the Phelps Dodge Corporation, at Tyrone N. M., is now engineer for the American Smelting & Refining Co. at Santa Barbara, Chihuahua, Mexico.

Bulkeley Wells, president of the Metals Exploration Co. and chairman of the Colorado Metal Mining Board, returned to Denver on April 15, after a six weeks' visit in New York City.

Morris Kullman, of New York, was a recent visitor in Phoenix, Ariz., in connection with the Stargo mine, of Morenci, for which he has furnished funds for the erection of a silver mill.

William Wearne, general superintendent for the Inland Steel Co.'s iron mines, has returned to Duluth, Minn., from California, where he has been on a leave of absence for several months.

General Pedro Nel Ospina, the President-Elect of Colombia, arrived at the United States on April 21 for a visit to this country. Of particular interest is the fact that General Ospina was educated at the University of California, at Berkeley, where he took a course in engineering and metallurgy. After a post-graduate course in France, he returned to Colombia, where in partnership with his brothers, he founded the firm of Ospina Hermanos. This firm operated in Medellin a smelter for precious metals. He was also the active head of other enterprises, including cotton and coffee planting, and cattle raising. After a military and political career General Ospina was appointed Minister from Colombia in Washington, and in 1916 was sent as plenipotentiary to Holland and Belgium. General Ospina will enter upon his duties as President of Colombia next August.

Photo by Underwood & Underwood

General Pedro Nel Ospina

Frank H. Sistermans has gone to Mexico on professional business and expects to remain there several months. His address will be in care of Hotel Cosmopolita, Guadalajara, Jalisco, Mexico.

Rudolf Gahl expects to complete his work in connection with the beneficiation of the low-grade silver ores at Cerro de Pasco and intends to return to the United States in a few months' time.

Fayette A. Jones, geologist, of Albuquerque, N. M., and formerly president of the New Mexico State School of Mines, is making a geological survey of the region about seventy-five to eighty miles east of El Paso, Tex., in Hudspeth and southern Otero counties.

J. M. Blayney, of St. Louis, Mo., president, and **W. C. Balm,** of Rosiclare, Ill., superintendent, of the Fairview Fluorspar Co.; **E. P. Hettiger,** of Cincinnati, manager of the Hickman, Williams Co., and **R. B. Ladoo,** of the U. S. Bureau of Mines, who have been inspecting the fluorspar mines of New Mexico, left for Los Angeles on April 9.

D. D. Irwin, formerly in charge of operations of the Moctezuma Copper Co. at Nacozari, and recently appointed general superintendent of the Copper Queen branch of the Phelps Dodge Corporation, has been visiting company properties at Tyrone, N. M., and Clifton-Morenci, Ariz. He will assume his new duties at Bisbee, Ariz., on April 10.

F. W. Bradley gave a luncheon on April 6 at the Pacific Union Club, San Francisco, in honor of **W. R. Ingalls,** who described the present position of the metal markets. Those present were **A. P. Anderson, Eugene Braden, Albert Burch, W. H. Crocker, R. S. Handy, C. T. Hutchinson, E. A. Julian, Jules Labarthe, C. W. Merrill, S. M. Morse, E. H. Nutter,** and **T. A. Rickard.**

Philip Seabury Smith, who recently became associate editor of *Ingenieria Internacional,* was graduated in electrical engineering from Yale University, Sheffield Scientific School, in 1907. From October, 1907, until March, 1916, he was employed by the General Electric Co. in different capacities, and during part of this time was in the foreign department at Schenectady in general supervision of sales. Following this work Mr. Smith became affiliated with the Department of Commerce, where he remained for about six years. During this time he traveled extensively in the West Indies and South America, investigating and reporting on a variety of projects. Mining operations were studied as to methods used and the opportunity for installing American types of apparatus. He was later appointed in charge of the office of Commercial Attaché to the American Embassy in Lima, Peru, and last year was made chief of the Latin American Division of the Bureau of Foreign and Domestic Commerce, Washington, D. C.

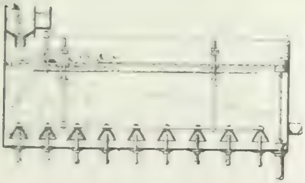
Mining and metallurgical engineers visiting New York City last week included: N. A. **Eilertsen,** of Hancock, Mich.; **W. A. Richards,** of Pottsville, Pa.; **H. A. Wheeler,** of St. Louis, Mo.; **George L. Collord,** of Pittsburgh, Pa.; **Frank L. Nason,** of West Haven, Conn.; **Edward N. Cooper,** of Camp Hill, Pa.; **W. A. Ross,** of Montreal, Quebec; **T. S. Dunn,** of Atlanta, Ga.; and **E. H. Dickenson,** of Philadelphia, Pa.

Recent Patents

Treatment of Oxide Copper Ores—No. 1,407,[illegible]. E. B. Thornhill, Hurley, N. M. The ores are dissolved by sulphuric acid or other suitable agent, and the copper precipitated by sponge iron which has not been further ground after reduction from iron oxide. The copper in the form of a flocculent precipitate is recovered by flotation.

Screening Ore—No. 1,407,229. R. A. Smith, Eureka, Utah. A sizing device for ore, consisting of a screen suspended in frame, with apparatus for vibrating it and equipment for removing the products.

Flotation Cell—No. 1,407,258. A. H. [illegible], Mullan, Idaho. In this flotation machine the air is introduced through nozzles over which are a series of inverted V-shaped hoods.



Hydrometallurgy—No. 1,407,324. W. J. Browning, Huelva, Spain. A process for the extraction of metals from solution which consists in passing sulphurous gases containing hydrogen sulphide through the solution to precipitate the metals as sulphides, treating the residual gases to convert at least a part of their sulphur content to hydrogen sulphide, and repassing them through the solution. Patent No. 1,407,323 covers the manufacture of hydrogen sulphide by passing sulphurous gases through an incandescent carbonaceous zone, in the presence of hydrogen.

Reduction of Ore—No. 1,407,372. W. E. F. Bradley, New York. A method of reducing ores which comprises distilling a hydrocarbon gas from coal, utilizing it as a reducing agent for the ore, and utilizing the resulting coke, out of contact with the ore, as a source of heat for maintaining the temperature of the ore during reduction.

Leaching Copper Ore—No. 1,407,420. N. V. Hybinette, Ottawa, Ont., assignor to Kristianssands Nikkelraffineringsverke, Christianssands, S. Norway. Copper sulphide ores are subjected to at least two roasting and leaching operations and the solutions so obtained subjected to electrolysis. Before the second roasting, the ore is treated with a solution of salts, which promotes the subsequent operations. The roasting and leaching are so carried out, and a sufficient excess of the electrolytic solution is separated, to maintain the iron content of the solution low enough to permit electrolysis without diaphragms.

Cyaniding Carbonaceous Ore—Canadian patent No. 217,519. The Merrill Co., San Francisco, assignee of Albert Silver, Tonopah, Nev. The ore, containing carbonaceous matter, is ground in water, mixed with an oleaginous substance, and without separating the carbonaceous matter from the ore, subjected to a cyanide treatment.

Recovery of Thorium—No. 1,407,441. I. W. Ryan, Chicago, assignor to Lindsay Light Co., Chicago. Thorium is separated from an acid solution containing the rare-earth metals and iron, by adding a water-soluble sodium metaphosphate of the character produced by the gentle heating of a phosphate containing sodium and hydrogen, as described.

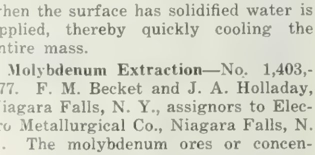
Ore Washer—No. 1,409,385. A. McDougall, Duluth, Minn. An ore washer comprizing two inclined troughs, one above the other. Ore and water, in the upper, discharge through openings in the bottom on to an endless conveyor belt in the lower trough, which discharges dewatered ore at the upper end while water and tailing pass off at the lower end.

Casting Slag—No. 1,402,363. W. T. Hurst, Pittsburgh, Pa., assignor to Slag Rock Machine Co., Pittsburgh. Slag is poured in a water-cooled mold, and when the surface has solidified water is applied, thereby quickly cooling the entire mass.

Molybdenum Extraction—No. 1,403,477. F. M. Becket and J. A. Holladay, Niagara Falls, N. Y., assignors to Electro Metallurgical Co., Niagara Falls, N. Y. The molybdenum ores or concentrates are leached with an alkaline sodium compound of proper strength, the molybdenum precipitated as calcium molybdate, and the precipitate smelted.

Chlorinating Silver—No. 1,403,516. P. R. Middleton, New York, assignor of one-half to J. C. Lalor, New York. A moist charge containing silver ore and a heavy-metal chloride is dried and heated, thereby chlorinating the silver, which is then extracted.

Dry Granulation of Slag—No. 1,404,142. F. Riedel, Duisburg, Germany, assignor to the Chemical Foundation, Inc., of Delaware. The air or other medium used for granulation is passed through a movable nozzle by means of which the granulated slag may be thrown against any part of a cylindrical cooling wall.



Technical Papers

Engineers' License Laws—Copies of the acts in those states in which all-inclusive license laws for professional engineers have been enacted have been compiled and are published by the American Association of Engineers, 63 East Adams St., Chicago, Ill.; price, 50c. It is stated that this association issued a pamphlet in 1920 containing copies of the engineering license laws in Florida, Iowa, Michigan, New York, and Virginia, and since then local chapters and members have been instrumental in obtaining the enactment of laws in eight additional states

Soapstone—The U. S. Bureau of Mines, Washington, D. C., has published a four-page mimeographed bulletin on "Soapstone." (Reports of Investigations, No. 2,327, obtainable on request.) The report gives various analyses, and discusses occurrence, production, mining and milling methods, and utilization of the final product.

Candelaria, Nevada—The geology of this old silver camp in western Nevada, which has produced $20,000,000, is discussed in U. S. Geological Survey Bulletin 735-A, twenty-two pages, obtainable on request from the Survey at Washington, D. C. There is some hope now of treating on an economic basis some of the rebellious ore on the upper levels of the old bonanza mines, but "to achieve success in reviving Candelaria will especially require engineering and administrative skill of the first order."

Metallurgy of Tin—An article in the March issue of *The Metal Industry* (99 John St., New York; price 10c.) discusses the essentials of modern methods of smelting and refining tin. The article covers only a little over two pages and is therefore incomplete and sketchy, but details of current practice are kept closely guarded.

Mineral Industries of Washington—The Washington Geological Survey, Olympia, Wash., has issued two bulletins, No. 21, "The Mineral Resources of Washington, With Statistics for 1919," and No. 23, "The Metal Mines of Washington," which describe in detail the various properties in the state, with especial emphasis on geological conditions. Bulletin 21 contains a good map of the state, showing the situation and names of all mines, quarries, and other plants connected with the mineral industries. Copies may be obtained from State Librarian, Olympia, Wash., at 50c. for No. 21, and $1 for No. 23.

Colemanite in Nevada—U. S. Geological Survey Bulletin 735-B (Washington, D. C., seventeen pages, free on request) discusses geological conditions relating to the deposits of colemanite in Clark County, Nev. This mineral is a source of borax.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

MANY tariff amendments have already been introduced, following the reporting of the Senate bill last week. Special exception to certain sections is taken by Senator Oddie, of Nevada, and Senator Nicholson, of Colorado.

Butte & Superior and Minerals Separation may settle their differences by compromise, according to a current rumor.

J. D. Wolf, owner of a flotation patent for which he claims priority, has filed suits against Minerals Separation and forty-four other alleged infringers.

The Lake Superior iron country is showing increased activity, preparations now under way indicating an improvement in the situation soon.

A strike, wage increase and return of the workers followed one another rapidly at the properties of two companies in the Joplin-Miami district last week.

In the Alworth Stephens Co. income tax case, Judge Morris, at Duluth, ruled recently that a lessee was entitled to a deduction for depletion as well as the lessor.

The Hibbing Village removal suit is to go to the U. S. Supreme Court.

A new schedule on zinc ores, of importance to British Columbia operators, has been announced at Trail.

New Zinc Schedule Announced by Trail Smelter

Prompt Settlement Provided For—Expected to Benefit Producers of East and West Kootenays

By Telegraph to Engineering and Mining Journal-Press

Spokane, Wash., April 17—Announcement of a new schedule of payment for zinc in ores has been made by the Consolidated Mining & Smelting Co. of Canada, whose smelter is at Trail, B. C. The schedule provides for payment on a sliding scale running from 30 to 50 per cent zinc. Sixty per cent of the zinc in ores containing 30 per cent zinc will be paid for, and 85 per cent of the zinc in 50-per cent ores will likewise be paid for. Intermediate stages are also duly determined. The charge for smelting residues of ores containing 30-per cent zinc will be $8.30 per ton, and $5 per ton for ores containing 50 per cent zinc.

The settlement for zinc will be 3.6c. per lb. off London quotations of the week of arrival. In smelting residues, payment is provided for 80 per cent of the gold, 80 per cent of the silver, and 80 per cent less five units of the lead, wet analysis. The London price for lead and the foreign-price for silver, as given in *Engineering and Mining Journal-Press* quotations for the week, will rule.

Payment is to be made in full soon after sampling. The schedule is effective now on straight zinc ores but not on mixed ores until the custom plant now under construction is completed, which will be about July 1.

The new arrangement is regarded as important to the East and West Kootenay producers, as furnishing a market for a class of ore hitherto hard to dispose of in those districts, especially when low prices prevail.

Old Dominion Starts Furnace

By Telegraph to Engineering and Mining Journal-Press

Globe, Ariz., April 17—The Old Dominion company started a blast furnace April 17. A second furnace will be blown in soon. A monthly output of over 2,000,000 lb. of copper is expected. Ore bins are full, and there is plenty of coke on hand. The suspension lasted for a few days over a year.

Gold Output of New South Wales and India

By Cable from Reuters to Engineering and Mining Journal-Press

London, April 13—The output of gold in New South Wales, during January, February, and March totaled 8,740 oz.

The production of gold in India during March amounted to 32,115 oz.

Trona Corporation Resumes

The American Trona Corporation resumed operations on April 10 at Searles Lake. It is said that there are expectations of a record output of potash and borax in the near future. Except for new condensers, there is no change in the plant's equipment and in the process used.

Results of recent research will be applied to the production of several byproducts as soon as practicable. The dry concentration plant in Death Valley is in successful operation, treating colemanite. It is said that the company intends moving its Bayonne, N. J., refinery to Los Angeles.

Wolf Sues Minerals Separation and Forty-four Others

Actions for Alleged Infringement Brought Just Before Patent Expires—Priority of Invention Claimed

Jacob D. Wolf, acting through the Wolf Mineral Process Corporation, a proprietary company, has brought suits against the Minerals Separation North American Corporation and forty-four mining companies, all of whom he claims have infringed on his flotation patent No. 787,814, issued April 18, 1905, and which therefore expired soon after the suits were filed. It is set forth in the bills of complaint that the process had been so carried on that the complainant had been unable sooner to ascertain the facts as to infringement, and, also, that the inventor had not been heretofore financially able to bring suit, but that the infringement suits are now being diligently prosecuted.

Among the companies against whom suit has been brought are the following: Federal Mining & Smelting Co.; Belmont Wagner; Calaveras Copper Co.; Consolidated Mines Co.; Federal Smelting & Refining Co. and the Miami Copper Co., Delaware corporations; and Kennecott Copper Co. and the Nevada, Ray and Chino companies, incorporated in Maine; also others of prominence.

Wolf's patent, No. 787,814, April 18, 1905, is prior to Minerals Separation, Sulman, Picard and Ballot patent No. 835,120, Nov. 6, 1906, by a short period. Mr. Wolf had made (following the description and drawings shown in his patent specifications) a model apparatus, from the operation of which, in accordance with the manipulations as now read from the same patent specifications, it is claimed that air froth flotation was obtained.

As to the quantity of oil employed, Wolf explained, following Judge Bourquin's decision in the Butte and Superior case, that though he used bulk oil prescriptions, nevertheless, the proportion of "frothing oil" in the oil which he used was so small that his process had therefore disclosed the use of less than 1 per cent of oil.

Colorado Legislature Convenes in Special Session

Laws to Make Possible Flood Control and Tunnel Construction Will Be Considered

A special session of the Colorado legislature was called by Governor Shoup for April 17, to enact laws providing for the organization of conservation districts for flood protection and for the construction of tunnels through mountain ranges in Colorado "for the purpose of aiding transportation and communication and to facilitate commercial intercourse within the state." These measures, which at this time seem certain of enactment, have special application to the creation of a conservation district near Pueblo, to prevent a repetition of last summer's flood, and to authorize and finance the construction of a tunnel near James Peak on the line of the Moffat Road, which would afford improved transportation facilities to a large area in northwest Colorado, rich in agricultural and mineral resources.

Amount Due Smith from Hovland Greatly Reduced

Hoval A. Smith is to get only $145,779.01, in his accounting action against Henry A. Hovland, instead of more than $1,000,000, to which he had been considered entitled by a master in chancery, Edwin F. Jones, who has been taking testimony in the action for a year. Judge Dooling, in the U. S. District Court, confirmed all the findings of the master, but refused concurrence in that section of the report that would have made Hovland responsible for $878,200 accruing through the sale of the Live Oak property at Miami, Ariz., to the Inspiration Consolidated and through the resultant Inspiration dividends.

In the final decree Hovland is declared liable to the extent of 15,700 shares of Inspiration Consolidated, valued at $255,125, and interest on the sum to the amount of $123,840. Hovland was adjudged to have had the right to dispose of 7,850 shares of Live Oak Development Co.'s stock, for the benefit of the partnership between himself and Smith.

Government Calls for Bids for Nitrate

The War Department has called for bids for 40,000 tons of sodium nitrate. Opportunity will be offered for purchase of the material in quantities as small as 100 tons.

Wage Increase Follows Walk-Out in Joplin-Miami District

To Have Been Granted Anyway—Trouble, Now Over, Attributed to Visiting Coal Strikers

By P. R. Coldren

Labor trouble visited the Joplin-Miami district for the first time in many months on April 14, when between fifty and one hundred miners at the Chanute Spelter Co.'s Hartley mine, near Baxter Springs, Kans., and the Kanok Metal Co.'s Premier mine, at Picher, Okla., walked out for higher wages. The walk-out, which took place at the Hartley mine on the morning of Friday, April 14, and at the Premier mine in the afternoon of the same day, resulted indirectly from numerous predictions of a wage increase made since the price of zinc and lead ore began advancing. Miners of the companies named evidently concluded to try to hasten the increase, which had virtually been promised by the operators as soon as a $30 price for zinc ore had been reached. Last week the price ranged from $27 to $29.50.

Oddly enough, the walkout came just when a wage increase had been decided upon by virtually all of the larger companies of the field. It is to the amount of 25c. per shift for the machine men and helpers, with a proportionate increase for shovelers and top men. Though wages have not been absolutely uniform at all the mines, in most properties machine men have been getting $3.25 a day and helpers $2.75. The increases granted make these wages $3.50 and $3. Most of the mines in the central part of the district have been paying shovelers from 7 to 9c. per can, but varying conditions and sizes of cans have made impossible an exact schedule for shovelers. An attempt will be made to give them such advances as will make their net increase approximately the same as that for the machine men.

With the establishment of the increased wages, the walkout ended, and it is predicted that no further trouble will develop. Strikes in the Kansas coal fields have resulted in the immigration of some of the coal miners to the zinc and lead fields, and they are sometimes a disturbing element.

Hibbing Removal Suit to Go to Supreme Court

The injunction suit which was started by a group of residents in the older part of Hibbing, Minn., against the Oliver Iron Mining Co. and the Village of Hibbing to prevent the moving of a part of the original townsite, is to go to the United States Supreme Court. Word has been received from Judge Andrew, associate justice, that the petition of the plantiffs asking that a writ of error be granted by the Supreme Court has been granted. This will allow a review of testimony and the U. S. Supreme States Court will pass on the writ of error. The first trial resulted in favor of the defendants, but the case was appealed.

Income Tax Ruling Reversed in Alworth-Stephens Case

Lessee Held Entitled to Deduction for Depletion in Figuring 1917 Tax, As Is Lessor

In awarding the Alworth-Stephens Co., of Duluth, Minn., $17,123.44 in its suit against the Collector of Internal Revenue for Minnesota, Judge Page Morris recently filed a decision in Federal court at Duluth which will be of keen interest to the mining profession generally. The decision holds that the lessee of an iron mine was entitled to figure its income tax for 1917 with a deduction for depletion from its receipts for that year, to the extent of the March 1, 1913, value of his interest in the mine. The decree contradicts all previous rulings of the Internal Revenue Bureau and the Circuit Court of Appeals of Ohio. It is stated that an appeal will be taken to the Eighth Circuit Court of Appeals.

The Alworth-Stephens Co., lessees of certain iron ore properties, had subleased these properties to operators prior to March 1, 1913, and its entire source of income was represented by the difference between the royalties which it received from said operators and those which it paid to its lessors. The award represents the sum of an additional tax demanded by the Internal Revenue Collector which the plaintiffs paid under protest. The Revenue Bureau held that the lessee did not have a property interest in the mines as of March 1, 1913, but that it purchased the amount of ore mined each year and sold it at a profit, all the royalties which it received above those paid the owners being profits of income for the year.

Judge Morris holds that a lessee of a mining property interest is just as much the owner of property in the mine as the fee owner, and is as much entitled to a deduction for depletion to the extent of the March 1, 1913, value of his interest in the mine as is the lessor. It is concluded that both the lessee and the lessor are entitled to depletion in figuring their taxes for 1917, proportionally to the value of their respective interests as they existed March 1, 1913.

Hollinger Conferring to Secure Larger Power Supply

Important conferences have been held recently between the Temiskaming & Northern Ontario Railway Commission, of Ontario, the Abitibi Paper & Pulp Co. and the Hollinger Consolidated Gold Mines, Ltd., of Porcupine, with a view to settling the question of the development of power on the Abitibi River, in Ontario. Some time ago the Hollinger made application for the rights to develop this power, but there were certain interests of the Abitibi company which had to be safeguarded, and to settle the matter the rights were given to the T. & N. O. commission. There is a report that the Hollinger and the Abitibi companies may join in the development.

News from Washington

By PAUL WOOTON
Special Correspondent

Many Amendments to Tariff Bill Introduced

Oddie Wants Cyanide on Free List—Nicholson for Duty on Manganese Ore and Oxide

A flood of amendments is being introduced in the Senate by those who disagree with the tariff conclusions of the Finance Committee. Senator Oddie has introduced an amendment restoring cyanide to the free list. He is outspoken in his criticism of the Finance Committee in amending the bill so as to make all cyanides subject to a duty of 10 per cent ad valorem. He declares it is the duty of Congress to insure free cyanide to the gold producers of this country because of the bearing which the production of new gold has on the whole financial structure. It is his opinion that a duty would be in the interest of a German trust and that it would discriminate in favor of German manufacturers as against American manufacturers who had constructed their plants just across the Canadian frontier, so as to secure the advantages of waterpower. He also told the committee that a duty on cyanide would preclude absolutely the treatment of millions of tons of tailings.

Senator Nicholson, of Colorado, has introduced an amendment providing a duty of 1c. per lb. on amorphous graphite, instead of 10 per cent ad valorem as prescribed by the House bill and the Senate committee. He advocates increasing the rate of 2c. per lb. on crystalline flake graphite, proposed by the Senate committee, to 5c. per lb. At the same time, he strikes out the 20 per cent ad valorem rate proposed by the Senate committee for crystalline lump and suggests a rate of 3c. per lb.

In another amendment, Senator Nicholson proposes to increase the duty on zinc oxide and on lithopone to 2c. per lb.

Senator Nicholson is particularly out of sympathy with the action of the Senate Finance Committee in placing manganese ore and oxide of manganese on the free list. He has introduced an amendment intended to restore the House provision which calls for a rate of 1c. per lb. on the manganese content of ore and concentrates. He also proposes to restore the House rate of 2½c. per lb. on the metallic manganese contained in ferromanganese. The Senate committee amended the bill so as to make the ferromanganese rate $2.50 per ton.

Engineers Confer at Washington on War Minerals

Mining engineers who have specialized in war minerals are to be designated to co-operate with Army officers in the study of the strategic mineral situation in the hope that peace-time activities can be directed so as to contribute most to the national defense in case of an emergency. The entire subject of war minerals was discussed in Washington last week by Pope Yeatman, J. E. Spurr, George Otis Smith, H. Foster Bain, and Colonel Arthur S. Dwight, who are members of the Committee of the American Institute of Mining and Metallurgical Engineers requested to co-operate with the War Department on this matter.

News by Mining Districts

London Letter

Great Boulder Proprietary Ventures Into Argentina—Rio Tinto's Report—Nile-Congo Syndicate Promising—A Canadian Flotation.

By W. A. Doman

London, April 4—Whether the name of the Great Boulder Proprietary will die out on the exhaustion of its West Australian property remains to be seen, but the directing power will apparently continue in some form or other. The management has sought for properties in other parts of the world, and not always with success. The latest venture is into Argentina, a nine-months' option having been obtained on a gold-bearing area in the province of La Rioja. The inducement to take up this option was presumably the report that values had been found ranging from 16 dwt. to 4 oz. of gold per ton. Engineers are being sent out to make the necessary investigation.

The annual report of the Rio Tinto company shows how seriously the reduction of trade the world over has interfered with the demand for the company's products, the sales for 1921 being not much more than half the pre-war figures. In the latter part of the year the demand increased slightly, but normal is not expected for many months to come. The price of standard copper was only £69 8s. 8d. against £97 12s. 4d. in 1920, and the balance sheet shows produce, shipped and afloat and remaining on hand in Great Britain and elsewhere, at cost as £578.923. If ore extracted and in course of local treatment and the partly manufactured copper in Spain, as well as mineral in open casts, be added, the total money laid out under these heads is £1,501,610. The British government has repaid to the company the amount of the 50.-000,000 6 per cent peseta loan issued in 1918, but the company has not yet repaid it in Spain. It figures in the accounts at £1,768,960, and as a set-off the company has invested £836,053 in War Loan, and other securities and has £672,155 in cash. The company's creditors have been reduced from £1,435,463 to £643,761.

If matters should turn out as indicated, shareholders in the Tanganyika Concessions may receive an agreeable surprise. In November, 1920, the Nile-Congo Divide Syndicate was formed, with a capital of £35,000 in £1 shares, of which 20,000 shares are issued and fully paid. In this syndicate the Tanganyika Concessions and Zambesia Exploring Co. have each a 40 per cent interest. Prospecting has been done on the Sudanese side of the Divide, and according to information —very limited in extent—alluvial gold has been discovered in the river systems over an area of about 150 miles in length by about sixty miles wide. Investigations are still in progress, and it is reported that values have been secured as high as £2 per cu.yd., and, in addition, outcrops of copper-bearing ores have been found in several places over a considerable stretch of country.

Another big Canadian flotation has taken place—or is taking place, rather—on this side. The people behind it are A. Mitchelson & Co., Ltd., an outside firm of brokers, and a finance house. The property has been reported upon by Frank Loring, George Bent and Lieutenant Colonel Rowland C. Feilding. The last mentioned seems rather optimistic, for he estimates the quantity of ore disclosed by the work so far done in five levels, including probable ore, at 350,000 tons, averaging $11 per ton extractable value. He puts working costs at $4 per ton—which I believe is less than the Hollinger's costs—and takes the profit value of this ore at £500,000 at the normal rate of exchange. The market does not quite like the idea of "probable" ore being included, as the proportion of "probable" to actually developed is not stated. Judging by the information given in the prospectus, the property would seem to have good speculative chances, but it appears to be rather heavily capitalized. The authorized capital is £1,000,000, in £375,000 of preferred shares of 5s. and £625,000 in ordinary shares of 5s. The effect of the purchase consideration is apparently £50,000 in cash and £625,000 in shares. It is not easy to see exactly [illegible] has been expended on the property, so that the vendors can [illegible] little profit even if they sell at a pretty good discount.

CANADA

British Columbia

Boundary of Quesnelle Division Changed to Facilitate Claim Recording

Victoria—The provincial government, anticipating that there will be a rush to the Cedar Creek section of the Cariboo district as soon as the snow disappears, is taking steps to provide adequate facilities for the recording of [illegible] of mineral claims. There is now a recorder at the 150 Mile House, Cariboo Road. The boundary of the present Quesnelle mining division has been extended a short distance southward to take in Williams Lake station, Pacific Great Eastern Ry. The mining recorder will be transferred from the 150 Mile House to this station. The change will permit him to carry out his duties as recorder for the Quesnelle division, [illegible] is Cedar Creek, and as sub-recorder for the Clinton division, in which is situated the Whitewater, with the maximum of convenience to the prospectors and mining men.

Greenwood—H. McGillvray and H. M. Stramberg have secured a three-year lease and bond on the Vendela, Hidden Load, and Silva claims, and are making preparations to work the property extensively this season.

Trail—Although the coal strike has extended to the Crow's Nest Pass coal fields, from which coke used at the Trail smelter is derived, no apprehension is felt that the smelter will experience an immediate shortage of coke, as the policy of the company has been to maintain a big stock on hand for such emergencies. Advices from the Crow's Nest section indicate that the strike is not likely to be prolonged.

Ore shipments received by the Consolidated smelter April 1 to 7 inclusive totaled 8,852 tons, of which 8,422 tons came from company mines. Other shippers were: Bell (Beaverdell), Beaverdell, 43 tons; Emerald, Salmo, 25; Horn Silver, Similkameen, 27; McAlister, Three Forks, 29; No. One, Sandon, 27; Renner & Drace, Ewings Ldg., 25; Rosebery Surprise, New Denver, 109; Silversmith, Sandon, 42; Silver Standard, New Hazelton, 31; Sally, Beaverdell, 39; Utica, Adamant, 33.

Ontario

Bailey Mine Closed—Merger of Teck-Hughes With Orr Sought

Cobalt—The annual report of the Beaver for the ten months ended Dec. 31, 1921, shows income of $31,538, and expenses of $22,523. The surplus shows a total of $944,500, of which $366,000 represents an investment in the Kirkland Lake Gold mine and bills receivable of $438,000, which apparently is money loaned to the Kirkland mine. The directors hold out the hope that operations may be resumed in a few months.

The crosscut from the 185 level of the Castle property, in Gowganda, has just cut the vein, which shows a width of 3 in., running as high as 3,000 oz.

During March Nipissing mined ore of an estimated net value of $172,747, and shipped bullion of an estimated net value of $362,441. No new veins were found, but development work on several small veins was encouraging. The low-grade mill treated 7,369 tons and the high-grade plant 152 tons. The refinery shipped 554,715 fine ounces of bullion.

Operations have been resumed on the Casey Mountain property.

The Bonsall claims in Gowganda have been acquired by the Miller-Lake O'Brien. The property comprises six claims adjoining the Castle-Trethewey.

The McKinley is dismantling the Savage property, removing everything except the pumps.

Coniagas has given up the claims in Larder Lake on which it held an option. On March 29 the company shipped seventy-two bars of bullion containing 73,000 oz.

For the three months ended March 31, 1922, La Rose produced 151,000 oz. of an estimated net value of $91,000. Revenue was somewhat smaller than for the corresponding period of last year, on account of lower exchange rates and lower payment for cobalt metal. Current assets, less liabilities, as of March 31, were $550,000.

The Bailey mine has been closed, but operations are being continued at the mill. The lease which this company held on the Silver Cliff has also been dropped.

Kirkland—The report of the Kirkland Lake Gold for the year ended Dec. 31 shows a production of $148,000 and income from exchange of $15,000, or a total of $163,000. Operating and administration costs were $150,000, showing an operating profit of $13,000, but this does not allow for interest on money borrowed. During the year the company treated 25,717 tons, of an average of $5.73 a ton, which is lower than that of any other operating gold mine in northern Ontario.

The Wright-Hargraves encountered a new vein while sinking the main shaft. It shows a width of about 6 ft. of $12 to $13 ore.

Financial arrangements are being made for the resumption of operations on the recently amalgamated Ontario and Montreal Kirkland.

The Tough Oakes mill has resumed operations after a shutdown since July, 1918. Recent developments on the property have been satisfactory.

Negotiations are proceeding for the amalgamation of the Teck-Hughes with the Orr property. It is understood that the main vein of the former property dips into the Orr at about 1,000 ft.

Porcupine—Dome's bullion output in March was valued at $312,000, as compared with $302,000 in February and $305,000 in January. It is understood that the directors will endeavor to maintain production at about this rate.

ARIZONA

Verde Central to Have Up-to-Date Plant—U. V. Extension Shipping 300 Tons Daily to Smelter

By James H. McClintock

Phoenix—The Tom Reed-United Eastern apex suit has been placed before the Supreme Court of Arizona, following argument on appeal from a decision favorable to the defendant in the Superior Court of Mohave County. It is the only apex suit that has come before the Arizona Supreme Court since 1883. It has novel features, one, in particular, involving the question whether a vein may be considered continuous despite a geologic fault that has separated the ends of the vein matter, in this instance a distance of 430 ft.

Argument before the Supreme Court on behalf of the Tom Reed was by William E. Colby, of San Francisco. John P. Gray, of Cœur d'Alene, Idaho, represented the United Eastern. The courtroom had been half filled with models of the mines and with map frames, used by the attorneys of both sides to demonstrate and illustrate their arguments.

The Arizona Commercial-Iron Cap suit was tried last December in Globe by Judge Sam. L. Pattee, of Tucson, but no decision has been announced.

Jerome—Gordon R. Campbell, head of the Calumet & Arizona, and a party of company officials have been inspecting the Verde Central and other local properties. It is said that authorization has been given the Verde Central management for purchase and installation of the best type of surface equipment, displacing inadequate machinery that has been retarding development. The C. & A. has option on 1,000,000 shares of Verde Central, which were contracted for at 70c. last summer.

United Verde Extension is employing a mine force of 250 men and is sending 300 tons of ore a day to the Clemenceau smelter. No increase in output is planned for the present.

The United Verde shovel operations are getting into the top of the hot sulphides.

No further action, it is said, will be taken in Prescott in the receivership application filed there by Charles H. Brown against the Calumet & Jerome Mining Co. and the Avery administration.

Mascot—Extensive diamond drilling will be conducted on the Central Copper Co.'s property this year. Work has already begun.

Mandy Mining Co. Reduces Capital

Reduction of the capital stock issued by the Mandy Mining Co. to 10,000 shares of common stock at $1 per share has been officially announced. The company owns the Mandy mine, in northern Manitoba. It is a subsidiary of the Tonopah Extension Mining Co., of Tonopah, Neb.

NEW MEXICO

Fluorspar Deposits Inspected by Illinois-Kentucky Operators—Coal Mines at Gallup Idle

From Our Special Correspondent

Bayard—A party of Illinois and Kentucky fluorspar producers made an inspection of the various fluorspar properties of New Mexico from April 3 to April 9, under the guidance of Alford Roos, a local fluorspar operator. In the party were J. M. Blaney and W. C. Bohn, respectively president and manager of the Fairview Fluorspar & Lead Co.; E. P. Hettinger, president of Hickman, Williams & Co., of Cincinnati; R. B. Ladoo, of the U. S. Bureau of Mines, and C. S. Nunn, representing the Kentucky Fluorspar Co. and Rosiclare Fluorspar Co.

It was determined that though fluorspar in a limited tonnage could be laid down in most instances at the railroad for less than was possible in the Illinois-Kentucky field, the New Mexican field as yet cannot offer serious competition, owing in part to the lack of development of the several mines, in a measure to the comparatively small size of the developed deposits and in part to the difficulties of transportation to railroad. Some of the mines, moreever, have unsolved metallurgical problems. It was also noted that without exception the New Mexican fluorspar mines were not sufficiently strong financially to carry on a protracted plan of proper development by which full justice could be done to the mines or to tide them over a lean period of economic stress, and that in fact production so far had been intermittent. Some of the properties had suffered keenly through losses incidental to irresponsible brokers handling their product.

Gallup—Organizers are making an effort to unionize the coal miners in this district. They are claiming everything but the indications do not point to complete success. All the mines are shut down. There are about 900 miners in this field. It is confidently predicted by operators that at least 40 per cent of the men will be working soon.

Santa Rita—New men are being put to work by the Chino Copper Co. in both mine and mill as needed. Labor to meet present requirements is available.

Tyrone—The Leeches, who have been experimenting in concentrating torbernite ores from the White Signal district, are meeting with sufficient success to warrant the hope that a process may be perfected that will have a commercial application. This is of particular interest on account of its novelty, there being no process known at present that is successful for this purpose. Recent prospecting has considerably extended the area over which this mineral is found.

Chloride—The annual meeting of the Silver Mountain Metals Co. was held on April 3 in El Paso. The following officers were elected: John M. McCutcheon, president and general manager; G. D. Walters, vice-president; J. M. McCutcheon, Jr., secretary.

CALIFORNIA

Movement to Organize National Silver League Under Way—Opinion Regarding Denison Bill Not Definite

[illegible]

San Francisco—Of interest to silver miners of the West is the recent move to organize the National Silver League. Preliminary meetings were held on April 1 and 6 in San Francisco. The purpose of the league is to re-establish silver as a money metal. Efforts are to be made to secure international action to stabilize the value ratio at 15½ of silver to 1 of gold and to further a bimetallic monetary standard. Frank H. Norcross, of Reno, Nev., was elected president. Plans are under consideration to hold a convention in San Francisco in June.

The Commissioner of Corporations, E. M. Daugherty, is urging bankers, brokers, civic organizations, and investment associations to support the Denison bill, but local opinion among mining men here apparently has not crystallized. Opinion where expressed is adverse, but this may be due to a concerted drive by "interests" opposed to this bill rather than the result of careful consideration of its provisions.

Northern California gold-mining districts continue to report increasing activity. The Lorenz hydraulic mine, near Weaverville, has five grants in operation. The Sybil mine, at French Gulch, reports its March clean-up at approximately $8,000.

In north central California, the Grass Valley district continues normal operation. From Quincy it is reported that the Jamison mine, at Sierra City, contains enough low-grade ore to operate steadily. The Emigrant Hill gravel mine, at Elizabethtown, has been reopened, and nine men are employed. Judson M. Coats is in charge of the operations. Some development work is to be undertaken in the old Meadow Lake district. An attempt to rob the mills at Grass Valley was nipped in the bud, and the alleged conspirators have been jailed.

The Mother Lode region shows increased activity. The Tonopah Mining Co. of Nevada is completing preparations for work on the Chileno. The old Thorpe mine, between San Andreas and Angels Camp, was recently bonded and will be reopened.

The Darwin Silver Co., in Darwin, Inyo County, is starting up its pilot mill, but operations will be restricted.

OREGON

Bayhorse Mine Makes First Shipment

Huntington—The first shipments from the Bay Horse mine were made the latter part of March by the U. S. Metals Co., which has had the property under development for several months. One car was sent to Salt Lake for testing, and a second was billed to Tacoma, the plans of the company being to ship about a car a day after a marketing point is decided upon. Values are in silver.

NEVADA

Candelaria Active—West End Breaks Tonnage Record—Tonopah's March Output Above Normal

From Our Special Correspondent

Candelaria—The camp of Candelaria shows activity. Construction of the 300-ton plant of the Candelaria Mines Co. is progressing satisfactorily. The power line from Mina to Candelaria has been started and an 800-hp. substation will be built at Candelaria. The old pipe line from Mount Montgomery, about twenty-five miles long, is being repaired, and a railroad spur being built. The Northern Belle mine was carefully sampled in 1919, and it is estimated that 600,000 tons of ore is available which will run between 10 and 15 oz. of silver per ton. The Lucky Hill mine has been taken over by the Candelaria Mines Co.

Hawthorne—A lease syndicate, composed of mining men from Tonopah, Hawthorne, and Virginia City, is operating from the tunnel level of the Lucky Boy mine, about 6,000 ft. from the portal. A shaft is down 40 ft., and shows some rich ore. The stopes above the tunnel contain variable widths of high-grade ore, which is being taken out and sacked for shipment. The Lucky Boy mine is famous for its lenses of high-grade ore, one of which produced over 1,000,000 oz. of silver. Values are mostly in silver, with some lead.

Tonopah—The March production of this district was approximately $650,000, or about $50,000 above normal. Recent bullion shipments from the district, representing the clean-up of operations for the latter half of March, were as follows: Tonopah Belmont, $131,842; West End, $95,000; Tonopah Extension, $74,000; Tonopah Mining, $40,000.

The Tonopah Extension Co. produced 11,535 tons of ore during March, which is a new record for this company. Conditions on the 1,880 level are reported as being satisfactory. The Tonopah Belmont accomplished the usual development on all levels, from the 600 to the 1,400, with nothing new of importance.

West End's tonnage in March was 8,400, which is the largest ever mined by the company. The Midway reports an interesting discovery in an old working on the 1,200 level about 150 ft. northwest of the new shaft. It appears that development work was discontinued in this particular working several years ago without a realization of the existence of commercial values. The vein is about 8 ft. wide.

Goldfield—About 550 tons of $57 ore was shipped from the Silver Pick lease on the Red Top during March. The last two cars averaged $95 per ton. The stope looks promising. The ore is typical Goldfield ore, spotted and difficult to sample, and its extent is indeterminate. Goldfield mining men state [illegible] is the most important Goldfield discovery since the Jumbo Extension bonanza.

Hornsilver—Favorable developments continue at the Orleans Hornsilver. The Northeast drift on the 700 level is following 4 ft. of $35 ore and the southwest drift on the same level is in commercial ore. Development has been temporarily suspended on the fifth and sixth levels. There is a noticeable decrease in silver values on the 700 level southwest, with a noticeable increase in gold values.

Ely—Milling operations recently resumed by the Nevada Consolidated at McGill lasted two weeks, the non-arrival of coal causing a quick shutdown. Men working at the mill have been transferred elsewhere. Similarly, miners at the Ruth mine have been placed on development until the situation shows improvement.

Operations in the Pioche District

By E. C. D. Marriage

Pioche — Operations continue on a steady scale at both the Bristol and Jackrabbit, with slightly more ore being moved. The grade of this product is of higher value, due to cleaner mining.

The Virginia Louise mine, adjoining the Prince, should benefit by the improved smelter situation, and the large ore reserves should soon be again in demand. The average analysis of the tonnage available is approximately: Gold, 0.01 oz.; silver, 2.6 oz.; lead, 3.4 per cent; iron, 34.6 per cent; manganese, 11.5 per cent; insoluble, 8.6 per cent; lime, 3.1 per cent; zinc, 1.8 per cent; and sulphur, 0.2 per cent.

Settlement was received this week on car lots from the Mascot and Alps mines, east of Pioche. The Alps settlement showed $2.50 in gold, 135.9 oz. in silver, and 52.0 per cent in lead. The Mascot averaging $6 in gold, 67.0 oz. in silver, and 19 per cent in lead for the thirty-eight tons shipped.

Shipments from the district for the week ended April 14 were as follows: Black Metals, 340 tons; Bristol Silver, 275; and Mendha mine, 50.

Canal for Iron-Ore Carriers Favored

In a letter to the Great Lakes, St. Lawrence Tidewater Association, E. G Grace, president of the Bethlehem Steel Co., especially emphasizes the fact that the Great Lakes-St. Lawrence canal project would be of great benefit to the steel industry. Mr. Grace, wrote in part as follows:

"The question of building ore-carrying ships for ocean service presents no difficult problems, as our experience has taught us in the fleet which we are operating between Cuba and the United States. It would seem that the transportation of ore from the upper Lakes to the seaboard ports in vessels should be considerably cheaper than the part-vessel and part-railroad method which is now necessary."

MONTANA

Forces Increased at Washoe Smelter—New Ore Cut in Katie Mine at Basin

By A. B. Keith

Butte—The East Butte's gold cyanide mill at Elkhorn, Jefferson County, where operations were begun last November, reached a self-supporting stage by the end of 1921, according to the comment of Robert H. Gross, president, in the annual statement. In the company's oil operations nothing was done beyond operating gas wells in Marion County, Kan., where the wells have no market beyond the requirements of neighboring oil fields, and this output is limited.

The Tuolumne Copper Mining Co. is continuing sinking of its Main Range shaft, which is now below the 1,900 level. By the middle of May it is thought that it will be possible to crosscut to the Spread Delight at that depth. Sinking will continue to the 2,400 level and this vein will be cut again.

The Black Rock concentrator of the Butte & Superior is now at capacity with ore production from the Black Rock mine at approximately 1,000 tons daily.

Basin—Cutting of a vein said to be 2 ft. wide on the 400 level of the old Katie mine has again called attention to this property. Assays of gold ore are reported to be high. In the early operations of the Katie it was necessary to search the miners to prevent "high grading." About half a hundred men are now employed at this mine.

Anaconda — Forces at Anaconda's Washoe smelting works have been increased by about 350 men, and an additional furnace has been fired, in connection with the resumption of the work of reclaiming the values from the old tailings pile.

IDAHO

Coeur d'Alene District

Hecla's Annual Meeting Held at Spokane

The annual general meeting of the stockholders of the Hecla Mining Co. was held at the Empire State Building, Spokane, on April 11. The regular quarterly dividend of $150,000, payable, June 28, was declared, and deeper development was authorized of the Wide West claim, which was acquired from the Federal Mining & Smelting Co. at the time the settlement of the Marsh Mines Consolidated apex litigation was effected. The only one change was made in the board of directors, George P. Mayer, of Milwaukee, succeeding Mrs. Sarah Smith, who is reputed to hold the largest individual amount of Hecla stock and who was one of the plaintiffs in the litigation started last year by a minority faction to prevent ratification of an agreement whereby the Hecla and Bunker Hill & Sullivan companies entered into a joint partnnership in the Sullivan Mining Co. for development and operation of the Star property near Mullen, Idaho.

Mr. Mayer is vice-president of the National Bank of Commerce and president of the F. Mayer Boot & Shoe Co., of Milwaukee, and president of the Washington Boot & Shoe Co., of Seattle. The Hecla board is now made up as follows: James F. McCarthy, Wallace, president; W. J. C. Wakefield, Spokane, vice-president; Frank J. Kipp, Carl Landsee, and George P. Mayer, Milwaukee; E. J. Nolan, Los Angeles, and Dr. H. C. Lambach, Spokane.

Other Districts

Copeland—Readjustments are being made to the mill of Idaho Continental mine and flotation equipment has been added, the work being undertaken under direction of Bunker Hill metallurgists following a series of tests extending over several months. It is expected that milling will be resumed early this spring. Work is being continued steadily on the driving of the lower tunnel, which will open up the mine 350 ft. below the levels hitherto worked. Operations are being conducted under a five-year lease held jointly by A. Klockmann and the Bunker Hill & Sullivan Mining and Concentrating Co.

Bonners Ferry—The Cynide Gold Co. ("Cynide" is the legal spelling, on account of incorporation error in spelling) has concluded arrangements for building a 100-ton cyanide mill. The property is twenty-four miles northeast of Bonners Ferry, and values are in a finely disseminated gold, which has hitherto resisted all methods of extraction. Recent cyaniding tests have given a 92 per cent saving.

Adair—Arrangements have been completed whereby the Richmond Mining, Milling & Reduction Co., with holdings in the Idaho-Montana copper belt, near Saltese, will have an easement on the long tunnel of Montana-Idaho Copper Co. The Montana-Idaho crosscut is now only a few hundred feet from its objective. The Richmond will have to drive about 1,200 ft. from the Montana-Idaho tunnel to cut the vein sought, and will then have a vertical depth of about 1,700 ft.

UTAH

U. S. Company to Open Bingham Properties at Greater Depth—High-Grade Cut in Ontario

From Our Special Correspondent

Bingham Canyon—The United States Mining Co.'s Bingham properties, according to the company's report are to be opened 1,100 ft. below the Niagara or main transportation tunnel level, to a depth 900 ft. greater than any so far attained. During 1921 the Bingham Mines, including the Niagara Mining Co., shipped an aggregate of 151,450 wet tons of complex gold, silver, lead, zinc, ore, compared with 102,842 wet tons the year preceding. In addition, 9,547 wet tons of copper ore was shipped Development at lower levels has been productive, both in tonnage and in average value, of the complex ore, and a large part of the output of copper ore came from this part of the mine. The concentrator at Midvale, milled 138,771 tons of crude ore of average grade in comparison with 106,874 tons for the preceding year. The lead smelter treated 187,192 tons of marginal ore as against 215,757 tons in 1920, the reduced tonnage being accounted for by reason of curtailment of custom ore shipments, due to the low price of lead in comparison with its production cost. The lead bullion output for the year amounted to 27,160 tons, or slightly less than in 1920. By-products, including arsenic and arsenical compounds, were recovered or manufactured into marketable forms, and this business is growing, providing an avenue for the consumption of one of the by-products of the ores.

The Montana-Bingham received a gross income of $43,556 from the sale of copper fluxing ore during 1921. The ore came from the Mayflower of the company's Fortuna holdings, which could be worked economically from the Montana-Bingham tunnel. A net deficit of $50,805 was shown.

Alta—The Columbus-Rexall has just paid its second dividend, amounting to $17,567 or 3c. a share. There is a substantial surplus in the treasury. The bins are full, and as soon as the roads are opened ore will be marketed for some time. Enough ore is reported to be developed to maintain profitable shipments for a considerable period.

Park City—Ore shipments for the week ended April 8 totaled 2,179 tons, as compared with 2,285 tons the week before. The shippers were Judge Allied Companies, 1,082 tons; Silver King Coalition, 586; Ontario, 511.

High-grade silver ore has been opened in the old Ontario mine on the east side of a porphyry dike and fault, which in the early days was thought to limit the ore on the east. The discovery was made in a raise above the 1,300 level, and two shipments from this ore had been made.

Eureka—Ore shipments from the Tintic district for the week ended April 8 amounted to 151 cars of ore, compared with 152 in the week preceding. Shippers were: Chief Consolidated, 42 cars; Tintic Standard, 36; Eagle & Blue Bell, 15; Colorado, 14; Iron Blossom, 12; Victoria, 9; Dragon, 5; Centennial-Eureka, 4; Grand Central, 4; Gemini, 3; Alaska, 2; Swansea, 2; Eureka Hill, 1; Sunbeam, 1; Eureka Mines, 1.

At the Grand Central, repairs have been completed on the tramway and shipments have been resumed. A number of improvements are being made at the shaft and at the upper terminal of the tramway. About 100 leasers are working at present.

26 Fatalities in Arizona

Despite inactivity in the larger mines of Arizona during 1922, twenty-six fatal mine accidents were reported during the year to the State Mine Inspector.

COLORADO

Reported Camp Bird Will Resume Development This Year

From Our Special Correspondent

Ouray—It is stated on good authority that the Camp Bird will resume operations this summer, probably next August. The new work will be a resumption of development in the west heading of the main drift on the vein at the level of the new crosscut tunnel. Good ore had begun to show here when work was stopped over two years ago.

Work has been resumed at the Black Girl, just north of Ouray, by leasers working under Fred Herzinger, of Ouray. Shipping ore of good grade in silver is produced by this mine, which has been idle ever since the rise in freight and treatment rates.

The Ouray Leasing Co. has struck high-grade gold ore in the lower adit of the Barstow, where it has been drifting all winter. A good shoot of milling ore has already been developed, and the high-grade free-gold ore now found will probably develop another of the rich shoots which have made the mine well known.

It is publicly announced that the owners of both the Revenue and Governor, well-known mines which have been idle for years, will let contracts for driving tunnels on their main veins this summer, the work aggregating 1,000 to 2,000 ft. of drifting.

Telluride—Shipments of concentrates from the Telluride district in March were 154 cars, compared with 114 cars in March, 1921. Smuggler Union shipped 102 cars and Tomboy 52. This compares with 143 cars in January this year.

Alma—The London Gold Mines Co. has completed its raise and made connections from its new lower tunnel with the Extension workings, and has a force of men enlarging and retimbering the latter. This tunnel, when completed, will open the veins at a point approximately 500 ft. below the South London workings.

Work has been resumed at the Hock Hocking property in Mosquito Gulch. The present workings will be extended a distance of 600 ft.

The Associated Mines Co., operating the Champaign property in North Mosquito Gulch, made its initial shipment of high-grade silver ore to the A. V. smelter in Leadville last week.

Breckenridge—The property of the Gold Bond Exploration Co. is being developed under lease. A 2-ft. vein of high-grade silver ore has been opened.

Kokomo—The Silver Queen property is being developed and operated by a leasing company, and six carloads of silver-bearing ore are shipped monthly to the Arkansas Valley plant of the A. S. & R. Co. at Leadville.

Alma—George W. Logan has closed a deal on his Hock-Hocking mine at Alma to local investors, who have put up a fund of $15,000 to extend the present tunnel on the vein 1,100 ft. to the end line of the property, with the option of purchasing at $175,000.

MICHIGAN

The Copper Country

Isle Royale Mill Started—Coal Stock Sufficient—Mayflower Seeking Lode from 1,700 Level

By M. W. Youngs

Houghton—Only 2,000 tons of "rock" is being shipped daily from the Calumet & Hecla conglomerate department to the Calumet mill, where six heads are in operation sixteen out of the twenty four hours. If there is no decrease in the high yield obtained during the first three months of 1921, this tonnage will give 1,887,000 lb. of refined copper per month, which is only 30 per cent of normal for the entire mine in average years.

Isle Royale's stamp mill was started April 10 with its battery of three heads. Tonnage from the mine will be at the rate of 1,000 tons daily for the entire week, but the mill will run only four days a week. The mill, however, will treat 1,500 tons of rock every twenty-four hours of the short week, equivalent to 1,000 tons daily for a full week. Based on the yield recovered during the three months the mine was operated in 1921, Isle Royale will produce at the rate of 534,250 lb. of refined copper per month, or 46 per cent of normal.

Shipments from Ahmeek average 1,500 tons daily, which will yield, based on 1921 recovery, 1,105,000 lb. of copper per month. This is at the rate of 83 per cent of normal.

The coal strike situation is not regarded as serious here. The docks are usually restocked early in the season, the first coal boats arriving soon after the opening of navigation the latter part of April. Some of the mining companies have been purchasing their coal for several years from non-union mines, and last summer one of these four bought 15,000 tons in excess of needs, expecting a coal strike at this time. No fear is felt that the docks will not be completely stocked and that the mines will be able to continue operations next winter. The reduced [illegible] of operations also will help considerably.

A new engine house has been completed at No. 2 Gratiot shaft, Seneca. The new hoist, which is on the ground, will not be needed, however, for some time, or, at least, until sinking is resumed from the thirteenth level. The work of cleaning out the shaft and straightening it to conform to the dip of the lode has been completed to the ninth level. The shaft will be deepened to a depth of 3,200 ft., at which point contact will be established with the third level drift from the Seneca shaft. Other openings from Seneca also are being pushed toward Gratiot ground, and connection with the Gratiot shaft will be necessary to establish ventilation. There are already over 8,000 ft. of openings in the Seneca and Gratiot.

Quincy continues to operate its new furnace at its smelter. It is the largest and most modern furnace unit in the output and most economical in operation. Its capacity is 250,000 lb. of copper daily, but is not, of course, being worked at capacity under present market conditions. Quincy is now on a production basis of about 1,000,000 lb. of refined copper per month.

In hope of re-establishing contact with the lode, the Mayflower Old Colony has begun work on a raise in the crosscut on the 1,700 level. Drifting continues south on the 1,450 level, but the rock at present is barren of values.

Gogebic Range

Townsite Mine To Resume Production Soon—Improving Power Service—Unique Compensation Decision

Ironwood—The Townsite mine is being put in condition for operation as rapidly as possible. It will be ready, it is thought, by May 15. About 125 men will then be employed, and it is planned to continue operation at capacity throughout the season.

Some improvements have been made in the public service electric system which supplies power to most of the mines and all of the towns on the range. It is understood that work on the water-power project on the Flambeau River will be renewed. It will develop about 15,000 hp.

A survey of the power conditions as to supply and demand on the Gogebic Range was made a short time ago by H. M. Byllesby & Co. for a syndicate controlling about 25,000 hp. water-power on the Sturgeon River near Sidnaw, Mich. On account of difficulties of development, however, this power will probably not be made available at present. It is situated nearer to the Marquette Range than to the Gogebic.

In a workman's compensation case which was appealed from the Michigan state labor commission to the Michigan Supreme Court, the award of the commission granting compensation to the heirs of a workman who apparently died from the shock of seeing another man injured in an accident was upheld by the court. The workman who died dropped a tool which struck the other man, causing the accident. The case was Klein vs. Len H. Darling Co.

MINNESOTA

Cuyuna Range

Kennedy Mine Will Reopen at Once—Hillcrest Shipping—Inland Steel Sending Ore to Docks

Cuyuna—Officials of the Rogers-Brown Ore Co. have received orders for the immediate reopening of the Kennedy mine. The mine normally employs about 175 men.

Ironton—First ore shipments to the docks for the Cuyuna Range were begun April 11 by the Inland Steel Co. from the Armour No. 2 mine. It is planned to ship four cargoes approximating [illegible],000 tons from this property before May 1. The mine has been idle since March 1, but is expected to resume operation in the next two weeks.

A petition asking for the vacating of a part of the platted area of the village of Ironton has been filed in the district court at Brainerd by Winona Kreitter and the Lamb Estate, Inc., fee owners of the Ironton mine.

Shipments from the Hillcrest mine (Coates & Tweed) were begun on April 18. Ore production will be rushed to meet the schedule of three boats reported for Hillcrest ore before May 15. One shovel is also busy on stripping at this pit. The new drainage shaft has been completed to a depth of 160 feet. A drainage drift is being driven across the formation at this level, and foundations are being placed for a 400-gal. Pomona deep-well pump.

An all-rail shipment to a St. Louis furnace has been made from the Huntington mine of the George H. Crosby interests. The property has been idle since early in 1919, and the recent shipment is the first from its stockpile.

Trommald—The Maroco mine of the Marquette Ore Co. has been reopened, and steam shovel and hydraulic stripping have been resumed to put the pit in condition for ore production this season.

Riverton—Bids were recently considered by the John A. Savage Co. for the furnishing of all conveying equipment for its drying plant at the Sagamore mine. A drag-line shovel is being used to dig an approach from the pit to the plant. Extension of ore reserves to the northwest of the present pit is being tested with diamond drills.

Mesabi Range

Laura Mine Resumes—Iron Ore Situation Brighter

Hibbing—The Laura mine (Inland Steel Co.) has resumed with 150 men.

The whole iron-ore situation in this district looks brighter, although there are many idle mines. It is anticipated that word will be received in the near future for resumption by many of the properties. The opening of navigation according to the present outlook will be around April 25, but prior to this date shipments will be made from the mines on the range which will be held in storage until boats are able to break through the ice.

Virginia—Mine rescue car No. 10, with headquarters at Houghton, Mich., and in charge of R. V. Ageton, is now on the Mesabi range, and will not complete its itinerary until the middle of June.

Biwabik—The Biwabik Mining Co., which operates the Biwabik open pit, has started repairs on its equipment preparatory to ore operations in its pit this season.

Chisholm—The Frazier open pit, (Oliver Iron Mining Co.) has been forced to close temporarily because of water and the soft ground around the dumps.

Keewatin—Loading of ore from stockpile has been started at the Sargent mine, a property of the Wisconsin Steel Co.

ALABAMA

Iron Making Increasing—District Aided by Coal Strike Elsewhere — Rock Asphalt Company Formed

By George Huntington Clark

Birmingham—The record of Alabama iron making during the first ten days of April continues to show regular and steady progress toward normal output of pig iron.

Blast furnace No. 3 of the Sloss-Sheffield Steel & Iron Company's plant at North Birmingham, which was overhauled during the last year, has been blown in.

As expected, the bituminous coal strike has not been participated in by the Alabama coal miners, only one mine having been adversely affected. On the contrary, the strike has stimulated coal production, which is responding to the demands for fuel supply received from outside districts. A material decrease in the district's unemployment is indicated, by reason of augmented shifts at the mines.

Mining industries in Alabama, not related to iron and steel making, show as yet little recovery from the war-induced stagnation.

The unfortunate deadlock in Congress over the utilization of the nitrate plant and other projected industries at Muscle Shoals has held up many mining operations already planned and dependent on the anticipated and ultimately assured manufacturing center there. Mention was recently made of the interest attracted to Alabama deposits of rock asphalt apparently suited to the surfacing of heavy-traffic main highways, which are necessary in this state on roads leading out from manufacturing centers.

The first evidence of definite action toward the mining and preparation of Alabama rock asphalts (recently mentioned), is seen in the incorporation, just announced, of the Muscle Shoals Asphalt Co., in Franklin County, owning 3,000 acres of asphalt deposits. The officers of the company are C. E. Dexter, president; W. J. Borries, chief engineer; C. J. Stillers, construction engineer—all of Louisville, Ken.—and S. M. Hills, of Indiana, in charge of quarry operation. W. S. Douglas, of Russellville, Ala., is local superintendent. The property purchased is near Littleville, in Colbert County.

JOPLIN-MIAMI DISTRICT

Federal Mine at Picher, Okla., Reopened After Two Years Idleness

Picher—After an idleness of over two years, the Federal mine, in the south part of the town of Picher, Okla., was opened up by the S. R. & W. Mining Co. early in April. The lease of the new company was formally approved by the Interior Department at Washington some weeks ago, and operations were started as soon as possible thereafter, with Homer Seals as general superintendent and J. W. Roberts as secretary-treasurer of the company.

THE MARKET REPORT

Daily Prices of Metals

Apr	Copper, N. Y., net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
13	12.625	30.25	31.00	5.00@5.15	4.90	4.90
14	12.625	30.25	31.00	5.00@5.20	4.90@4.95	4.90
15	12.625	30.25	31.00	5.00@5.20	4.90@4.95	4.90
17	12.625	30.00	30.875	5.00@5.20	4.95	4.90
18	12.625	30.00	31.125	5.00@5.25	4.95@4.975	4.90
19	12.625	29.75	30.75	5.00@5.25	4.95@4.975	4.90

*These prices correspond to the following quotations for copper delivered: 12.875c. for the week.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Apr.	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
13	59¼	59⅞	64½	151½	153	22¼	22¼	26⅝	26⅝
14	...	...	...	....		..			...
15		.	.	..	...	..	..	...	...
17	..	...	...	....	..			..	...
18	59	59⅝	64½	152¾	154	22¼	22¼	26½	26¾
19	58¾	59⅜	64	151¾	153¼	22¾	22¾	26¾	27

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Apr.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	Apr.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
13	441	99⅝	65½	33⅜	17	441½	99⅝	65¾	...
14	441	99⅝	65⅜	...	18	441½	99⅝	66	33⅝
15	441	99⅝	65⅜	...	19	441½	99⅝	70	35⅞

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, April 19, 1922

The metal markets have been quieter than usual during the last week, largely in consequence of Easter. The New York Stock Exchange was closed on Good Friday, and trading in the metals was also practically at a standstill. Copper, tin, and zinc prices are virtually unchanged today from the levels ruling a week ago. Lead is slightly firmer. The feature of the week was the sudden advance in the price of silver in London today, the price being 35⅞d. compared with 33⅝d. yesterday. The exact reason is unknown, but is thought to be a sudden demand from China caused by revolutionary movements there, some of the natives wishing to transfer their resources into metal.

Copper

Copper is unchanged in price from last week, and much the same marketing conditions also obtain. The general basis of quotation and sale has been 12⅞c. delivered during the second quarter, and 13@13⅛c. for the third quarter by those producers willing to go so far ahead. No large orders are reported, but some of the companies have been able to do a small business each day at this level. The last three days efforts have again been made by more than one interest to market large blocks of copper at 12.75c., delivered to particularly desirable consumers so situated as to take a low freight rate. But little of this business was accepted, however, consumers preferring to remain aloof for the time being. In no case, it is believed, would these offers have netted producers as low as 12.50c. It is said that wire-drawers have a large amount of business in prospect, and the metal continues to go well into consumption.

The export market has been quiet, owing to the Easter holidays, which are more generally observed in Europe than here. Sales have in general been at about 13⅛c. c.i.f., thus netting producers in this country better prices than were obtained for domestic deliveries.

Lead

The official contract price of the American Smelting & Refining Co. continues at 5c., New York.

Sales have been in smaller volume during the last week, but this has not been because of lack of demand; rather have producers been indisposed to contract for the sale of any more April metal, their supplies being sold out. This condition has served to magnify the spot demand. Supplies in the Middle West continue ample, and almost any amount of lead could be obtained there at the prices which we quote. Delivery in New York, however, would cost 35c. per 100 lb. more, thus bringing the price up to about 5.30c. on lead shipped from St. Louis—a somewhat higher figure than the market has yet reached. Regular customers of the large producers are still obtaining their customary requirements of lead [illegible] near 5c. Other business is considerably higher, and deliveries inside of thirty days can hardly be obtained today for less than 5.25c; in fact, one producer reports turning down a bid for 300 tons at that price yesterday. May lead is obtainable at about 5.15c. Some bonded lead is going to Europe.

The lead market has got away from the producers. The speculative demand from consumers is partly responsible, but actual consumption is also better, a large amount of lead going into building materials, storage batteries, and particularly into paint. It is to be hoped that the price is not forced up to such a point that a violent reaction will occur. Several mines are reported reopening.

Zinc

Sales of zinc have been unusually brisk, but at generally unchanged prices, on the basis of 4.90c., East St. Louis. A large proportion of the inquiries from consumers, and the sales actually negotiated, were for May delivery, which commanded a 5-point premium. The coal strike has been a [illegible] upon their active demand from galvanizers and is probably responsible for the steadiness in price and the tendency of the market to advance. The statistics issued by the American Zinc Institute, as finally revised, show a decrease in stocks of 3,862 tons. Stocks on hand March 1 were 64,124 tons; production for March was 26,532; shipments were 30,394; and stocks on hand March 31, 60,262. Average number of retorts operating during the month, [illegible]. Stocks are now only sufficient for two months' supply of metal and the statistical position is much improved over that of last fall. New York prices rule at the customary advance of 35 points over the St. Louis level. High-grade zinc sales have been excellent at unchanged prices of 6c., with [illegible]c. per 100 lb. freight allowance.

Tin

The demand for tin has been quiet since the price advance, but yesterday and today there was evidence that consumers are getting accustomed to the present level, as the market was somewhat more active. Offerings of Chinese tin, and later of English tin of 99 per cent grade, which arrived here unsold, have depressed the price of the lower grade until yesterday it was possible to obtain it at more than 1 cent discount from the price of Straits. Tin for forward delivery has in general been obtainable at the same price as that asked for spot, though a premium of one-eighth cent has been realized in some sales.

Arrivals of tin, in long tons: April 15th, Straits, 110; 17th, London, 50; Straits, 15; 18th, Liverpool, 205.

Gold

Gold in London: April 18th, 93s. 4d.; 19th, 93s. 6d.

Silver

The market has been quiet during the Easter holiday period, but on the 19th advanced sharply to 35⅞d. in London and 70[illegible]c. in New York on heavy buying by China. The tendency at the close is uncertain.

Mexican Dollars—April 13th, 50[illegible]; 14th, 50¼; 15th, 50¼; 17th, 50[illegible]; 18th, 50⅝; 19th, [illegible].

Foreign Exchange

European political developments have affected exchanges somewhat during the week, but no important changes have resulted. On Tuesday, April 18, francs were 9.265c.; lire, 5.43c.; marks, 0.34125c.; and Canadian dollars, 97.[illegible]c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 5c. for the week. Market active and firm. W.C.C. brand, 5½@6c. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh) nominal at 5¼c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6½@7c.

Arsenic—6.75@7c. per lb. Slight improvement in demand.

Bismuth—$2@$2.10 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Iridium—Nominal, $160@$170 per oz.

Nickel—Standard market, ingot and shot, 36; electrolytic, 39c. Small tonnages, spot, nominal at 30@33c.

Palladium—Nominal, $55@$60 per oz.

Platinum—$85@$90 per oz.

Quicksilver—$51 per 75-lb. flask. San Francisco wires $50. Firm.

The prices of **Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of April 8.

Metallic Ores

The prices of **Bauxite, Chrome, Manganese, Tungsten, Molybdenum, Tantalum, Uranium, Vanadium, Titanium,** and **Iron Ore, Zircon** and **Zirkite** are unchanged from the prices in the issue of April 8.

Zinc and Lead Ore Markets

Joplin, Mo., April 15—Zinc blende, per ton, high, $31.40; basis 60 per cent zinc, premium, $31; Prime Western, $30@$29; fines and slimes, $28@$26; average settling price, all grades of blende, $27.07.

Lead, high, $69.05; basis 80 per cent lead, $69@$70; average settling price, all grades of lead, $66.32 per ton.

Shipments for the week: Blende, 9,027; lead, 1,758 tons. Value, all ores the week, $360,970.

Producers of zinc ore authorized a 10 per cent wage advancement and held for a $30 basis this week, with the result that premium ore commanded $31 basis and some sales of Prime Western were made on $30 basis, though the bulk of these sales were made on $29 basis. Purchases this month have exceeded the output, and when shipped out will materially reduce the reserve stock of zinc ore. The high price of lead ore is causing many owners to turn their [illegible] production to that mineral as largely as possible, with a tendency to restrict rather than increase the production of blende. Lead prices for next week's market were not given out today, the quotation given being reported as the probable market.

Platteville, Wis., April 15—Blende, basis 60 per cent zinc, $29 to $30. Lead ore, basis 80 per cent lead, $67.50 per ton. Shipments for the week: Blende, 583; lead ore, 40 tons. Shipments for the year: Blende, 4,607; lead ore, 720 tons. Shipped during the week to separating plants, 424 tons blende.

Non-Metallic Minerals

Prices are unchanged from those in the issue of April 8, on **Asbestos, Barytes, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc.**

Mineral Products

The prices of **Copper Sulphate, Sodium Nitrate, Potassium Sulphate and Sodium Sulphate** are unchanged from the issue of April 8.

Ferro-Alloys

Ferromanganese — Domestic prices have advanced $5 to $67@$69, f.o.b. furnace.

The prices of **Ferrotitanium, Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotungsten, Ferrovanadium** and **Ferro-uranium** are unchanged from the issue of April 8.

Metal Products

The prices of **Copper Sheets, Lead Sheets, Nickel Silver, Zinc Sheets,** and **Yellow Metal** are unchanged from the issue of April 8.

Refractories

The prices of **Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick,** and **Silica Brick** are unchanged from the issue of April 8.

The Iron Trade

Pittsburgh, April 18, 1922

Strikes in the Connellsville and lower Connellsville region have increased somewhat in the last week, the coke output being reduced by more than one-half and the output in coal shipped by a still greater proportion. A few furnaces have had to be banked.

The steel interests are making strong efforts to maintain production. Buyers of steel have stocked up to an extent in anticipation of the coal strike and in general there is no particularly urgent call for deliveries. With the heavy buying of late, the steel market in general is quieter, with prices well maintained and showing some advancing tendency. The 10c. advance in nails, to $2.50, has been made by all independents, but the leading interest has not acted. A little sheet business is already being booked at the prices as recently advanced $2 a ton. Bars, shapes, and plates remain quotable at 1.50c., with possibly an occasional concession on a particularly desirable order.

Pig Iron—Most of the furnaces have withdrawn from the market, on account of Connellsville coke supplies being so largely shut off. There is no precisely defined market, but Valley prices are not under $21 for bessemer, $20 for basic, and $21 for foundry, making $1.50 advance in bessemer and $2 advance in basic and foundry in the fortnight. A sale of 1,000 tons of basic is reported at $20, Valley.

Coke

Connellsville—Furnace, $3.50; foundry, $4.25@$4.75.

Many More Copper Companies Resume Operations

BY FELIX EDGAR WORMSER

Assistant Editor, *Engineering and Mining Journal-Press*

ONLY A FEW COPPER COMPANIES in the United States now remain closed. Generally they are the smaller producers. The four porphyry copper companies—Utah, Ray Consolidated, Chino, and Nevada Consolidated—comprise the last great group to announce resumption—the most important development in the copper market since the merger of Anaconda Copper Mining Co. and American Brass Co. They will not be able to produce much marketable copper before July, and if the domestic and foreign industrial situation improves by that time, their action will have justified itself, but overproduction would be a misfortune. Much market and industrial history has been made since they closed down. Although the porphyry coppers had unusually heavy stocks of copper in their possession at the beginning of 1921, they have disposed of a large amount of the metal during the various buying movements in the last year. Most of their present stocks will be absorbed by agreements with the Copper Export Association, and are available only for export business, so that, so far as domestic trade is concerned, a shortage of copper is a serious possibility.

The porphyries profited greatly by the financing of surplus stocks early in 1921 and collectively accounted for over 20 per cent of the 400,000,000 lb. set aside for export purposes. Strong financially, and with a common sales agency, they have been able to adopt an independent attitude in the market consistent with their views of the copper situation. While other companies have continued operations and some have but recently resumed, the porphyries have refrained from taking any step which would jeopardize the welfare of the industry. They have probably done more to improve the position of copper than any other group of producers, and deserve great credit for the rôle they have taken.

Now that the most trying period of the industry is behind them, they courageously believe that business conditions warrant, or will warrant within the next three months, a greater production of copper, and they are the last important group to resume operations. A list of the active companies follows:

Anaconda Copper Mining Co.
Phelps Dodge Corporation.
Calumet & Hecla and subsidiaries.
Copper Range, Quincy, Mohawk, Wolverine.
Old Dominion Copper & Smelting Co.
Inspiration Consolidated Copper Co.
Miami Copper Co.
Calumet & Arizona Mining Co.
New Cornelia Mining Co.
United Verde Extension Mining Co.
American Smelting & Refining Co. (Custom smelting.)
Tennessee Copper & Chemical Corporation.
Ducktown Sulphur, Copper & Iron Co.
Utah Copper Co.
Nevada Consolidated Copper Co.
Chino Copper Co.
Ray Consolidated Copper Co.

The fact that the United Verde Copper Co. is not included in this list is explained by the nature of that company's organization. Its stock is closely held and is one of ex-Senator Clark's valuable properties. The stock is consequently not listed upon any exchange, whereas all the companies listed above, with the possible exception of Phelps Dodge, have numerous shareholders whose interests are always a dominant note in their operations. Copper companies cannot hope to pay dividends when shut down, and if business is on the high road to recovery, as the stock market for one thing seems to indicate, the resuming companies are placing themselves in a position to take advantage of any improvement. The United Verde is in a splendid position to wait until it considers the market price of copper sufficiently high to permit operating at a satisfactory profit.

The sales of copper for the first three months of 1922 totaled about 350,000,000 lb., compared with about 270,000,000 for a similar period in 1921. Last June, July, and August were poor months, and will probably be critical months this year. To show that a great inroad has been made into surplus stocks it is only necessary to consider that foreign and domestic sales of copper for the last twelve months have been about 1,287,000,000 lb., whereas smelter production plus imports have been 700,000,000 lb. All the company reports that have been issued lately indicate large declines in unsold stocks and confirm this position.

Some observers are of the impression that the general reopening of the copper mines will affect prices adversely. Without denying this possibility, there is also, on the other hand, danger of an unexpected shortage of domestic copper as a result of continued curtailment. Resumption may act as a brake to a runaway market and should help to prevent violent fluctuations in price. Should prices remain at a low level there will be some compensation in the knowledge that the reintroduction of copper into abandoned consuming channels will be much easier.

It is noticeable that practically all of the sales of copper that have been made during the last six months have been for future delivery. Selling of copper for delivery even three to six months ahead is at present nothing unusual. This is in decided contrast to the sales in the lead market, which are almost wholly confined to prompt shipments. May not this have something to do with the relative stability of the two markets? Lead is noted for its steadiness; copper for its violent fluctuations.

An interesting development in the foreign copper market occurred recently that has been given scant notice. It was the announcement that the Japanese government has increased the duty on imported copper and brass and bronze. It is now about 2.75c. per lb. The Japanese copper industry has been appealing for protection by its government against cheaply produced American copper for some time. How similar is this argument to that advanced by various interests in Washington! Japan has been a good consumer of American copper, and during the eight months ending Feb. 28, 1922, 70,335,000 lb. of copper was shipped to her. That country is becoming an increasingly important manufacturing competitor, and so should consume larger amounts of the metal. It is one of the ironies of the present world tariff situation that the copper industry, which [illegible] tariff consideration at Washington, should be the [illegible] of tariff discrimination abroad. Fortunately, exports of copper to Japan are not so important as those to Germany, France, and Great Britain, which remain the bulwarks of foreign commerce in that metal.

Smelter production, exports, and imports are compared in the following table, and indicate little change from the situation of last year. Germany is still the most important customer:

TEN YEAR PRE-WAR EXPORTS AND IMPORTS OF COPPER

Year	Total Exports 000 Omitted	United Kingdom, 000 Omitted	Germany, 000 Omitted	France 000 Omitted	Imports	United States Smelter Production
1904	554,550	112,225	[illegible]	[illegible]	[illegible]	[illegible]
1905	534,900	60,946	[illegible]	[illegible]	[illegible]	[illegible]
1906.....	454,752	55,098	[illegible]	[illegible]	[illegible]	[illegible]
1907.....	508,930	81,409	107,607	93,075	252,620,100	868,966,500
1908	661,876	117,810	[illegible]	[illegible]	[illegible]	942,570,700
1909.....	682,847	156,311	[illegible]	[illegible]	[illegible]	[illegible]
1910.....	708,317	98,030	175,861	116,194	344,435,800	1,080,159,500
1911	786,553	108,062	[illegible]	[illegible]	[illegible]	1,097,232,700
1912.....	775,000	95,422	252,136	[illegible]	[illegible]	[illegible]
1913.....	926,441	133,680	307,150	160,000	408,700,000	1,224,484,100

POST-WAR EXPORTS AND IMPORTS OF COPPER

Year	Total Exports 000 Omitted	United Kingdom, 000 Omitted	Germany, 000 Omitted	France 000 Omitted	Imports	United States Smelter Production
1919	515,959	105,620	[illegible]	[illegible]	[illegible]	[illegible]
1920	623,613	99,480	[illegible]	[illegible]	[illegible]	[illegible]
1921	626,447	62,335	[illegible]	[illegible]	[illegible]	[illegible]
Jan. '22..	54,803	2,757	[illegible]	[illegible]	[illegible]	[illegible]
Feb. '22..	50,777	3,799	14,300	10,494	23,163,300	47,418,000

COMPANY REPORTS

Calumet & Hecla Mining Co.

A [illegible] of the Calumet & Hecla Mining Co. for 1921 [illegible] a loss of $1,491,259.77, [illegible] to the statement:

[illegible] 15,167,136

PRODUCTION COSTS

		Cents per Lb.	
[illegible]		[illegible] 72	$[illegible] 607 83
[illegible]		2 88	438 [illegible] 08
[illegible]		[illegible] 87	132 [illegible] 04
[illegible]		[illegible]	854 385 10
[illegible]	[illegible]	[illegible]	$2 897 036 05
[illegible] 1921	47 [illegible]	[illegible]	6 117 579 13
	62 221 487	[illegible]	$9 014 615 18
[illegible]	38 361 249	[illegible]	4 986 961 98
	23 [illegible]	[illegible]	$4 027 653 20
[illegible]			686,666 46
[illegible] 1921	23 [illegible]	[illegible]	$3 340 986 74

EARNINGS STATEMENT

[illegible]	38 361 249 [illegible]	[illegible] per lb.	$4 951 164 42
[illegible] per lb.	$4,986,961 98		
[illegible]	220 [illegible]	[illegible] per lb.	5 208 896 68
[illegible]		[illegible]	$257 732 26
[illegible]			686,666 46
			$944 398 72
[illegible]	$869,004 98		
[illegible]	[illegible]		
[illegible]	230,276 94		1,502,721.25
			$2 447 119 97
[illegible]	93,151 70		
[illegible]	281 669 91		
[illegible]	[illegible] 71	[illegible]	
[illegible]		[illegible]	955 860 20
[illegible]			$1 491 259 77
[illegible]	[illegible]		
[illegible]	[illegible]		
	$511,426 64		
[illegible]	[illegible]		
[illegible]		[illegible]	
[illegible]	$[illegible]		
[illegible]	[illegible]		
[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	
[illegible]			[illegible]
			[illegible] 421 [illegible]
[illegible]		$1 084 [illegible]	
[illegible]		[illegible]	[illegible] 4 4[illegible]2 04
[illegible]			$566,929 85
[illegible]			12,901,087 65
[illegible]			[illegible]

Centennial Copper Mining Co.

A report of operations of the Centennial Copper Mining Co. for 1921 states that no copper was produced during the year. Loss for the year was $50,944.75. Balance of current assets Dec. 31, 1920, was $239,703.79; and on Dec. 31, 1921, $[illegible]0.86. Copper on hand Jan. [illegible], 1922, amounted to 139,802 lb.

Old Dominion Copper Co.

A report of operations of the Old Dominion Copper Co. for 1921 shows a loss of $1,482,055.71, according to the following income amount:

Income		
Sales of copper, silver and gold		$1,987,997 45
Expenses		
Mining, treating and refining	$2,675,914 77	
Selling, general, and administrative	66,165 69	
Expenditure during suspension of operations	372,232 26	
Depreciation of plant	142,527 54	
Depletion of mines	82,661 04	
Interest	130,551 86	
		$3,470,053 16
Loss for the year 1921		$1,482 055 71

Balance sheet as of Dec. 31, 1921, follows:

ASSETS

Fixed		
Mines and mining claims	$13,035,503 39	
Plant and equipment	4,149 632 80	
Investments in sundry companies	5,000 00	$17,190,136 19
Current		
Materials and supplies on hand	$436,965 48	
Finished metals on hand, copper [illegible] silver and gold at market	840,803 12	
Copper sold, Copper Export Association, Inc., carried at cost less [illegible] account	396,536 20	
Accounts receivable	145,719.59	
Cash and securities	171,747 01	
		1 991,771 40
		$19,181,907 59

LIABILITIES

Capital stock		
Authorized and issued 350,000 shares [illegible] $25 each		$8,750,000 00
Current		
Loans and accounts payable		1,382 402 04
Reserves		
For depletion	$3,878,498 11	
For depreciation	3,596,561 12	
		7,475,059 23
Surplus		
Balance Dec. 31, 1920	$3,056,502 03	
Loss for 1921	1,482,055 71	
		1,574,446 32
		$19,181,907 59

Production amounted to 7,389,648 lb. of copper, 71,155 oz. of silver and 1,186.9 oz. of gold. A total of 14,902,677 lb. of copper was sold at 12.813c. per lb. Operations ceased on April 12, 1921.

United States Smelting, Refining & Mining Co.

A report of operations of the United States Smelting, Refining & Mining Co. for 1921 shows a profit of $1,455,571.98, according to the following consolidated profit-and-loss account:

CONSOLIDATED PROFIT-AND-LOSS ACCOUNT

[illegible] companies, after charging cost of operation, selling expenses, repairs and [illegible] providing for depreciation [illegible] federal taxes		$2 903 450 72
Deduct:		
[illegible] depreciation and depletion	$1 114 430 83	
[illegible]	333 447 91	1 447 878 74
Profit for year 1921		$1 455 571 98
[illegible] surplus [illegible]		$16 781,591 44
Profit for 1921		1 455,571 98
		$18 237,163 42
Less dividends [illegible] preferred stock [illegible] U. S. S. R. & M. Co. at 7 per cent per annum		1 702 225 00
Consolidated surplus [illegible]		$16,534,938 42

The metals and byproducts produced in 1921 from ores extracted at the company's mines in the United States and in Mexico, and those from custom ores, is given as follows:

		[illegible]
Copper, lb.	[illegible]	[illegible]
Lead, lb.	[illegible] 4,721,18[illegible]	[illegible]
Zinc, lb.	2,64[illegible]	[illegible]
Silver, oz.	18,34[illegible]	[illegible]
Gold, oz.	138,4[illegible]	[illegible]
Byproducts	3,647,084	[illegible] 4
Coal, tons	771,[illegible]	[illegible] 4
		[illegible]

Current assets on Dec. 31, 1921, were $15,346,681.30, and current liabilities $9,514,679.60. The increase in capital assets amounted to $1,414,227.48.

American Zinc, Lead & Smelting Co.

A report of the operations of the American Zinc, Lead & Smelting Co. for 1921 shows a loss of $260,100.97, according to the following statement:

Losses from operations, being the results of the sales of zinc and lead ores, sales of spelter, pig lead, zinc oxide, limestone and sulphuric acid, receipts from royalties, after deducting all cost of mining, manufacture, marketing ores, spelter, pig lead, zinc oxide, limestone and sulphuric acid, other expenses of operation and all administrative, general and selling expenses and taxes	$188,433 18
Add interest on bonds, less interest on bank deposits	71,667 79
Total loss	$260,100 97
Adjusted surplus at Dec. 31, 1920	2,655,021 09
	$2,394,920 12
Deduct:	
Transferred to depletion and depreciation reserves	379,563 48
Surplus at Dec. 31, 1921	$2,015,356 64

Balance sheet as of Dec. 31, 1921, follows:

ASSETS

Property account:		
At Dec. 31, 1920	$12,516,518 19	
Deduct sales, less additions during year 1921	10,562 05	
		$12,505,956 14
Investments..........		1,472,457 20
Cash in sinking fund for retirement of bonds		2,917 53
Current assets		
Ore stocks..........................	$687,027 17	
Spelter, pig lead, zinc oxide and sulphuric acid stocks..........	604,905 66	
Inventories of materials and supplies	757,395 91	
Cash.......	338,059.65	
Notes receivable	69,950 94	
Accounts receivable	445,934 61	
Advance to Wisconsin Zinc Co.	100,000 00	
		3,003,273 94
Deferred charges to operations		84,464 29
		$17,069,069 10

LIABILITIES

Capital stock issued			
	Shares	Par Value	
Preferred stock	96,560	$25 00	$2,414,000 00
Common stock	193,120	25 00	4,828,000 00
			$7,242,000 00
Of which 80,330 shares are in the hands of the public			
First Mortgage 5 Per Cent, Ten-Year Gold Bonds			
At Dec. 31, 1920		$1,481,700 00	
Less retired through sinking fund		110,800 00	
			1,370,900.00
Reserves for depletion, depreciation, insurance and sundries			5,884,239.18
Current liabilities			556,573.28
Surplus			2,015,356.64
			$17,069,069 10

No record is given of production costs or details of operation of any of the company's units.

Utah Consolidated Mining Co.

A report of operations of Utah Consolidated Mining Co. for 1921 shows a net loss of $338,312, according to the following income account:

EXPENSE

Exploring and development		$1[illegible],[illegible]87 45
Mining, including operating aerial tramway		127,436 88
Smelting		[illegible] 73
Refining and selling		240 53
Administration, including corporation, state and local taxes		[illegible]9,658 85
Legal and professional charges		2,338 40
Litigation expense		[illegible]9,619 49
Depreciation		2,627 07
Interest		1[illegible],250 12
		$351,132 32

INCOME

Sales of metals		$292,759 76
Deduct decrease in metals on hand:		
Inventory at beginning of year	$4[illegible],[illegible]48 2[illegible]	
Inventory at end of year	1[illegible],190 64	292,157 65
		$602 11
Rentals and miscellaneous receipts		12,218 21
Balance, net loss		338,312.00
		$351,132 32

The balance sheet as of Dec. 31, 1921, is given as follows:

ASSETS

Fixed:		
[illegible] property	$1,[illegible]4[illegible]	
[illegible]	[illegible]	
		$1,88[illegible]
Investments:		
$200,[illegible]		
Copper Mining Co.	$[illegible]00,000 00	
U. S. Liberty Loan Bonds [illegible]	[illegible]62,400 00	
		[illegible]62,[illegible] 00
Current:		
Supplies on hand and expense prepaid	$287,7[illegible]	
Metals on hand	138,190 64	
Accounts receivable and cash	64,[illegible] 30	
		$490,[illegible]39 2[illegible]
		$3,238,108 62

LIABILITIES

Capital stock:		
Authorized and issued, 300,000 shares at $5		$1,500,000 00
Reserves:		
For depreciation	$91,826 17	
General reserve	50,000 00	
		141,826 17
Current:		
Accounts and wages payable		671,439 31
Surplus:		
Balance Dec. 31, 1920	$1,263,155 14	
Net loss for the year ending Dec. 31, 1921, per income account annexed	338,312 00	
		924,843 14
		$3,238,108 62

Production amounted to 299,909 lb. of lead, 41,073 lb. of copper, 4,600 oz. of silver, and 60 oz. of gold. Ore reserves are 837,000 tons of copper ore, averaging 1.07 per cent copper, 0.57 oz. of silver, and 0.04 oz. of gold.

Shattuck Arizona Copper Co.

A report of operations of the Shattuck Arizona Copper Co. for 1921 shows a loss of $33,861.96 as the following account indicates:

INCOME ACCOUNT

Interest	$41,067 18	
Miscellaneous receipts	758 67	
Gross income		$41,825 85
Con. Virginia exploration expense	$21,884 51	
General administrative expense and taxes	25,113 01	46,997 52
Loss		$5,171 67
Reserved for depletion	$12,006 60	
Reserved for depreciation	16,683 69	28,690 29
Net loss carried to surplus		$33,861 96

SURPLUS ACCOUNT

Balance Dec. 31, 1920	$318,555 61	
Less net loss for year 1921	33,861 96	
Balance Dec. 31, 1921		$284,[illegible]

Balance sheet as of Dec. 31, 1921, follows:

ASSETS

Mining property	[illegible]	
Less depletion reserve	[illegible]	
		$5,815,[illegible]
Buildings, plant and equipment	$[illegible],[illegible]24 40	
Less depreciation reserve	377,[illegible]	2[illegible],214 74
		$6,121,[illegible]01 39
Deferred charges for development		21[illegible],[illegible]87 13
Cash on hand	$[illegible] 74	
Liberty Loan bonds	[illegible] 15	
Other securities	8,500.00	
Interest accrued on Liberty Bonds	6,287 06	
Accounts receivable	[illegible] 54	
Lead copper on hand at 13c per lb.	[illegible]12 01	
Ores and concentrates on hand at cost	3,624 38	
Materials and supplies, per inventory	[illegible] 52	1,467,799 40
		$7,709,387 92

LIABILITIES

Capital stock		$3,500,000 00
Property surplus		3,839,015 62
Accounts payable ...	$616 86	
Selling expense, not due	15,015 56	
Reserve for taxes	26,017 27	
		41,649 69
Reserve for accidents		44,028.96
Surplus from operations, per annexed statement		284,693.65
		$7,709,387.92

Production amounted to 287,928 lb. of copper, 12,093 oz. of silver, and 28.8 oz. of gold. Operations were stopped on Aug. 1, 1921.

MINING STOCKS

Week Ended April 15, 1922

Stock	Exch.	High	Low	Last	Last Div.	
COPPER						
Ahmeek	Boston	62¾	62	62	Sept. '20, Q	$0.50
Alaska-Br. Col.	N. Y. Curb	3¼	3	[illegible]		
Allouez	Boston	27	26	26½	Mar. '19	1.00
Anaconda	New York	53¼	51⅞	53	Nov. '20, Q	1.00
Arcadian Consol.	Boston	4	2¾	3½	....	
Ariz. Com'l.	Boston	9½	9	9¾	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*25	*16	*25		
Bingham Mines	Boston	15¼	14	15¼	Sept. '19, Q	0.25
Calumet & Arizona	Boston	61½	57	60½	Mar. '22, Q	0.50
Calumet & Hecla	Boston	279	274	278	June '20, Q	5.00
Canada Copper	N. Y. Curb	*65	*25	*54		
Centennial	Boston	11	11	11	Dec. '18, SA	1.00
Cerro de Pasco	New York	37½	35½	36½	Mar. '21, Q	0.50
Chile Copper	New York	18¼	17¼	18¼		
Chino	New York	29	27½	28½	Sept. '20, Q	0.37½
Columbus Rexall....	Salt Lake	*28½	*28	28		
Con. Arizona	N. Y. Curb	*4	*3	*4	Dec. '18, Q	0.05
Con. Copper Mines..	N. Y. Curb			1¼		
Copper Range	Boston	45	43	44	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1¼	1⅛	1¼		
Davis-Daly	Boston	7½	7¼	7¼	Mar. '20, Q	0.25
East Butte	Boston	11½	11	11½	Dec. '19, A	0.50
First National	Boston Curb	*95	*70	*95	Feb. '19, SA	0.15
Franklin	Boston	3	1	3		
Gadsden Copper	Boston Curb	1¼	*60	1¼		
Granby Consol.	New York	27½	26½	26½	May '19, Q	1.25
Greene Cananea	New York	29½	28½	29½	Nov. '20, Q	0.50
Hancock	Boston	3	3	3		
Howe Sound	N. Y. Curb	3½	3¼	3½	Jan. '21, Q	0.05
Inspiration Consol.	New York	42	40	41½	Oct. '20, Q	1.00
Iron Cap	Boston Curb	†8	†7	7	Sept. '20, K	0.25
Isle Royale	Boston	25	24½	24½	Sept. '19, SA	0.50
Kennecott	New York	31½	29¾	31½	Dec. '20, Q	0.50
Keweenaw	Boston	3¾	1	3¾		
Lake Copper	Boston	5¾	3½	5¾		
La Salle	Boston	2	2	2		
Magma Copper	N. Y. Curb	29½	28½	28½	Jan. '19, Q	0.50
Majestic	Boston Curb	*6	*6	6		
Mason Valley	Boston	2	2	2		
Mass Consolidated	Boston	4½	2½	4½	Nov. '17, Q	1.00
Miami Copper	New York	29½	29	29½	Feb. '22, Q	0.50
Michigan	Boston	7	2	6½		
Mohawk	Boston	59½	57½	58½	Feb. '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	8½	8	8½		
Nevada Consol.	New York	16½	15½	16½	Sept. '20, Q	0.25
New Cornelia	Boston	18	17½	18	Feb. '22, K	0.25
North Butte	Boston	13½	12¾	13½	Oct. '18, Q	0.25
North Lake	Boston	*50	*40	*50		
Ohio Copper	N. Y. Curb	*11	*9	*10		
Old Dominion	Boston	26	25	26	Dec. '18, Q	1.00
Osceola	Boston	36	25	35½	June '20, Q	0.50
Phelps Dodge	Open Mar.		†160	...	Apr. '22, Q	1.00
Quincy	Boston	46½	45	46	Mar. '20, Q	1.00
Ray Consolidated	New York	16	15¼	16¼	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	*1	*1	*1		
St. Mary's Min. Ld.	Boston	46	44½	44½	Dec. '21, K	1.00
Seneca Copper	Boston	14½	14	14		
Shannon	Boston	1½	*95	1½	Nov. '17, Q	0.25
Shattuck Arizona	New York	9	8½	9	Jan. '20, Q	0.25
South Lake	Boston	1	1	1		
Superior & Boston	Boston	2	1	1½		
Tenn. C. & C. cfs.	New York	12¼	11½	12½	May '18, I	1.00
Tuolumne	Boston	*75	*61	*75	[illegible]	0.10
United Verde Ex.	Boston Curb	28	27	28½	[illegible] '22, Q	0.25
Utah Consol.	Boston	2¼	2	2¼	[illegible]	0.25
Utah Copper	New York	67	65½	66	Mar. '22, Q	0.50
Utah Metal & T.	Boston	1½	1		[illegible] '17,	0.30
Victoria	Boston	2½	1	2		
Winona	Boston	2½	*60	2		
Wolverine	Boston	12½	12	12		
NICKEL-COPPER						
International Nickel	New York	16½	16½	16½	Mar. '19,	0.50
International Nickel, pfd.	New York	78	78	78	[illegible] '22, Q	1.50
LEAD						
National Lead	New York	92	90½	91½	Mar. '22, Q	1.50
National Lead, pfd.	New York	112	111	111	Mar. '22, Q	1.75
St. Joseph Lead..	New York	14½	13¾	14¼	Mar. '22, Q	0.25
QUICKSILVER						
New Idria	Boston	1½	1½	1½	....	....
ZINC						
Am. Z. L. & S.	New York	16½	16	16½	May '20,	1.00
Am. Z. L. & S. pfd.	New York	42	40	41½	Nov. '20, Q	1.50
Butte C. & Z.	New York	6½	6¼	6¼	June '18,	0.50
Butte & Superior	New York	29½	26½	28½	Sept. '20,	1.25
Callahan Zn-Ld	New York	7½	6½	6½	Dec. '20, Q	0.50
New Jersey Zn	N. Y. Curb	145	145	145	Feb. '22, Q	2.00
Yellow Pine	Los Angeles	*45	*45	*45	Sept. '20, Q	0.03

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.	
GOLD						
Alaska Gold	New York	¾	⅝	⅝	....	....
Alaska Juneau	New York	1⅜	1	1⅛	....	....
Carson Hill	New York	15	14⅞	15	...	
Cresson Consol. G...	N. Y. Curb	2 13/16	2 11/16	2¾	Apr. '22, Q, X	$0.10
Dome Extension	Toronto			[illegible]	.....	..
Dome Mines	New York	25¼	25	25	Jan. '22, Q	0.25
Florence Goldfield...	N. Y. Curb	*22	*18	*22	.....	..
Golden Cycle	Colo. Springs	*72	*70	*70	June '21, Q	0.02
Goldfield Consol.....	N. Y. Curb	*9	*7	*8	Dec. '19,	0.05
Hollinger Consol.	Toronto	9.65	9.50	9.54	Mar. '22,	0.05
Homestake Mining..	New York	75	70	75	Mar. '22, M	0.25
Kirkland Lake	Toronto	*47	*44	*45	....	..
Lake Shore	Toronto	2.39	2.20	2.35	Nov. '21, K	0.02
McIntyre-Porcupine.	Toronto	19.80	19.00	19.55	Jan. '22, K	0.05
Porcupine Crown	Toronto	*27	*26	*27	July '17,	0.03
Porcupine V. N. T...	Toronto	*31½	*30	*31½	....	...
Portland	Colo. Springs	*33	*26	*26	Oct. '20, Q	0.01
Schumacher.........	Toronto	*55	*50	*53	....	....
Silver Pick	N. Y. Curb	*26	*16	*16	....	....
Teck Hughes	Toronto	*53	*50½	*52½	....	....
Tom Reed	Los Angeles	*65	*58	*60	Dec. '19,	0.02
United Eastern......	N. Y. Curb	1⅝	1 7/16	1 7/16	Jan. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*12	*10	*12	Jan. '20, Q	0.01
White Caps Mining..	N. Y. Curb	*5	*4	*5	......	....
Wright-Hargreaves.	Toronto	3.06	2.85	2.85	....	
Yukon Gold........	N. Y. Curb	1⅛	*95	1⅛	June '18,	0.02½
SILVER						
Batopilas Mining..	New York	1¼	1	1⅛	Dec. '07, I	0.12½
Beaver Consol......	Toronto	*38½	*35	*37½	May '20, K	0.03
Coniagas	Toronto			1.00	May '21, Q	0.12½
Crown Reserve	Toronto	*18	*16	*16	Jan. '17,	0.05
Kerr Lake..........	N. Y. Curb	3¾	3⅜	3⅝	Apr. '22, Q	0.12½
La Rose	Toronto	*34	*31	*34	Apr. '18,	0.02
McKinley-Dar.-Sav..	Toronto	*24	*22	*23½	Oct. '20, Q	0.03
Mining Corp. Can...	Toronto	1.15	1.03	1.03	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6½	6⅛	6⅛	Jan. '22, Q, X	0.30
Ontario Silver.......	New York	7⅝	7⅝	7⅝	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	.		*12	Jan. '12,	0.10
Temiskaming...	Toronto	*39	*32	*36	Jan. '20, K	0.04
Trethewey..........	Toronto	*6½	*3	*5½	Jan. '19,	0.05
GOLD AND SILVER						
Boston & Montana...	N. Y. Curb	*25	*21	*22	....	....
Cash Boy	N. Y. Curb	.	..	*4	....	...
Dolores Esperanza...	N. Y. Curb	2¼	1½	2	....	....
El Salvador	N. Y. Curb	*4	*4	*4	....	.
Jim Butler..........	N. Y. Curb	..		*8	Aug. '18, SA	0.07
Jumbo Extension....	N. Y. Curb	*4	*4	*4	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*5	*5	*5	May '10,	0.02½
Tonopah Belmont..	N. Y. Curb	1⅝	1⅝	1⅝	Apr. '22, Q	0.05
Tonopah Divide.....	N. Y. Curb	*74	*67	*72	..	
Tonopah Extension..	N. Y. Curb	1 9/16	1 9/16	1 9/16	Apr. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1¾	1 11/16	1 13/16	Oct. '21, SA	0.05
West End Consol....	N. Y. Curb	1 3/16	1⅛	1⅛	Dec. '19, SA	0.05
SILVER-LEAD						
Caledonia..........	N. Y. Curb	*6	*5	*5	Jan. '21, M	0.01
Cardiff M. & M.....	Salt Lake	*97	*95	*95	Dec. '20,	0.15
Chief Consol........	Boston Curb	3¾	3⅝	3⅝	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	24½	22	24	Oct. '20, Q	0.62½
Daly Mining.	Salt Lake	†1.85	†1.50		July '20, Q	0.10
Daly-West	Boston	2	1⅞	1	Dec. '20, Q	0.25
Eagle & Blue Bell...	Boston Curb	†3	†2½	2½	Apr. '21, K	0.05
Electric Point	Spokane	*7	*6	*6	May '20, SA	0.03
Federal M. & S.....	New York	.		11	Jan. '09,	1.50
Federal M. & S. pfd.	New York	40	39¼	39¼	Mar. '22, Q	1.00
Florence Silver......	Spokane	*25	*25	*25	Apr. '19,	0.01¼
Grand Central	Salt Lake	*57	*56	*57	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	5¼	5¼	5¼	Mar. '22, Q	0.15
Iron Blossom Con...	N. Y. Curb	*21	*21	*21	Dec. '21, Q	0.02½
Judge M. & S.......	Salt Lake	†2.40	†2.00	2.60	Sept. '20, Q	0.12½
Marsh Mines.......	N. Y. Curb	*7	*7	*7	June '21, I	0.02
Prince Consol	Salt Lake	*8½	*3¾	*3¾	Nov. '17,	0.02½
Rambler-Cariboo....	Spokane	*4	*4	*4	Feb. '19,	0.01
Rex Consol	N. Y. Curb	*10	*8	*8	.....	.
South Hecla	Salt Lake	†*60	†*35	...	Sept. '19, K	0.15
Standard Silver-Ld..	N. Y. Curb	*17	*17	*17	Oct. '17,	0.05
Stewart Mines......	N. Y. Curb	*18	*11	*18	Dec. '15,	0.05
Tamarack-Custer....	Spokane	2.25	2.25	2.25	Jan. '21, K	0.04
Tintic Standard.....	Salt Lake	1.92½	1.85	1.85	Dec. '21, Q	0.05
Utah Apex	Boston	3½	3 1/16	3⅜	Nov. '20, K	0.25
Wilbert Mining.....	N. Y. Curb	....	..	*2	Nov. '17,	0.01
VANADIUM						
Vanadium Corp.....	New York	44⅞	42	44	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp	Montreal	63	59	62	Apr. '22, Q	1.50
Asbestos Corp. pfd...	Montreal	....	....	77½	Apr. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	18⅜	16½	18	Nov. '19, Q	1.00
Texas Gulf.	New York	43⅝	40¾	43	Mar. '22, QX	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref....	New York	59⅜	56⅛	58⅞	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	98¼	97⅜	97⅝	Mar. '22, Q	1.75
Am. Sm. Sec. pf. A..	New York	95	91⅛	92	Apr. '22, Q	1.50
U. S. Sm. R. & M.	New York	39	38	38	Jan. '21, Q	0.50
U.S. Sm.R.& M. pf..	New York	46½	46	46	Apr. '22, Q	1.75

NEW MACHINERY AND INVENTIONS

A New Type Jaw-Crusher Frame

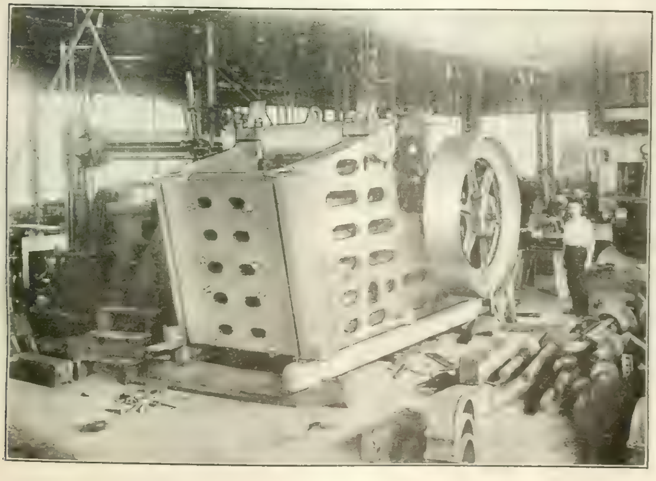
The use of Blake-type jaw crushers of increasingly large sizes has led to the design of these machines with sectional frames. The reasons are that the single piece frame is unwieldy and also because of the difficulty of making such a frame that would withstand the great crushing strains developed in the breaking of large pieces of hard rock. The rigidity of a single-piece casting, particularly at the corners, has always been a source of trouble, excessive strains resulting in a breaking away at one of these points.

In an effort to obviate both of these difficulties the sectional or four-piece frame was developed. Ordinarily, the four-piece frame is designed so that the side frames are grooved and the end frames mortised into them. Bolts through the end frames and secured outside the side frames hold the parts together. It is difficult to say definitely which of these alternatives, so far as breakage is concerned, is worse. The solid frame is absolutely rigid, and the mortised construction provides a sharp corner in which the slightest flexure of the end frame develops a crack which soon results in a breakage of the side frame. To further promote this sort of breakage, the ordinary crushing strains are not distributed along the central axial plane of the side frames, but are to one side, or overbalanced. This breakage is not unusual.

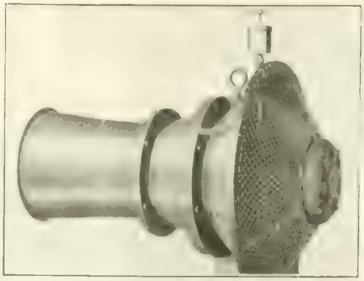
Recognizing the basic error of existing designs of this kind, the engineers of the Kennedy-Van Saun Manufacturing & Engineering Corporation have sought the development of a new type of crusher frames that would obviate this corner weakness and make a strong point out of what has always been a particularly weak one. The result is the Kennedy hinge-joint frame. In this machine the extremities of the side and end frames are made circular in section, the end frames fitting into the side frames, the whole joined by a heavy steel pin. In this design the crushing strains are balanced through the side frames, taking advantage of all the strength of the metal. Being made of box section steel castings, they will resist any strain placed upon them in normal crushing operations. There are no corners or edges, and any slight flexure of the end frames under heavy crushing has no effect whatever on the side frames, as the pin allows enough freedom to relieve any such movement without transmitting it to the side frames.

Rigidity of the essential parts of the frame, to maintain shaft alignment throughout, is insured by three precautions: First, the front end frame is inclined and the rear end frame is vertical; second, heavy through bolts with spacers join the side frames between the swing jaw and pitman; third, the rear end frame is made with a heavy rib projecting inwardly and securely bolted at its extremities to the side frames. There is no possibility of the machine getting out of alignment. The inclination of the front end frame, about the same as the swing jaw, also insures half of the weight of the stone being carried on the frame, increasing the sliding moment with less power. This equalizing of the slope also has the advantage of allowing the machine to handle effectively a larger piece than would be possible in crushers of the same size that have one of the two jaws vertical.

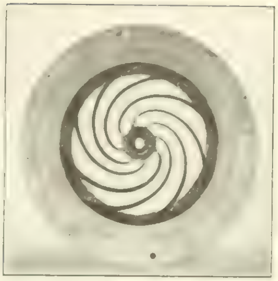
The remaining parts of the machine are made in the same way that has been typical of Kennedy crushers and all features that go to make a successful Blake-type crusher are incorporated.



Jaw crusher with hinge joint frame



The Coppus "Vano" blower



Stationary guide vane of blower

A Propeller Blower of Wide Application

The field of usefulness for propeller blowers has been limited. With the exception of low-duty ventilating fans, propeller blowers have been employed almost exclusively for under-grate draft on hand-fired boilers or with chain grate and over-feed stokers, on account of their low efficiency at higher pressures. However, with the inclusion of certain features propeller blowers may be adapted to many uses, such as under-grate or forced draft for hand-fired boilers, chain grate, over-feed and under-feed stokers; induced draft; ventilation for mines; air heating and drying installations; cooling of electric motors and generators, and ventilation of factories, boiler rooms, ships, and tunnels.

A new type of blower, which has a screw-blade propeller, has been developed by the Coppus Engineering & Equipment Co., of Worcester, Mass. This blower, known as the "Vano," delivers the air parallel to the axis; or, in other words, the air leaves in the same direction as it enters. The blowers differ from other propeller types in the following points: They operate against pressures up to 8-in. water, and therefore can be employed where, until now, only centrifugal blowers could be used; their efficiency runs up to 80 per cent, and the power consumption at constant speed is practically unaffected by variations in air delivery or pressure.

The principal feature of the "Vano" blower is the stationary guide vane of [illegible] [illegible] beyond the propeller. The air stream leaving the propeller is partially subdivided by the individual guide vane blades and taken up by them without shock. The guide vane blades, which have a curvature, decreasing in the direction of the rotation of the propeller, concentrate the air current and give it a further acceleration inside of the stationary guide vane so that a considerable part of the pressure is produced in the latter. A large part of the end thrust is thus taken up by the stationary guide vane casing. The air streams, into which the flow of air has been subdivided by the guide vane blades, leave the guide vane casing, on account of the kinetic energy, slightly rotating and convergent toward the axis, so that the smallest section of the air flow is reached beyond the guide vane casing.

It is claimed that these blowers have an efficiency as high as 80 per cent for both high and low pressures, so that the power consumption is much smaller than that of any other type of blower of the same capacity and pressure.

Vano blowers are high-speed machines, and as a result of the compactness of design, the blowers can readily be installed in pipe lines, which is a distinct advantage in ventilating, heating, and drying systems. They work with the same effect and efficiency when installed at the entrance or at the end of the air duct, operating as blowers or exhausters, respectively.

To deliver air through long pipe lines, high initial pressure is necessary As it is impossible in mine practice to keep air ducts tight, especially at the joints, the losses on account of leakage, which, of course, increase with higher pressures, are often many times the actual air delivery at the discharge of the pipe. Instead of using a centrifugal blower delivering a certain capacity at, for instance, 12-in. pressure, three Coppus Vano blowers delivering the same amount of air at 4-in. pressure can be installed in series equidistant apart in the pipe line or air duct. The losses through leakage are thus reduced to a fraction of the losses at high pressure.

The blowers allow the reversing of the direction of rotation, which changes the direction of the flow of air through the blower. Thus operated they deliver from one-third to one-half of their normal capacity.

A remarkable feature which is claimed by the manufacturers is the constant power consumption at a constant speed, practically unaffected by air delivery and pressure. The power consumption of a propeller blower increases materially with increase in pressure, whereas with centrifugal blowers the horsepower curve rises rapidly with decreasing resistance. As in few installations the required pressure is known exactly beforehand, it is necessary with electrically driven machines to select motors with ample reserve capacity to prevent overloading and subsequent burning of windings.

INDUSTRIAL NOTES

The General Chemical Co. announces that the New York offices have been moved from 25 Broad St. to 40 Rector St., New York City.

On and after March 30, 1922, the principal office of the Uehling Instrument Co., manufacturers of CO_2 recorders and other fuel-economy equipment, will be at the company's factory, 473 Getty Ave., Paterson, N. J., instead of at 71 Broadway, New York City.

The General Engineering Co. of Salt Lake City and 120 Broadway, New York, have been appointed metallurgical engineers for the Annapolis Lead Co., St. Louis, Mo., in the design and construction of a 500-ton concentrating plant at Annapolis, Mo. The work will be under the personal charge of C. E. Chaffin, eastern manager of the General Engineering Co.

The Lytle Coal Co. recently ordered two additional 7-ft. diameter Hardinge conical mills to complete their grinding plant at the colliery at Minersville, Pa. Experimentation has shown that the power required for grinding three tons per hour of anthracite coal to a fineness of 92 per cent through 200 mesh is only 22.3 hp. hours per ton. For the mill and air separation equipment it required only a total of 72.5 kw., or 24.2 kw.-hr., per ton; steel consumption amounted to about 5c. per ton, and replacements are made without shutting down the mill or one minute lost time, merely by feeding balls into the discharge end of the mill as the operation continues.

Increased activity is indicated in recent sales of electric-furnace equipment, according to the Electric Furnace Co., Salem, Ohio. A large manufacturer of manganese steel castings for railroad purposes has just placed an order for a 250-kw. car type Baily annealing furnace for one of its plants on the Pacific Coast. This equipment will have a capacity to heat seventeen tons of manganese steel per day. Another recent order calls for a 125-kw. melting furnace for ferromanganese. This furnace is to be installed at the plant of the Pettibone-Mulliken Corporation, Chicago, and will be used for making hot additions to each charge from their Herroult electric steel furnaces. The Baily unit will have a capacity of 1,000 lb. of ferromanganese per hour. The Griffen Wheel Corporation has ordered a 75-kw. melting furnace for melting bronze for railway bearings. This furnace will have a hearth capacity of 1,000 lb., and will be installed at Tacoma, Wash. The Best Foundry Co., Bedford, Ohio, a subsidiary of the American Stove Corporation, has contracted for a 50-kw., 500-lb. melting furnace for melting its copper-zinc alloys.

TRADE CATALOGS

Iron Ores—Clement K. Quinn & Co., Duluth, Minn., and Cleveland, Ohio, have just issued their 1922 "Season Analysis" book, which contains the names and range of analyses of the various grades of iron and manganiferous iron ores mined and sold by the company.

Cyanide Equipment—Full descriptions of Merco precipitation processes and products are given in an attractive new catalogue of eighty-three pages recently issued by the Merrill Company, of San Francisco. The subjects include The Merrill Precipitation Process, the Crowe Vacuum-Zinc Shavings Process, the Merrill Sluicing Clarifying Filter, the Merco-Nordstrom Plug Valve, and Merrillite. The information given will prove highly interesting to all gold and silver metallurgists, for it is attractively presented and authoritative. The Crowe Process, described in this book, is possibly the latest great advance in precipitation practice, and has been approved by metallurgists throughout the world.

Flotation Oils—The Hercules Powder Co., has recently issued a pamphlet giving complete specifications of the various flotations oils now marketed by that firm. These include: Yarmor, a steam-distilled pine oil; Remoh, similar to but not so highly refined as Yarmor; Floto, similar to Remoh but of lower grade; Century, a specially made pine product; Risor, the crudest steam-distilled pine oil manufactured; and Tarol, a crude reagent. Directions are also given for testing flotation oils and detecting adulteration. Another brochure by H. J. Stander, "Flotation," gives a brief survey of the subject and mentions the method of manufacture of steam-distilled pine oils. Both booklets may be obtained without cost on application to the Hercules Powder Co., Naval Stores Division, Wilmington, Del.

Fireless Steam Locomotives—The fireless steam locomotive is without boiler and firebox. In place of a boiler, it carries a tank containing water which is heated by steam from a suitable stationary boiler. To insure dry steam the storage tank is only four-fifths filled with water. The locomotive tank is specially lagged and jacketed to prevent loss of heat. As steam is used by the locomotive the temperature of the water and the pressure of the steam in the tank are gradually reduced and part of the water turns into steam. Fireless steam locomotives are not new and are not offered as a universal substitute for steam locomotives of usual construction. The H. K. Porter Co., Pittsburgh, Pa., has issued a thirty-two page catalog which describes the types and uses of this kind of locomotive. It is entitled "The Porter Fireless Steam Locomotive."

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Volume 113 — New York, April 29, 1922 — *Number* 17

The European Chessboard

THE TREATY signed at Rapallo between Germany and Russia is more than the drawing together of the "two Ishmaelites among nations." It is true that European diplomacy makes strange bed-fellows. There is nothing stranger to contemplate than the chumming together of highly capitalistic Germany and anti-capitalistic Russia. But deeper than theories of political economy and of government is economic necessity. The constructive thought of Germany ever since her military defeat has turned toward Russia as her only hope of regaining her pre-war power. A wall shuts her in on the West, South, and North; but in exploiting the vast resources of Russian territory and in organizing a broken and spent people, her thinkers, true to their pre-war type, foresee a possible future greater than that which she lost. We are publishing a review of a German book, just issued, the conclusion of which is that Germany must look to Russia's iron and manganese reserves, in the future, for the support of her steel industry.

On the other hand, Russia and her leaders are at the end of their rope. They must have increased prestige and outside help at once. They have appealed to America, but find no recognition here. They look to England, but the terms are stiff. Better Germany than nothing; and besides, they think, the spectacle of a German alliance should make it easier for them to deal with the former Allies.

Government Co-operation in Quoting Metal Prices

THE CURRENT metal price quotations, especially those of copper, lead, and zinc, which for so many years have been officially established by *Engineering and Mining Journal*, will be further safeguarded by co-operation with the Government. An arrangement has been effected whereby a Government official, representing both the Interior and Commerce Departments, will co-operate in this work with the market editors of the *Journal-Press*. Thus a co-operative service between the Government, the industries, and the press is effected, that should be beneficial to all three.

The Government representative is Mr. H. S. Mulliken, of the Bureau of Mines, who will represent, besides the Bureau of Mines, the United States Geological Survey and the Bureau of Foreign and Domestic Commerce.

The Edge Trade Association Legislation

THE DILEMMA in which trade associations find themselves as the result of the Hardwood decision continues to be the subject of much discussion. The most recent developments include the Hoover conference at Washington and the introduction, in Congress, of a tentative bill by Senator Edge placing such associations under the Federal Trade Commission, and of a joint resolution, fathered by Senator Edge and Representative McArthur, providing for a Congressional investigating committee.

"Business is entitled to know in definite terms what it may and may not do," declares the preamble of the proposed joint resolution. This declaration will strike a sympathetic chord in many a weary heart. For fifty years American business has been struggling to attain certainty in its legal status. Ever since the first halting steps in great combination movements, legal uncertainty has been an ever-present condition. Under the old common-law doctrines, under the state anti-trust laws, and under the Federal Sherman Act, business has been operating under the handicap of indefinite and negative restrictions. The process has been one in which business, denied definite positive guidance, has tentatively adopted in its tendency toward combination one legal form after another—the pool, the trust, the holding company, the merger—only to be checked and turned back by the Supreme Court, which has finally evolved that marvel of indefiniteness—the "rule of reason." The latest decisions have made it clear that combinations in restraint of trade cannot be erected under the guise of open-price associations. One more experiment tried and the check once more applied!

Business now asks for a statement of what it can do. It demands an opportunity to submit plans for trade-association activities to the Federal Trade Commission for approval or disapproval before operations are begun.

The uncertainty which has been present has been costly in the past—much more costly than is ordinarily realized. If one were to attempt to devise a plan for dampening business enterprise, it would be difficult to evolve a more efficient implement than a threat of illegality. This type of uncertainty is a perfect wet blanket.

We do not mean to infer that business should be left free to do anything it chooses. So long as competition is the force relied upon to protect consumers from high prices, it will be necessary to prevent by law combinations in restraint of trade. We merely point out that certainty as to what is legal and what is illegal would greatly simplify the problem of the business man. How can one proceed confidently so long as the rules of the game are undetermined and constantly shifting?

In this particular case, moreover, uncertainty is likely to be exceptionally costly. Unless positive guidance is given, the trade-association movement will receive a blow which will prevent in large measure the performance of many functions which are highly useful in the economic process and quite free from objection on the ground of restraint of trade. For the fact-finding function of the trade association is really a risk-elimination function. If a business man can make his plans and decisions on the basis of fact and knowledge rather than guess and speculation, he can price more closely, eliminating the reserves and insurance premiums which inevitably accompany the conduct of business when surrounded by uncertainties. Trade associations now supply many valuable data; they can be so developed as to supply many more. Such data are essential to wise business decisions and will result in fewer losses to business men and lower prices to consumers.

The Edge bill may not be perfect. Senator Edge does not pretend that it is. But certainly his proposals are steps in the right direction. It is possible to define fairly precisely the things which trade associations "may and may not do," and Congress owes it to the business community and to the country to make this clear.

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A Lesson in Management

THE RECENT DECISION of the directors of the Tintic Standard Mining Co. to pass another quarterly dividend has aroused much speculation as to the condition of the company's affairs. Although no explanation accompanied the public announcement, we happen to know some of the facts. The mine, in the North Tintic district in Utah, contains large deposits of rich lead-silver-copper ore in limestone beds. It is a "young" mine, the first ore having been shipped only about five years ago. Since then dividends amounting to $1,715,000 have been distributed and an expensive milling plant and a standard-gage railroad from the mine to the mill, a distance of about ten miles, have been built at a cost said to have been nearly a million. All of this came from proceeds of the sale of ore.

A mine, however, can be overworked; it can be abused; and this is what was done to the Tintic Standard mine. The only concern of the management seemed to be the maintenance of current production. When the mill was completed, early in 1921, about four hundred tons of medium-grade ore was shipped daily in addition to the smelting ore. This necessitated the extension of the stopes from which the high-grade ore had already been taken, and the open areas became larger than ever.

The ground was "good" from the miners' standpoint, and huge square-set stopes were left unfilled. Finally, warning came in the form of several costly caves; others were imminent, and one of the shafts was threatened. It became apparent that a serious mistake had been made in allowing the stopes to remain virtually unfilled. The management realized, what it should have known all along, that the function of timbers in a mine is to serve as a scaffold from which miners may work; to afford temporary protection, and to maintain necessary passageways; they should not be expected permanently to support mine workings, particularly where the orebodies are large, as they are in the Tintic Standard.

For some months now many hundreds of tons of waste have been poured daily into the old stopes, and, we understand, danger of disaster is past. A new policy has been formulated; the greatest ultimate profit will be obtained from the property by doing systematic, if somewhat slower, mining. The mine will be put in good physical condition and will be kept that way. A disproportionately large expenditure will be necessary for some time, but in reality a considerable part of the current mining cost is a deferred charge on ore that was shipped many months ago.

Naturally, earnings have been decreased, and the decrease has been reflected in the passing of dividends and the decline of the price of shares on the exchange. We are informed, and we have every reason to believe, that the reserve of proved ore is exceptional and that the outlook for the future is excellent. A lesson has been learned; it was expensive, but lessons that are not expensive frequently are easily forgotten.

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Increasing the Use of Copper

PROBABLY the most constructive work which has been done looking toward an improvement in the demand for copper has been that of the Anaconda Copper Mining Co. in putting copper roofing shingles on the market. For some months past a large amount of research work has been done, two of the chief problems being, first, to perfect a suitable joint which would be leak and wind proof, allow expansion, and be easy to put together; and, second, to produce a finish which would be artistic. Both of these requirements seem to have been met in the Anaconda product. The crimped edge by means of which the shingles are fitted together is both cheap to manufacture and satisfactory to use and the oxidized greens, reds, and browns obtained by subjecting the shingles for varying length of time to nitric acid are not only beautiful but considerably more permanent than paint. Of course, copper naturally oxidizes to an attractive color, but by this process the effect is obtained even before the roof is laid.

During the last month the Anaconda company has carried several large advertisements in the *Times* and other New York newspapers, calling the attention of the general public to the economy and beauty of the company's product. The response has been large. Coming just at the time when builders are beginning to make up for lost time, thousands of people are interested. A large show room is being fitted up at 25 Broadway, and a house at South Orange, the first to be roofed with the new material, has attracted great attention. Later, it is planned to extend the publicity campaign to other sections of the country. The singles are ready for delivery from the Perth Amboy works and will be sold direct to the user in large or small quantities.

It is of interest to note that whereas the copper roofing sells for from $22 to $25 per hundred square feet, zinc shingles made in the same way can be had for half that price. Properly laid, either one should last a lifetime or more, and the only reason for the use of copper would seem to be its greater beauty. The zinc shingles, though obtainable in an oxidized finish, nevertheless cannot be toned to a desired color, but remain a silvery white or light slate color.

The New Jersey Wire Cloth Co., which markets the Roebling product, is also conducting a national advertising campaign in the *Literary Digest* and other publications, for copper screen cloth. Much of the copper screening formerly sold has been in reality bronze, whereas the new product is 99.8 per cent copper, specially processed to give additional strength. Not only has the aim been to make a superior product, but to avoid charging extortionate prices. Inquiry at the local warehouse developed the fact that ordinary insect screening made of No. 14 copper screen cloth could be obtained even in small quantities for 8¾c. a square foot.

The Rome Brass & Copper Co. is continuing its campaign for the wider use of copper kitchen utensils. One of the company's practical ideas has been to give every buyer of a Monarch range a set of copper pots and pans.

These companies are all doing their share to put the copper publicity movement on a practical basis. The work of the Copper & Brass Research Association is no less real, but is less apparent. The name of this organization is unfortunate. To engineers it is misleading, for no research work, in the technical meaning of the word, is done. It is purely a publicity organization, and its work so far has been, generally speaking, to find out, by conversations, reading, and correspondence, what copper is good for and what it is not good for, and to put the truth before as many people as possible. Being financed by a large number of producers and fabricators, care must be taken to play no favorites and not to push any one company's product unduly. Little can be done in the matter of price control without running the risk of Government interference. The work of the association is therefore a kind of moral suasion.

That the use of copper can be stimulated there is little doubt. We do not expect a sudden and largely increased demand, although the possibilities of the radio telephone must be considered. Nothing that any producer or manufacturer or group of either can do is likely to result in every copper mine working to capacity in the next two or three years. However, a very real increase in the demand can be obtained by intelligent effort such as the companies already mentioned are making. The building industry offers possibly the greatest prospect of an immediate outlet. Roofing, screens, piping, and the other things that go into a house can be made to absorb a lot of copper. It only remains to advertise the economy of copper and brass for these uses and to pay particular attention to marketing problems. Copper products must be easy to obtain and must be sold at a reasonable price compared to other metals. Because copper screws will last four times as long as iron screws is no reason to sell them for three times the price, and then to preach the economy of their use. They actually cost less to manufacture than do iron screws, and they should be sold certainly at no advance.

Care must be taken, also, not to try to invade fields in which other metals are rightly established as being superior. Zinc, aluminum, nickel, and other metals have established reputations for certain purposes in which they are probably economically preferable to copper. It is as a substitute for iron that copper has the greatest possibilities, and we say this with no apology to our friends in the iron industry. This country produces about ten times as much iron as copper, and the demand for copper could be doubled at the expense of the commoner metal without inflicting any appreciable hardship on the iron industry.

Drift to State Socialism

FREEDOM OF INITIATIVE and legislative machinery for the speedy enactment of wise, unwise, and even pernicious laws work out in a curious way. The North Dakota debacle is a case in point. The proposed Five Hundred Million Dollar Power Bill which is now under discussion in California and which no doubt will be submitted to the vote of the people of that state is another example of socialistic trend. The proposed bill has for its object the conservation, development, and control of the water powers of the state for the use and benefit of the people. A board of five men to be appointed by the Governor is to administer its provisions. Almost unrestricted power is to be given this board. To all intents and purposes it can embark on any business. Bonds to the amount of $500,000,000 are to be issued to carry out the provision of the bill. The bonds are to be in fact a first mortgage upon the state.

There are two fundamental objections to this unwise proposal. California has already a great system of hydro-electric plants which cover the state with a network of transmission lines, adequately and equitably serving a vast number of consumers. These plants are privately owned and represent an investment of $500,000,000 and have a total capacity of 1,200,000 hp. There is a surplus of power ready for the market. The entire system is closely regulated by the State Railroad Commission. Power and lighting rates are on as reasonable a basis as in any other state. The service is dependable.

The entrance of the state as a competitor in the existing market will result in a degradation of the private capital already invested and will destroy the confidence of investors in business enterprises in the state. The existing wealth of California has been largely the result of private capital put into mines, farms, orchards, and business generally. To change this principle fundamentally is to invite disaster. To relegate immense power to an oligarchy of five men is to strike at the roots of democracy.

The second fundamental objection is an inevitable and almost unrestricted increase in taxation. The $500,000,000 and interest will have to be paid by the people of the state either directly as taxes or indirectly in rates for service. The isolation of $500,000,000 of wealth from taxes merely increases the tax upon all other wealth. The advocates of this bill make the insidious argument that the profits of the state-owned enterprises will pay the bills, but carefully conceal the fact that the people pay these profits, for there is no one else to pay. During the last ten years, the expenditures of the state government have increased 243 per cent as compared with an increase of 40 per cent in population and an increase of 60 per cent in wealth.

In view of the well-established and wisely controlled public-service corporations made possible by private investment, this move to embark upon state-owned and state-controlled power plants seems to us to be unwise and to strongly invite financial disaster, not only to many innocent investors but to the state as a whole.

Boston & Montana Again

BOSTON & MONTANA has been thrown into public notice more than ever by the publication of the results of the Herzig report and the withdrawal of Harris & Co. from acting as brokers for the sale of its stock. We hear that legal proceedings have been instituted against Mr. Herzig and others, the implication being that his report was made to depress the stock in the market.

We are no more favorably impressed with these methods of the Boston & Montana Co. than we have been with its promotion methods in the past. If the company wishes to refute the Herzig report, it should do it with engineers, not lawyers. It is customary to have a mining engineer determine a mine's resources and future possibilities. So far as we know, Boston & Montana has not published a complete and calculated statement of ore reserves. To establish confidence, it should have such an estimate made at once by an engineer of unquestioned standing. Otherwise, its position must remain unfavorable in the eyes of the investing public.

The Functions of Institutes—III

By T. A. Rickard

MY LAST article on this subject ended with a reference to a Mining Congress. This prompts further mention of the American Mining Congress, which, after many vicissitudes, has achieved success as a permanent lobby established at Washington for the purpose of protecting the mining industry from adverse legislation. It is also a parliament of mining men, for its annual conventions are well attended and serve to render articulate the ideas of those engaged in mining, more particularly those of the big operators and the representatives of the principal mining companies, that is, of those on whose financial support the Congress depends for its existence. The chief factor in its success has been its permanent secretary, Mr. James F. Callbreath, a man of good sense and untiring energy. The Mining Congress performs its two functions, as a lobby and a general convention, so well that it is a pity it should have started to indulge in a cheap kind of journalism, the chief features of which are puffs and piffle. Moreover, it is endeavoring to meet the cost of its incursion into the publishing business by soliciting advertising, and to do that it is compelled to rely upon a false inference, namely, the statements that its members are 'subscribers' to its monthly 'Journal'. The same thing is done by the American Institute, which likewise issues a second-rate monthly magazine that is supported partly by the dues of the members and partly by advertisements. The latter are obtained by two devious methods, first, the statement that the members are 'subscribers', and, second, the employment of advertising agents who are quick to make the most of the coincidence that many of the leading managers of mines and smelters are directors of the Institute, and therefore persons whom the manufacturer would like to please. If the Institute and the Congress were to place a subscription price on their publications, as the Canadian Institute has done until recently, they would not impose upon the members that do not desire these publications, but even then they would be engaging in a business entirely foreign to their *raison d'être*. It is no part of the province of such organizations to engage in buying and selling—in purely commercial enterprise. It would be quite as proper for them to run assay-offices, reduction works, or livery-stables. Their journalism is of the 'kept' kind, because it is controlled by persons engaged in the affairs on which they comment. Of such journalism there is too much already; and not only because it is superfluous, but because it is spurious. The Institute magazine and the Congress journal are not independent publications, by any means; both are dominated by small coteries that control our large mining enterprises. The Canadian Institute is drifting that way, for as soon as it becomes a congress of mining men it will have to depend upon the financial support of a small group of rich men or of men representing rich companies. Indeed, it is inevitable for the control of large organizations to become centralized in the hands of a few, simply because centralization is the easiest way to obtain a concentrated management. This management, particularly the paid officials, like many other people, desires to have a house organ; that is, a periodical publication in which it can ventilate its opinions. The publication is also a convenience to sundry members, chiefly resident near headquarters, who have propaganda of their own. And yet the claim is made that the Institute 'Magazine' is an 'independent' organ of opinion, and representative of the membership. On the contrary, it is a publication subsidized by the directors and wished upon the membership. That it is a menace to independent technical journalism is manifest; indeed, the Institute has issued circulars recently in which the passing of the 'Mining and Scientific Press' is used as an argument in soliciting 'professional cards' from consultants. On this I shall remark that the technical press was largely influential in starting, developing, and supporting the Institute; that the commercial contest between them now being waged is highly detrimental to the profession; nay more, as I am no longer a publisher, I do not hesitate to say that if the mining profession is to choose between an independent technical journalism and the misuse of the powers of the Institute, it will know what to do. The mining industry and the mining profession will lose more—it will lose more, I repeat—by killing independent journalism than by losing the Institute itself.

On the other hand, the Mining and Metallurgical Society has escaped most of these pitfalls by remaining a professional organization, by curtailing its publishing activities, and by restricting itself to the performance of its proper functions. So has the Institution in London. Indeed the only reason why the Society has not replaced the American Institute is its exclusiveness, which has caused it to fail as a representative of the mining-engineering profession in the United States. That defect can be remedied at any time, whereas the nondescript inclusiveness of the Institute cannot be corrected except by the slow substitution, by death and resignation, of the fit for the unfit. In short, the Institute occupies a position between a technical society and a congress; it will have to elect which it is to be. The time has come to consider these questions seriously; the mining profession will make an irremediable blunder if it ignores them. I write on my own initiative, without prompting from anybody, but as one familiar with the organization and management of the technical societies in the English-speaking countries. The mining profession needs to have an organization of its own, for the preservation and development of its code of conduct, its solidarity, and its ideals. The War and the no less serious period since the War have shown how the mining engineer can serve the public and the Nation. The great industrial conflicts of our time—more particularly the quarrel between Capital and Labor—will not be solved for the good of our country unless the engineers, who are the managers and consultants for the companies that control industrial enterprise, are independent, intellectually honest, and humane. To be that they need the stimulus of coming together, of comparing notes, and of exchanging experience. The remedy for the present unsatisfactory condition of the Canadian and American Institutes, particularly the latter, because it is the one in which the majority of my readers are interested, is a frank discussion. With the Editor's permission, I invite such discussion for publication in the 'Journal-Press'.

DISCUSSION

Deflating Mining Engineers

Caustic Observations Respecting the Obliquity of the Black Sheep of the Profession

THE EDITOR:

Sir—Rising to a question of personal privilege in the *Engineering and Mining Journal-Press* of April 8, "The Guilty One" confesses to having been particeps criminis to an arrangement whereby the management of two mines was taken over for the salary of $200 per month and "find yourself"—including a business office.

Careful business men—not inexperienced in mining, he explained—took advantage of the fact that "there are so many mining engineers unemployed." Being predisposed toward "economy"—and deflation being the order of the day—the Boston directors must have observed that the nut crop is the largest of recent years—and nuts are both meat and dessert for those seeking vitamines, or their equivalent. Hence an inexplicable optimism on the part of "The Guilty One," who, while deprecating the inclusion of mining engineers in the liquidating movement, inconsistently expects the tape to immediately reflect an advance in the price of engineers as a commodity, from $200 to $201½. Manifestly, he should have debited the $200 with the office rent. Instead of a bull market, it is "a bear"—there is more "distress" commodity overhanging, and quotations may not have found their level.

This does not commend "experienced business and mining men" of Boston, who might have exacted a subscription to the working capital before taking on a line of technical stuff. New England undoubtedly has Down-East ca'canniness. The trouble is, even Agassiz left a collection of lithographs among his papers—and when Boston is depressing quotations for mining engineers it may be setting other really wasteful precedents, notwithstanding "The Guilty One" no doubt has professional pride, ability, and an educational pedigree.

Not long ago, other New Englanders ventured afield—not to Utah and Nevada. Under the leadership of a historic professional business man, who years ago introduced the "Boston Blacksmith" to the footlights, they retained or were retained by an "engineer," who represented a property that was said to be triple-plated. What was not precious metal was not worth mentioning. The "engineer" became general manager; the New England pugilistic impresario—unrecognized by moderns of the profession — went on circuit. Somehow the dollars did not roll with the requisite rhythm. The managing director in New England sent a series of S.O.S.'s for jazzy news from the mine, and "samples—no matter where they come from." It was a mere detail whether or not the samples were taken from the triple-plated treasure vault. A bear market in experts and shares necessitated the fanciest exhibit obtainable—from private specimen cases, or elsewhere, so long as it was high grade.

Wires were kept warm. Rush messages and their pernicious portent, as one newspaper asserts, brought resentment from the engineer on the spot. He wearied of effort without reward; and then he published the telegrams, for which he was hailed as an exemplar. The New England managing director was exposed. His duplicity deserved it. But not a word has appeared about the record of the self-adulatory "engineer," who has been in durance on sundry occasions, and who was in compulsory retirement for a period in a western Canadian institution. He was the sort of "engineer" upon whom prosecuting authorities of late have had their stop-watches. His class has been depressing the quotations for real mining engineers who are expected to economically operate properties for the wages of a drill-runner.

Possibly reputable engineers have seen the worst. They may be a "lock-up," as inactive stocks are classified; but the parsimony of principals and cupidity of those who trade on credulity, knowing "there is a new one born every second," has had enough attendant losses of late to bring about changes of policy. Once a "boob" always a "boob," need not be so universally. Otherwise, watching the tape for quotations on M.E.'s will be confined to ticker service in lunatic asylums.

With mining industrialism expanding—and the tape running behind—Canada is in open competition with the principals in the Boston episode. It would standardize the profession of engineering. There is a rising market for the competent, but that has not perceptibly affected the supply of the too-willing witness variety. On the contrary, Canada can export certain kinds of specialists. This is admonitory, as applied to possible importations, there being no domestic shortage.

Obliquity is not a matter of locality. Humans are apt to err, regardless of longitude, latitude, or altitude. Canada simply seeks a closed season for the pseudo—at least until the government at Ottawa refrains from offering employment to M.E.'s and Ph.D.'s—at salaries infinitely less than that referred to by "The Guilty One." By imposing an embargo upon fatuously frugal directors and indifferent speculators, it is sought to create an atmosphere in which the true scientist may exist, instead of being necessitously suppliant.

"I'll give you a report for $200, and put silver in the claim for $250," volunteered an incorrigible "engineer," when Cobalt was in its prime and brokers were playing to standing-room audiences.

He got the $250 and did not have to examine the property. Preferring "consulting work" to more strenuous employment, he was in greater demand among "business and mining men" of the Boston type than the soundly circumspect. Cobalt experience was costly. One "engineer" was feeding $3 rock to his mill at Porcupine while his shares were being pushed at a premium. The most complicated section at Porcupine was placed in charge of a "mucker." Who did it? A conscientious Cobalt superintendent, who has since developed engineering capacity and persuaded his principal not to sell his valuable ground for $200,000. He started the chief owner on the highway to becoming a millionaire. For his foresight, he was rewarded at Christmas with an honorarium of $5.

"Oh," said the superintendent with unbecoming modesty, "I never expected anything of that sort. I'm perfectly satisfied with my salary." And his salary never was more than $1,800 a year!

Neither ethics nor blue-sky codes can govern where the human factor is lacking. Inevitably the functions of mining scientists are variable—largely made to order or of necessity. Fortunately, not every principal or combination has the viewpoint of the Boston syndicate. Discriminating capital regards mining enterprise as legitimately speculative, but declines to invite unnecessary risks. In this connection, ex-Governor Mackintosh, a veteran of the Canadian Northwest mining movement, points a moral. He had an old crony—a prospector—always optimistic, but never a non-resident of Poverty Gulch. The sourdough went to the Governor with a wonderful find—almost indescribably so. Fabulous was the word. "It's a basin of gold—the biggest thing ever"—urged the prospector. "You can have it for $750,000—because you're my friend; and I must have the money in a hurry."

Very gravely the Governor replied: "That sounds good. I'll have D. J. Macdonald take a look at it."

"I don't like to have Macdonald make the examination," parried the knight of the pan. "He'd condemn the mint."

Macdonald was commissioned and returned with the not unexpected report that the "basin" was "bunk."

When the pioneer came along, he never referred to Macdonald, but he tendered the property for $75,000.

The Governor was in a quizzical mood. With a severity of manner that was unusual he inquired: "Now, what is the lowest, bedrock price you'll take?"

"Seeing it's you," assented the prospector, "I'll let you have it for $75."

On general principles that sum was handed over, title was taken, and the prospector opened an account with a bank across the street, where he borrowed $100 on the strength of having "just closed a big deal."

The cheap engineer is expensive in the long run. At no time in the history of mining is there greater need of efficiency, and in due time those other than the fakers will find that out. ALEXANDER GREY.

Montreal, Canada.

The Premier Mine

THE EDITOR:

Sir—On page 610 of your issue of April 15, I observe an article upon the Premier mine which contains quite a little misinformation, and in the interests of accuracy I am making corrections as follows:

The option upon the property was taken by R. K. Neill in March, 1917, and the property thereafter developed by him and his associates. In the summer of 1919 I visited and examined the property in the interests of the American Smelting & Refining Co., along with other engineers of our organization and in conjunction with H. B. Price, engineer for Messrs. Keith and Untermyer, and shortly thereafter completed the purchase of a controlling interest for a group of four parties: American Smelting & Refining Co., Guggenheim Brothers, Minor C. Keith, and Isaac Untermyer.

Since then the mine has been extensively developed, and equipped with water power and with semi-Diesel engines as power auxiliaries in winter months; also with a mill of 100 tons' daily capacity and an aërial tramway of 11½ miles from the lower tunnel and mill direct to dock at Stewart, B. C.

A dividend of $400,000 was paid at the end of December, 1921, and $500,000 at the end of March, 1922, and if no particular publicity was given to either of these dividend payments, it was purely because there are only a few stockholders of the Premier, which is a Canadian corporation, and its shares are not publicly dealt in.

First-class shipping ore goes to the American Smelting & Refining Co. Tacoma smelter; second-class shipping ore to Granby smelter, Anyox, B. C., and lower grade to mill.

The management is lodged with the A. S. & R. Co., with myself as vice-president and managing director of the Premier. The plant manager is Dale L. Pitt.

New York City. H. A. GUESS.

The Hope for the Graphite Industry

THE EDITOR:

Sir—I do not know what interest Mr. Schmehl, who writes in your issue of April 8, represents, but assuming that he is a miner and producer, an impression which his article is intended to give, let us briefly analyze his figures.

Alabama graphite ore as mined averages about 2 per cent graphite in free form; selected Pennsylvania ore, about 5 per cent. This represents fifty tons of ore to the ton of graphite with a 100 per cent recovery in Alabama and twenty tons of ore to the ton of graphite in Pennsylvania.

His plant-cost estimate for Alabama is therefore $20 per ton of capacity and for Pennsylvania $50 per ton of capacity. The ore must be mined, crushed, ground, and milled. These figures speak for their author, not for themselves.

A cost of ½c. per lb. amounts to 20c. per ton for Alabama ore, and to 50c. per ton for Pennsylvania ore. This still includes mining, crushing, grinding, and milling, but no drying or finishing. Pennsylvania ore, to be of this grade, must be mined underground and selected.

Mr. Schmehl's article is printed on the wrong page. It should have been on page 562 under "One Is Born Every Minute." E. E. ELLIS,

Birmingham, Ala. President Celyon Co.

THE EDITOR:

Sir—I have read Harry A. Schmehl's article, "The Hope for the Graphite Industry," in your issue of April 8. Mr. Schmehl brings out some good points, but some of them are misleading.

He says, in regard to flotation of graphite, "One machine will produce from three-quarters of a ton to a ton of concentrates daily at a cost of about one-half a cent a pound." This is true, but this one-half a cent a pound represents not more than 20 per cent of the total cost.

Again, he says, "A 98 per cent extraction of the loose flake can be obtained." This is true, but represents not over 85 per cent economic recovery of the total carbon, under the most favorable conditions.

Again, he states, "The cost of a plant to produce five tons of 80 per cent concentrate daily would be less than $5,000, not including the land." Accepting his statement that from three-quarters of a ton to a ton of concentrate per day can be made from one flotation machine, then his five-ton plant would require from five to seven flotation machines. Standard flotation machines cost from $800 to $2,000 each—not including freight and cost of installation. The $5,000, then, would not even cover the cost of the flotation installation, much less the necessary mining equipment, primary breaker, grinder, drier and other apparatus. The Buhr stone system, including a bolting system that he mentions, would add additional expense for one finishing by that system.

Mr. Schmehl's article brings out his belief that a high tariff on graphite will be harmful; and that the low cost of production and the small capital required, together with efficient management, is enough to protect the graphite industry. Possibly! I would like to believe that graphite needs no protection, but the graphite tariff rates, as recommended by the Senate Finance Committee, are well in line with the needs of the industry and will not harm those graphite producers who are "honestly attempting to make a success of the venture."

Ashland, Ala. J. C. BARTON.

THE EDITOR:

Sir—In your issue of April 8 under the heading of "The Hope for the Graphite Industry" your correspondent, Harry A. Schmehl, advocates that instead of depending upon a tariff graphite miners in the United States should get down to hard work and make it possible to compete with the imported product. This may or may not be good advice, as it is possible that some properties could never compete with the best grade of graphite no matter how much work and time was devoted to them.

As one who has had some experience with graphite I realize that general statements of the comparison of graphite from different countries or districts are likely to be misleading. Some graphite ores lend themselves to economical and comparatively easy treatment and others do not, and the character as well as the grade of each ore must be carefully considered before a reliable statement can be made regarding the relative value of certain deposits, the recovery, including percentage of flake, that can be extracted, and the cost of production per pound.

The impression one might form from reading Mr. Schmehl's letter is that the profitable mining of graphite is a simple matter, as he states that the cost of a plant to produce five tons of concentrate daily amounts to less than $5,000, not including the land, and that one machine (flotation) will produce about one ton of concentrate daily at a cost of one-half cent a pound.

I am glad he does not include the land in the $5,000, but nevertheless his figures differ so widely from any that I have that I think some explanation from him might make them clearer to the average reader. Your publication is read by many, and it would be unfortunate if any likely investor gained the impression that refining graphite generally was a simple matter requiring little capital and plant, although it is possible that in certain districts conditions may be exceptionally favorable.

Too much money has already been wasted in the graphite industry on both sides of the line, and the records of the last thirty years are not much assistance in establishing what ultimately should be a thriving industry on this continent. H. H. CLAUDET.

Ottawa, Canada.

Russian Placer Mining

THE EDITOR:

Sir—In the *Mining and Scientific Press* of March 18, 1922, there was published a letter from L. A. Perret, referring to one that I wrote several months previously to the same journal. Mr. Perret states that I had therein ventured to prove the superiority of electricty as a driving power for dredges. This is far indeed from the case, for I would not advocate under every circumstance electrical driving for a single dredge. My letter was written merely to correct some gross misstatements concerning the Orsk Goldfields dredges, which Mr. Perret had used to support his contentions in a controversy with others.

It is quite evident that Mr. Perret's knowledge of the Orsk dredges is obtained from distorted gossip. Having been convicted of one serious blunder, he comes at it again. He now suggests that the steam dredge was fitted with a boiler that had previously been used on a stacker-scow, and was entirely inadequate for the purpose of the steam dredge. Mr. Perret in this suggestion is again entirely wrong.

Having previously confined myself to the correction of mistakes by Mr. Perret, I will now contribute briefly my own opinions: (1) The two Orsk dredges are so different, and work under such different conditions, that no satisfactory conclusions can be reached from their performance as to whether steam of electric driving is best. (2) Considering that the power station is fifteen miles distant from the electrically driven dredge, and as there was only one electric dredge, I think it would have proved cheaper had it been constructed for steam drive.

I trust that Mr. Perret will now see that my intervention in the controversy was solely to correct misstatements that had been made by him, and were likely to mislead your readers. S. J. SPEAK.

London, England.

Dean Probert's Protest

THE EDITOR:

Sir—I wish to second Dean Probert's spirited protest against the false impressions given by Mr. Young's articles on mining-engineering education. While Mr. Young's article showed a certain reportorial ability and an undoubted perseverance in his visiting so many mining colleges and filling so many pages in the *Journal*, they failed in many respects to present a true or even recognizable picture of the institutions they professed to describe. As Dean Probert stated, the articles could not be compared to the findings on mining engineering education recently published by the Mining and Metallurgical Society. Possibly Mr. Young lacks the philosophical background that characterizes the discussions of the Society. At any rate I think that Dean Probert was warranted in rising up and registering a protest.

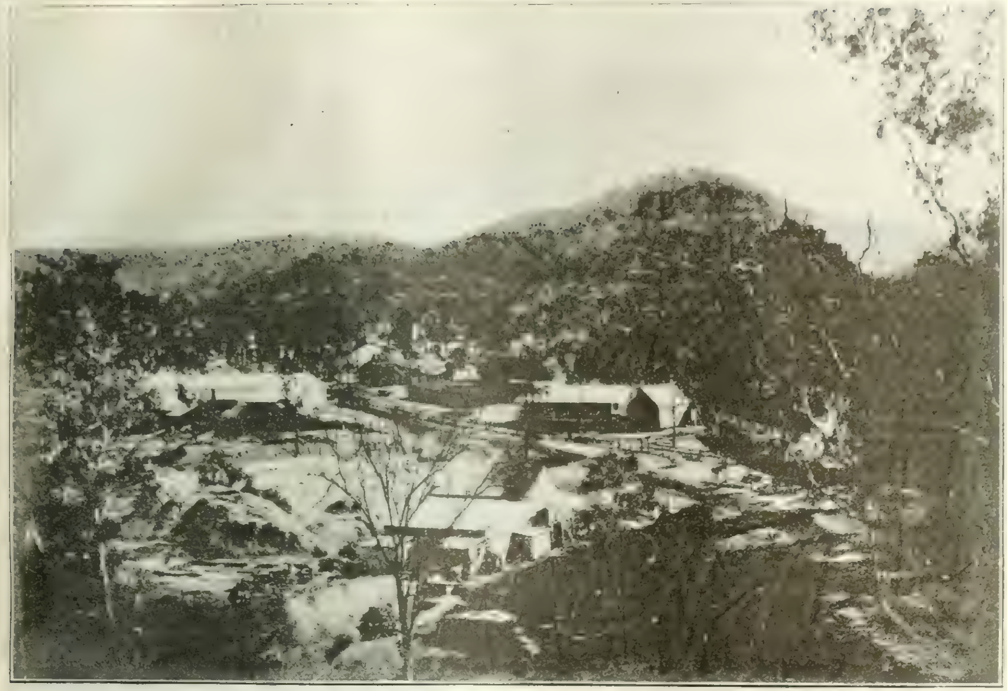
If you will permit me to proceed to another subject, I should like to express appreciation of the suggestion made by J. R. Finlay in your issue of April 8 to the effect that the *Journal-Press* should not confine itself to topics pertaining directly to mining. Certainly its readers, representing what Mr. Rickard calls the "class" of class journalism, have other class interests besides mining. That is, they have many predilections and sympathies in common, and like to see the lump of technique leavened with arguments of human interest.

New York. P. B. McDONALD.

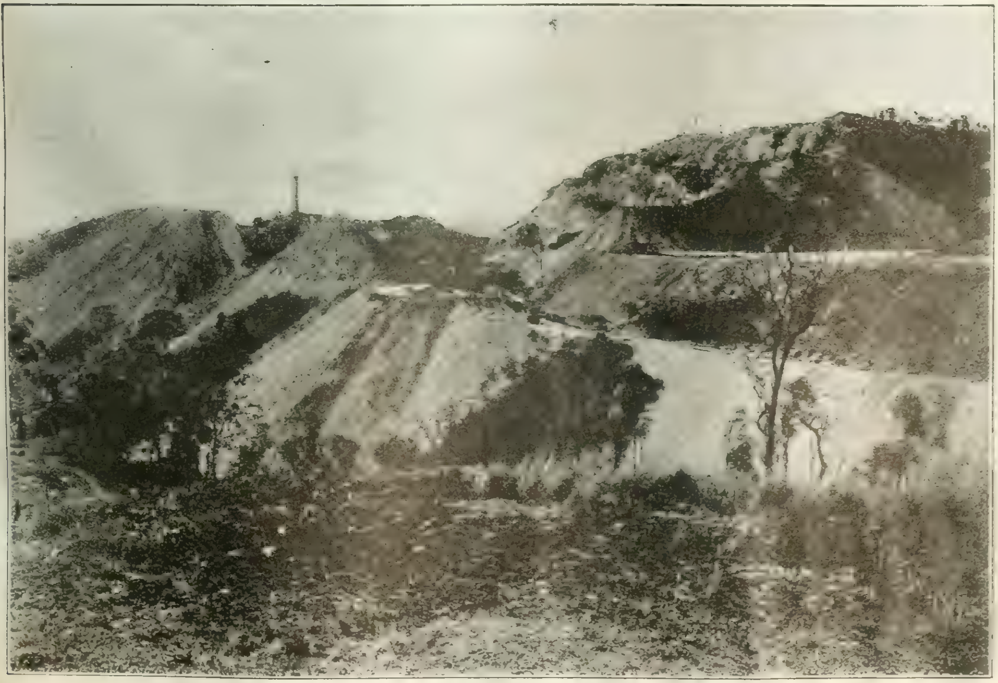
Views of Mount Morgan, Queensland

Copper reduction works of Mount Morgan Gold Mining Co., Queensland, Australia, which has resumed operations under a government subsidy

A nearer view of Mount Morgan's copper smelter



Mount Morgan mine and works in 1884



Mount Morgan's open cut and dumps, looking south

Heap Leaching of Low-Grade Copper Ores—I

Success of This Process at Rio Tinto in Spain Led to Trials in the Bisbee District—Over 70 Per Cent of Copper Extracted from an Ore Containing 27 Lb. Per Ton—A Large Part Lost by Floods and Seepage—Further Large-Scale Work Planned

By Joseph Irving

HEAP LEACHING of low-grade copper ores is economical in a double sense; not only is the cost of treatment and recovery extremely low, but the method is applicable to those ores that are too low in copper for ordinary smelting or milling, as well as to those for which smelting or milling is too costly to be practicable, owing to their chemical and physical characteristics. One outstanding feature of heap leaching is that, with some simple modifications, all classes of copper ores are amenable. These include ores that contain the copper as oxide or carbonate, ores that contain the copper as sulphate, and ores that contain the copper as a sulphide. Those in the last class include dense sulphides, as well as schistose and siliceous ores such as the porphyries, which may contain a relatively small amount of sulphide.

Although it is admitted that cement copper was produced from mine water at Schmollnitz, Hungary, during the fifteenth century, the first authenticated record of the recovery of copper by heap leaching refers to practice at Rio Tinto in 1752. The heaps had been weathering for years, and had undergone a natural decomposition by atmospheric influences; the copper was leached by water and was precipitated on iron. At that time the process met with strong opposition from the general superintendent of the Hacienda Real, Pedro de Lerina, who stated that the cement copper obtained was nothing more than iron coated with copper, and that this falsification would do a great deal of harm to the Spanish copper trade. After a series of experiments by chemists at Madrid it was shown that he had made a mistake, but it was a long time before the lixiviation process was looked upon with favor.[1]

The wonderful success of heap leaching, or, as it is sometimes called, natural cementation, as evidenced by

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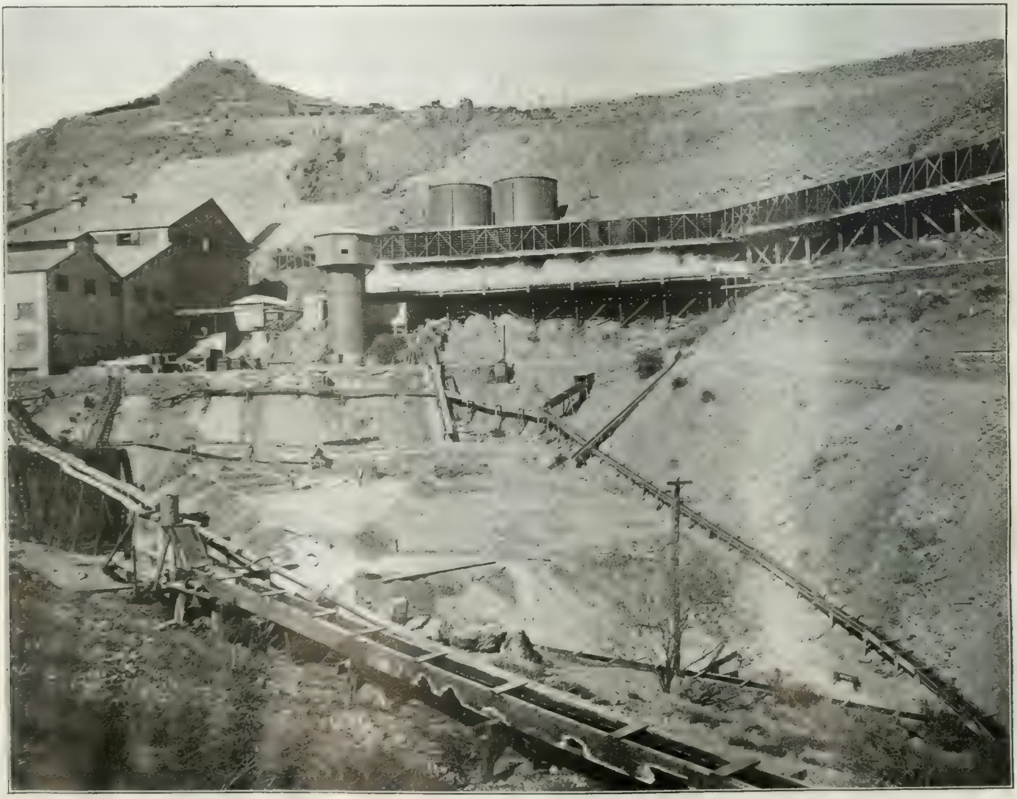
[1] Eissler's "Hydro-Metallurgy of Copper."



Ten-thousand-ton leaching heap at Bisbee. Sacramento Hill in background the results obtained at Rio Tinto, Tharsis, Aznalcollar, and other mines in Spain and Portugal, as well as at the Wallaroo and Moonta mines of South Australia, leads one to consider the possibilities in applying such a method to the millions of tons of low-grade ore already mined and on dumps as waste in the southwestern states. One would think that a method for recovering copper that was so simple in its fundamentals would have appealed to many who had large quantities of low-grade ores on hand and for which there was no available market. In fact, the simplicity of the process is its best recommendation, as efficiency and simplicity are often synonymous.

My own experience with heap leaching started in Spain, where for several years I was cementation superintendent for the Seville Sulphur & Copper Co., besides having various opportunities to follow the work at Rio Tinto, at Tharsis, and at other mines in the south of Spain. The following is a general outline of Spanish practice:

A suitable site having an easy slope for drainage is first selected. The floor for receiving the ore is prepared and hardened; to assist oxidation and drainage, culverts 2 ft. high and 12 to 18 in. wide are laid long-ways, with intervening cross-culverts, so that all drainage from the heaps will run in one direction toward a common settling tank. These culverts are made from large pieces of poor ore that have been laid aside for cementation and thus serve a double purpose. Formerly, chimneys were arranged at various cross-section points of the culverts, so that a current of air could be maintained through the heap, thereby assisting sulphatization.

The ore which is to be treated, averaging 2 per cent copper, is now brought to the site, the larger pieces being laid first to a height of 2 ft. The remainder of the ore is then piled on this prepared base; it should contain about 10 per cent of 8-in. material and 50 per cent of 1-in. material, the rest being the usual run of fine. The heaps may be carried to a height of even 30 ft. The surface has a slight dip of 1 in 300, and is divided into shallow basins about 20 ft. square and 1 ft. deep. The water coming from the mine or from a reservoir is mixed with a proportion of the waste or tail-end liquor (with certain classes of ore the use of tail-end liquor is of immense advantage), and is distributed cautiously over one part of the heap for some weeks, a small proportion only of the copper being recovered thus.

The water is then diverted to another section of the heap, so that the partly treated ore may have a chance to heat and oxidize. The heat developed at this stage is not allowed to exceed 140 deg. F. When the temperature approaches this point the flues are closed to stop the draft, and the heat disseminates through the heap. When the partly treated portion of the heap is washed again, most of the copper present will be dissolved. The divisions on the surface of the heap are then leveled, and the positions of the shallow squares are shifted so that fresh areas of the heap are exposed for treatment.

Precipitation canals in Spain

The resultant copper-bearing liquors from this operation are led by a main channel through a filter bed of clean pyrite "smalls," placed in a suitable concrete vat (to reduce the excess of ferric salts), and thence to a common settling tank. The copper liquors are finally run through a series of vats, canals, or launders containing iron, which precipitates the copper in metallic form. This copper precipitate is known as cement copper. The iron goes into solution as ferrous sulphate. In the recovery of the copper it is customary to use vats at the upper end of the system, where the copper liquors are richest. Concrete vats with a cement facing were formerly used, but now frequently they are lined with wood. We found by experience that wood-lined vats are the best and cleanest with which to work; they last longer than do bare concrete vats. These are 20 ft. long by 10 ft. wide by 3 ft. deep. The floor has a slight slope to the lower end. They are generally filled for three-quarters of their length and for all their width with pig iron, laid on timbers 6 in. above the floor and piled in castle form. Some scrap iron is laid on top. The copper liquor passes through these vats in a steady flow, being diverted at the entrance so as to fall to the bottom of the vat and rise through the stacked iron to the overflow, care being taken to keep the iron always covered in the copper-bearing liquid.

From the vats, the liquor passes through a series of wooden canals or launders, 3 ft. by 1 ft. in section, which have an inclination varying from 1 to 200 in the first set to 1 in 50 in the last sets. These launders are arranged in sets of at least two, the liquor passing through them and running off at last with only a trace of copper. It is good practice to have a trace of copper in the tail liquor; it shows that iron is not being consumed unnecessarily.

The slope at the lower end of the plant also prevents an unnecessary consumption of iron. These vats and launders are arranged in series, so that precipitation each step; when one portion of the system is being cleaned, the liquors containing copper are still being treated in the remainder of the plant. When the cleaning of the vat or launder is finished, the liquors are partly diverted, and the cleaned area of the plant is filled up again and put in operation. In this manner the plant is kept in continuous operation. Vats drain into the launders; and the launders are built so that the upper set can be drained entirely into the succeeding set.

Liquors are sampled automatically, and flows are checked at the head and tail of the plant, and also wherever a fresh stream is introduced at an intermediate point. The launders are made of 3-in. pine, held together by dowel pins. Each side is painted carefully with hot pitch, and all seams are calked with oakum and pitch. The consumption of iron can be reduced to as low as 1.15 parts to 1 of copper. With ordinary care it need not go above 1.25 parts of iron to 1 of copper. One meter of canal (launder) holds 573 lb. of pig iron, and a cleaner can attend to 30 m., or, say, 95 ft. It may be noted that, from these heaps in Spain, some of the silver is recovered with the copper. I have known the first launders to return as much as 48 oz. per ton of precipitate.

PROCEDURE AT RIO TINTO

Heap roasting was practiced at one time at Rio Tinto. The heaps, or *teleras*, had a base of 20 by 26 ft. and a height of from 10 to 30 ft. Each contained from 800 to 1,200 tons of ore, and had one transverse and three longitudinal flues about 20 in. square, formed by the larger blocks of ore, communicating with vertical chimneys, of which there were two in the 800-ton heap and three in the 1,200-ton heap. Roasting might last for two months. Sometimes salt was added in the proportion of fourteen tons to the 800-ton heap, or about 1.75 per cent. In the Doetsch process, carried on for some time at Rio Tinto, the principal features were (1) the introduction of ferrous sulphate gathered from the Rio Tinto River bed, (2) mixing with salt in a roasting furnace, and (3) passing the fume over manganese dioxide, placed conveniently in the flue, thereby producing an excess of chlorine gas, which was led through towers and which met a descending shower of ferrous solution, forming ferric chloride. This process, together with the heap-roasting process, was abandoned many years ago, in favor of the simpler method of natural cementation.

For a long time it was contended that heap leaching as described is suitable only for heavy sulphide ores; but modern practice has shown that it can be applied successfully to ores in which the copper may be combined with small quantities of iron pyrite in a heavy schistose gangue, even in piles 30 ft. high. One essential requisite is to provide facilities for washing with tail liquors containing ferrous and ferric salts, as these help considerably in both washing and leaching. This is being successfully carried on at Rio Tinto and at Aznalcollar, near Seville, on ores containing from 1 to 2 per cent of copper. At Aznalcollar the heaps are from 5 to 6 m. high, say about 20 ft., and are washed with about 100 gal. of mine water per minute. This carries about five grains of copper per gallon. The mine water is augmented with 75 gal. of tail water per minute from the cementation plant.

The liquors from the heap enter the cementation plant with a copper content that varies from 15 to 20 g. per gallon, according to whether an old or new part of the heap is being washed; they leave the plant with from nil to 1 g. per gallon.

LEACHING THE ORE IN THE MINE

At the Aznalcollar mines of the Seville Sulphur & Copper Co. we also practised leaching *in situ;* in other words, river water mixed sometimes with tail water from the cementation plant was allowed to run into one of the mines, and the resulting copper-sulphate solution was pumped to the surface and passed through the cementation plant, where the copper was recovered. In leaching *in situ,* care must be taken to regulate the temperature, as too much cold water may develop a chill in the interior, and temporarily stop the leaching. On the other hand, the use of too much tail water will result in foul solution, which hinders recovery in the vats and launders unless the solution from the mine is passed through a pyritic filter before entering the cementation plant. The leaching *in situ* of waste material, gob, and old workings is practicable so long as it does not interfere with mining operations, but precipitation underground, other than under exceptional conditions, should be avoided.

Where a mine has a water supply that contains copper leached from various parts of the workings, and if it is provided with a drainage system that makes it independent of pumping, interior precipitation might be adopted with profit and safety, provided there is plenty of room and the ventilation is good. When, however, the mine drainage has to be pumped to the surface and discarded, precipitation underground should be avoided; it is not efficient.

Leaching in place was also practiced at the Cronebane and Ovoca mines, in County Wicklow, Ireland, about 1880. It is worthy of note that at the latter place the operators had a monorail system for distributing the iron, which was dropped into launders on each side of the rail. This may be a digression, but it seems an easy step from heap leaching to leaching in place; and to some it would appear better to get the copper from poor workings and so to save on the mining cost.

AUSTRALIAN HEAP-LEACHING PRACTICE

For the last twenty years, the heap leaching of old coarse tailing has been carried on successfully at the Wallaroo and Moonta mines, in South Australia. The general scheme is similar to the Spanish practice, the old tailing being piled in heaps varying in height from 30 to 60 ft. and the surface being divided into 12-ft. squares, to control the distribution of the solutions. The leaching solutions, containing sulphate of iron and a little free sulphuric acid, are pumped to the surface of the heap by acid-proof Worthington compound duplex pumps. Cast-iron wood-lined pipes are used to convey the solutions, which consist of mine water and tail solutions, from the precipitating plant. These are supplemented by sea water pumped from Moonta Bay, which makes up for losses by evaporation and seepage. The copper-sulphate solution that percolates through the heap to the base is conducted by drains to earthenware pipes, and flows by gravity to the precipitating vats and canals, all the copper being precipitated on scrap iron. The tail water from this plant is returned to the heap.

About the same time that heap leaching was started at Wallaroo, I introduced it into Tasmania, and tested its possibilities on some heaps at Mount Lyell with moderate success, recovering about fifty tons of high-grade copper precipitate. The work was still in operation when I left, although not viewed with much enthusiasm, as the ore was partly chalcopyrite and partly bornite, the latter being difficult to dissolve. The climatic conditions, with a rainfall of 140 in. per annum, were far from ideal for a method that requires a certain amount of atmospheric heat and dry weather to produce good results.

In view of the success attending the heap leaching of low-grade copper ores in Spain and Australia, it occurred to me that there was a field for this method in the Southwest, and that the same success could be duplicated in part, at least, on the great tonnage of low-grade siliceous ores that had been considered worthless. In 1914 I brought the subject to the attention of the Phelps Dodge Corporation—the pioneers in so many of the recent advances made in the copper industry—and explained to several officials the possibilities of this method for the treatment of the low-grade ores belonging to the company in Arizona and New Mexico. As a result, I performed a number of small-scale tests at Douglas and Bisbee, in Arizona, and at Tyrone, in New Mexico, from which it was evident that heap leaching had every chance of success with the low-grade siliceous ores of Bisbee and Burro Mountain. The ores of the Copper Queen mines at Bisbee were particularly amenable on account of their high sulphur and iron content, about 10 and 8 per cent, respectively.

WORK ON HEAP LEACHING IN ARIZONA

Laboratory tests at Douglas and Bisbee, on Sacramento ore crushed to 8 mesh, showed that in this fine condition the ore was readily amenable to a straight percolation treatment, using a mixture of ferrous and ferric solutions and no free acid. Most of the work done at Bisbee was on low-grade material from the Sacramento orebody, as that seemed to offer the greatest possibilities on account of the plan under consideration, of mining the hill by the open-cut method; this, it was expected, would release several million tons of extremely low-grade ore, probably running about 1 per cent copper. Contemporaneously, a test on Burro Mountain ore crushed to 10 mesh and assaying 2.05 per cent copper, using a solution containing 2 per cent iron (1.60 per cent ferrous and 0.40 per cent ferric), gave, by percolation only, an extraction of 50 per cent in fifty-eight days.

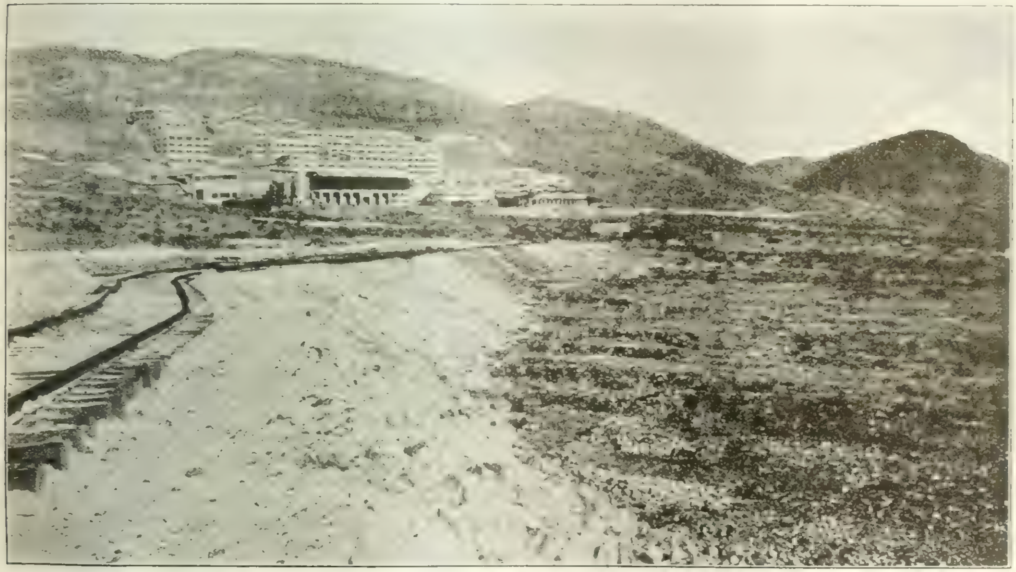
Another test on Burro Mountain ore was made at Tyrone, on a larger scale; it confirmed the probable value of this method when applied to the old waste dumps there. About ten tons of ore was placed in a vat provided with a false bottom to permit of free percolation. The ore was taken at random from the heap, large pieces being rejected, so that the charge had a chance to pack and settle, thereby making the percolation test more thorough. The ore in the vat was washed with mine liquor that contained no copper and with the following results:

Mine Liquor, Gallons	Percolation, Gallons Per Minute	Filtrate, Pounds per 1,000 Gallons	Surface Area, Square Feet	[illegible] Depth, Feet
10,000	16	7.12	50	5

	Cu, Per Cent	SiO_2, Per Cent	Fe, Per Cent	Al_2O_3, Per Cent	S, Per Cent
Ore, head	2.44	[illegible]	5.50	14.62	3.44
Ore, tail	1.75				

The results were an extraction of 28 per cent in less than a week.

Then it was resolved to test the Sacramento air-shaft dump, which had been weathering for years. Thirteen 100-lb. samples from this dump gave an average of: Cu, 1.3; SiO_2, 69; Fe, 11.2; Al_2O_3, 11.1, and S, 11.1 per cent. The rough rejects of these samples, crushed to



Leaching heap of the Phelps Dodge Corporation, Copper Queen branch

Showing track for the delivery and distribution of ore, and arrangement of culverts in foreground. Ore bins for leaching and [illegible] ore in middle distance, with Copper Queen concentrator behind.

1 in. were used for tests, which were made on lots of 200 lb. each. All tests were made with tail liquor from the cementation plant used for recovering copper from mine waters. Details follow:

(1) Two hundred pounds of rejects, 1.05 per cent copper, treated by tail liquor from the cementation plant, showed in fifteen days, by assay of the liquor, an extraction of 1.03 lb. copper, equal to 49 per cent. Residue, 0.59 per cent copper, equal to 44 per cent extraction.

(2) Two hundred pounds of rejects, 1.35 per cent copper, treated in similar manner, showed in fifteen days, by liquor assays, a 36 per cent extraction; residue, 0.86 per cent copper, equal to a 36 per cent extraction. This ore being crushed to 1 in., a good extraction was possible in a comparatively short time. Further sampling of the Sacramento air-shaft dump confirmed the estimation of copper content given above, and it was finally decided to make a large-scale test on about 10,000 tons of this ore.

The ore on the air-shaft dump had been exposed for some time. This raised the question as to whether freshly mined ore would be amenable to this treatment. Accordingly, a series of tests on freshly mined Sacramento ore was made, which resulted as follows:

DETAILS ON LEACHING FRESHLY MINED SACRAMENTO ORE

[illegible] Hundredths of 1 Per Cent Copper, Crushed to 1 In., 200 Pounds. Straight Percolation. Treated With Tail-Liquor From Cementation Plant

Extraction of copper in ten days, grains	647.55
Interval, fourteen days	
Extraction in fourteen days, grains	1,404.60
Total extraction in six weeks, grains	2,052.15
Equal to, per cent	15.5
Residue assayed 0.85 per cent = extraction, 14 per cent.	
Interval, six weeks	
Extraction in ten days, grains	1,182.00
Previous extraction, grains	2,052.15
Total extraction in three months, grains	3,234.15
Equal to, per cent	24.7
Interval, six weeks	
Extraction in nineteen days, grains	2,700.12
Previous extraction	3,234.15
Total extraction in five months, grains	5,934.27
Total extraction in five months, pounds	0.847
Original content of ore, pounds	1.88
Extraction, per cent	45

DETAILS ON LEACHING FRESHLY MINED SACRAMENTO ORE

[illegible]-Hundredths of 1 Per Cent Copper, Crushed to ½ In.; 100 Pounds Treated With Tail Liquor From Cementation Plant

Liquor, Gallons	Copper Content, Pounds per 1,000 Gallons	Actual Weight of Copper, Pounds
1.50	51.73	0.026
2.00	22.90	0.046
2.90	31.48	0.065
1.50	34.27	0.071
1.50	28.87	0.043
2.60	5.42	0.014
2.50	5.84	0.015
2.50	4.70	0.012
2.25	5.59	0.012
2.25	4.90	0.011

Total extraction of 0.347 lb. in twelve days, equals 40 per cent.

DETAILS ON LEACHING FRESHLY MINED SACRAMENTO ORE

[illegible] Hundredths of 1 Per Cent Copper, Crushed to ½ In. Six Tests Carried on Side by Side. Straight Percolation, Using Tail Liquor From Cementation Plant

Test No.	Total Gallons To Ore	Total Gallons From Ore	Copper Extracted: Lb. Per 100 Gallon	Copper Extracted: Pounds	Extraction: By Liquors As Calculated	Extraction: By Tailing Samples
1	40.0	36.75	3.35	0.123	67.5	70.0
2	37.5	30.50	3.70	0.113	55.0	71.0
3	37.5	33.40	3.65	0.122	63.2	65.0
4	37.5	34.25	3.58	0.122	66.2	60.0
5	37.5	36.75	3.15	0.116	67.8	69.0
6	37.5	36.50	3.83	0.141	74.0	70.0

Test No. 2 leached badly and liquor results can not be accepted.

Average extraction:

By liquor analyses, per cent	67.74
By tailing samples of leached ore, per cent	67.50

Special experiments demonstrated that if the liquor going on the heap was passed through a bed of sulphide ore (a pyritic filter), the leaching power of the solution was much increased, and the extraction of the copper was hastened. This is an item in a patent that has been applied for in connection with which several claims have been allowed. Some of the experimental results follow:

		Copper Per 1,000 Gallons, Lb.
A	Liquor to heap	0.27
B	Liquor from heap	1.30
A	Liquor to pyritic filter	0.27
B	Liquor from pyritic filter to heap	8.50
C	Liquor from heap	16.00

The last result is a decided improvement over the first, and proves that there is an advantage in using this method.

USE OF HIGH FERRIC-IRON LIQUORS

It was expected that, as treatment progressed, there would be a gradual increase in ferric salts coming from the heap, which would mean an increase in the consumption of iron in the cementation plant. The value of the pyritic filter to offset this is well known, but it occurred to me that something more economical might be devised, using Sacramento ore; and accordingly some experiments with liquors heavy in ferric iron were made on freshly mined Sacramento ore, crushed to ½ in. and containing 0.94 per cent copper, with the following results:

POUNDS PER 1,000 GALLONS

	Copper	Fe''	Fe'''	Acid
Liquor to Ore	3.55	0.20	31.80	38.50
Liquor from Ore 1	26.00	21.00	0.20	2.25
Liquor from Ore 2	24.00	25.00	1.25	2.20
Liquor from Ore 3	20.45	27.00	1.00	1.20
Liquor from Ore 4	21.25	27.00	2.65	2.40

The chosen site lay in the gully between the power plant and the Sacramento loading station; though not ideal, it was selected as being the most convenient. Owing to the nature of the ground, great care was taken in preparing this site; old lumber and slime were used to form a surface to prevent excessive losses of the copper liquors by seepage. The creek bed was also covered with cribbing, on which a layer of large pieces of ore and rock was placed. This creek was the main drain from the heap, serving also as the main inlet for air; other culverts or drains, nine in all and each 12 x 12 in. in the clear, were laid out, all passing from the edge of the heap to the main drain. The culverts were constructed from the large pieces of ore coming from the dump. The floor between the culverts was covered with large pieces of ore, to assist oxidation.

DETAILS OF THE TEST

The ore in the heap had in all probability been weathering from two to three years before it was moved to the site. This conclusion is deduced from the fact that the air shaft was sunk between May and August, 1912, and ore was still being dumped during 1915. There is no doubt that the heap was composed principally of the material dumped during 1913 and 1914.

We began moving ore from the air-shaft dump in October, 1916; and with few interruptions this was maintained until Jan. 31, 1917, by which date we had on the heap:

Wet Tons	Moisture Per Cent	Dry Tons	Copper as CuO, Per Cent	Total Copper, Per Cent	Copper, Pounds
9,754	2.74	9,487	0.15	1.33	252,354

The amount of copper reported as CuO was obtained from mill records, which showed that about 2,200 tons was treated.

The ore was transported to the heap in 19-cu.ft. mine cars, the contents of each of which averaged 2,086 lb.; so that after allowing for moisture there was a little over one ton dry ore per car. At the start each carload was weighed and tared. Later we weighed and tared 12 per cent of the total each day. A sample was taken from each car at the loading bins, and the whole daily sample was sent to the laboratory and assayed for copper only. Moisture samples were also taken daily. A composite sample was prepared at the end of each month, and run for general analysis, of which the following is a fair average: January, 1917: Ag, 0.12 oz.; Cu, 1.30 per cent; SO_3, 60.7 per cent; Fe, 10.5 per cent; CaO, 1.2 per cent; Al_2O_3, 12.1 per cent; S, 9.9 per cent. When complete, the heap had an average depth of nearly 20 ft., and a surface area of 12,000 sq.ft.

Leaching was started on April 2, 1917, being continued without serious interruption until Nov. 2, 1917. Treatment for the first three months consisted of intermittent washing with water from the spray. After that period all washing was with tail liquor from the cementation plant, no free acid being used. At the beginning of operations the extraction of copper was high, ranging from 10 to 20 lb. per 1,000 gallons, for the heap had been weathering for about three years. During April and May the average extraction was 9.76 lb. per 1,000 gallons, or an average of 444.75 lb. copper per day. From June 1 to Nov. 2, the average extraction was 4.73 lb. per 1,000 gallons, or an average of 269.20 lb. Thus, each week we were recovering from 0.8 to 1.0 per cent of the original copper.

	Gallons To Heap	Gallons From Heap	Pounds Copper Per 1,000 Gallon	Pounds Copper Extracted
June 1 to Nov. 2	8,670,122	8,765,155	4 73	41,458

— Pounds Copper in Heap —		Pounds Copper Extracted	Extraction Per Cent
April 2	Nov. 2		
252,354	184,211	68,143	27.00

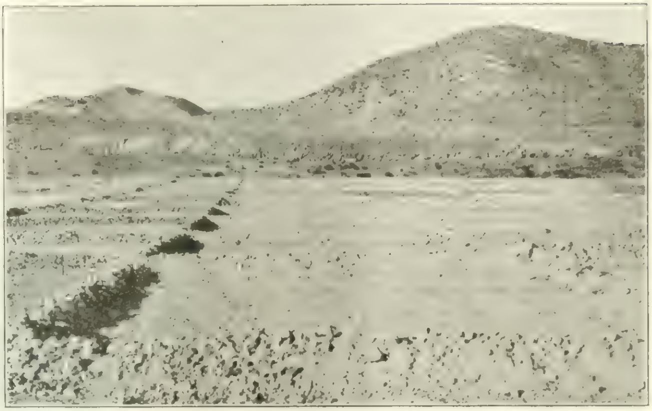
	Total Gallons	Pounds Copper Per 1,000 Gallons	Pounds Copper Extracted	Operating Cost	Cost Per Pound of Copper Extracted
April 2 to Nov 2	11,496,546	5.94	68,143	$2,301 54	3 36c

Pounds Extracted	——Recovery At —— Cementation Plant		Recovery Costs, Cents	Total Cost Per Pound On 90 Per Cent Recovery
	Per Cent	Pounds		
68,143	90	61,329	3.50	7.26c.

During the period of rest, November, 1917, the heap was sampled by a series of drill holes and pits, from which about fifty samples were taken at depths running from 3 to 18 ft. The result of this sampling showed that an average of 31.53 per cent of the copper originally in the heap had been dissolved. Copper extracted, according to liquor samples, was 27 per cent and copper extracted according to sampling of heap, 31.53 per cent. This difference may be accounted for partly by dissolved copper still in the heap, partly by loss as a result of seepage, and partly by loss as a result of floods. Leaching was resumed on Dec. 19, 1917, and maintained until March 24, 1918, thus completing one year's treatment.

SUMMARY FOR APRIL 2, 1917, TO MARCH 24 1918

Total copper, 80,810 lb.
Cost per pound copper extracted, 4c.
Cost per pound on a 90 per cent recovery, 4.45c.
Recovery cost, 4.6c.
Total cost per pound, 9.05c.
Cost of piling heap, plant, etc., $8,479.54.
Total cost, $11,719.37.
Copper extracted, 80,810 lb.
Copper recovered, 72,729 lb.
Copper in heap on April 2, 1917, 252,354 lb.; on March 25, 1918, 171,544 lb.
Extraction, 32 per cent.



Surface of the Copper Queen leaching heap, ready for operations

The heap was allowed to oxidize from April, 1918, to November, 1918, when leaching was resumed and continued until April, 1919:

	Copper, Pounds	Extraction, Per Cent	Accumulated Extraction, Per Cent
April, 1918, to April, 1919	21,486	8 52	40 60

From April, 1919, onward, leaching was intermittent, results being:

	Copper Pounds	Extraction, Per Cent	Accumulated Extraction, Per Cent
April, 1919, to June 11, 1920............	14,861	5.90	46.49

Total copper in heap:

April 2, 1917, Pounds	June, 1920, Pounds	Copper Extracted, Pounds	Extraction, Per Cent
252,854	135,197	117,657	46.5

According to the estimated amount (0.15 per cent) of CuO in the heap, there was present about 28,461 lb. of easily soluble copper; the results show that in addition to this, 88,696 lb. of copper was acted upon and extracted. Although there is no doubt that the long period of weathering to which the heap had been exposed made the copper more amenable to treatment, too much stress should not be placed on that particular feature, as proved by the results already recorded of experiments on freshly mined Sacramento ore. One feature noticeable during the second and third years of treatment was the steady increase in the amount of ferric salts, which ultimately assumed serious proportions, rising on occasions to as high as 40 lb. per 1,000 gallons of solution from the heap. This meant a decided increase in iron consumption in the cementation plant, as well as fouling of the precipitate produced. This probability had been foreseen and experiments had been made previously on strong ferric solutions. Owing to limitations of surface area we could not hope in this instance to duplicate the experimental work, but we were able to circulate and return at various times a part of those solutions high in ferric salts, and with decided advantage as shown herewith:

1919		Pounds Copper Recovered Per Day	For Period.	Days
May 24-31 straight leach only .		89 50	716	8
June 1-8 straight leach plus 33 per cent returned liquors		123 00	984	8
June 9-13	Do.	115 00	575	5
July 6-13	Do.	143 00	1,144	8
July 14-20	Do.	146 00	1,022	7
July 21-31 straight leach only . . .		76 50	689	9

These figures show the advantage to be gained by the circulation of leach liquors.

The heap was carefully sampled by a series of drill holes placed 20 ft. apart, from which samples were taken of each 3 ft. as the drill descended; 79 drill-hole samples were obtained. A pit 8 ft. in diameter was sunk near the center of the heap to a depth of 6 ft. Samples were taken on the north, south, east, and west sides, and a drill hole was sunk in the center of the pit to a depth of 9 ft., from which three more samples were taken.

By reason of a steam-shovel cut through the south end of the heap, seven 12-in. cuts were made at 10-ft. intervals, each sample representing 3 ft. of each cut, with the following results:

COPPER, PER CENT

[illegible]	2	3	4	5	6	7
[illegible]	[illegible]	0 30	0 40	0 47	0 70	0 26
[illegible]	0 45	0 43	0 42	0 68	0 29	0 22
[illegible]	0 38	0 45	0 48	0 50	0 26	0 22
	[illegible]	0 20	0 22	0 35	0 35	0 26
	0 44		0 70	0 41	0 21	....
	0 40			....	....	....

One carload of ore was removed by steam shovel and dumped on a platform, then mixed and piled evenly; three separate cuts were sampled, and assayed 0.22 per cent, 0.34 per cent, and 0.55 per cent copper, or an average of 0.37 per cent.

The following figures show averages and losses: Drill-holes (79), 0.37 per cent copper; pit samples (11), 0.31; faces exposed by steam shovels (32), 0.39; carloads removed by steam shovel (3), 0.37; general average, 0.36; average extraction according to samples, 72.93; average extraction according to daily liquor samples, 46.49; difference, 36.25 per cent. This great difference can only be accounted for by seepage and floods. A trench 1 x 1 x 10 ft., dug at the base of the face exposed by the steam-shovel cut, showed 0.85 per cent copper. Assuming that this seepage was general under the heap, it is evident that an area of 20,000 sq.ft. or, say, 1,000 tons of soil, was impregnated so that it contained 0.85 per cent copper, which denotes a loss of 17,000 lb. of copper. The following summary shows the losses:

COPPER IN HEAP 252,354 POUNDS

	Copper, Per Cent	Extraction, Pounds
[illegible]	72 93	184,041
[illegible] samples	46 49	117,157
Difference		66,884
Assumed loss by leakage, pounds		17,000
[illegible] pounds		49,884

The dump was badly situated; it caught all the drainage of that side of Sacramento Hill from the power plant up to the old machine shop, the waters from the Gardner side, as well as the water discharged from the power plant. We put in safety launders to catch ordinary drainage and leakage from these points, but could not cope with heavy floods. The total may seem to represent a large amount of copper carried away by floods, but the Rio Tinto company has been known to lose, in a single night of storm, copper valued at several thousand pounds sterling from the same cause.

IMPORTANT ASPECTS OF THE TEST WORK

Protection of Heap.—In view of the heavy losses incurred during treatment of the 10,000-ton heap, it is evident that a good layer of slime should be placed on the floor of the site, for a minimum depth of 6 in. This would obviate all losses from seepage. As to losses by floods, the heap must be protected by storm ditches, so placed that all flood-water will be carried past the heap, and away from the settler or reservoir for copper solutions.

Solubility.—It has been proved that the copper is soluble in a mixture of ferrous and ferric salts, such as may come from the mine or may be available as effluent from the cementation plant.

Penetration.—This was satisfactory, as shown by the fact that after seven months' treatment, pieces the size of an 8-in. cube taken from the 10,000-ton heap at a depth of 6 ft., and broken up, showed distinct evidence of oxidation throughout the mass, proving that the copper present in the heap, whether in fine or crushed ore or seemingly locked up in large pieces of rock, was all subject to the penetrating influence of the leaching solution.

Percolation.—This was all that could be desired; with an ore depth of 15 to 20 ft., the leaching solutions traveled from the surface through the heap and to the settling tank in 1.5 to 2 hours. This rate of percolation was maintained to the last. Of course we had the usual trouble due to the settling of basic iron salts, causing from time to time a temporary stoppage of percolation; this, however, was remedied easily by diverting the solutions for a few days and by shoveling off the mud when dry.

Saturation.—This was also good, as evidenced by the solutions seeping through the sides of the heap at a depth of 8 ft. from the surface.

From the foregoing it is evident that Sacramento mine ore can be safely piled to a height of 30 ft.; if delivered coarse enough it can be safely piled to 50 ft. Aside from the desirability of confining operations within a suitable area, there is a decided advantage in having a deep heap.

Ferric Salts.—Fouling with ferric salts is an important subject and deserves careful consideration. The accumulation increases steadily; in the third year it is likely to become a menace. The following figures showing the copper and iron salts in the liquor from the heap are instructive:

POUNDS PER 1,000 GALLONS

	Cu	Fe''	Fe'''
June 29, 1917	3.94	0.50	1.00
Nov. 1, 1917	4 81	6.33	7.33
Mar. 24, 1918	2 59	14.85	15.19
Nov. 1, 1918 (after six months' rest)	20.95	27.37	73.94
Nov. 5, 1918	9.84	22.53	26.28
Feb. 10, 1919	3.34	13.85	7.93
May 16, 1919 (after one month's rest)	3 07	7.00	17.40

INFLUENCE OF FERRIC IRON

During 1919-'20, the amount of ferric iron present varied from 15 to 20 lb. per 1,000 gallons of solution, and this in face of an ever-decreasing copper content. It is evident that if indiscriminate washing is maintained, a large amount of ferric iron in the solution from the heap will become noticeable during the second year, and it will continue to increase until it is out of proportion to the amount of copper coming from the heap. This increase in ferric salts will mean a corresponding increase in the consumption of iron in the cementation plant. This, in the third year, might amount to 5 lb. iron per pound of copper produced. With iron at 1c. per pound, this might be considered a high-water mark of inefficiency; it would certainly insure a cost of more than 6c. per pound of copper produced. The ferric iron comes from the heap or mine in the proportion of 3 of ferric to 1 of copper; it frequently goes as high as 7 to 1. In the third year, when the daily flow of solution from a heap might be expected to attain a volume of 1,500,000 gallons, the amount of ferric iron present may vary from 20 to 40 lb. per 1,000 gallons. Suppose we consider 30 lb.; this would mean 45,000 lb. of ferric iron per day, which in turn means a consumption of 22,500 lb. of iron, with no equivalent return in copper. In addition, 5,825 lb. of iron was consumed as equivalent for 6,553 lb. Thus:

$$\begin{aligned} 6{,}553 \text{ lb. copper} \times \tfrac{8}{9} &= 5{,}825 \text{ lb. iron} \\ 45{,}000 \text{ lb. ferric iron} \times \tfrac{1}{2} &= 22{,}500 \text{ lb. iron} \\ & \quad 28{,}325 \text{ lb. iron} = 4.32 \\ & \quad \text{lb. iron per pound copper.} \end{aligned}$$

But 4.32 lb. of iron at 1c. per pound means an additional cost of 4.32c. per pound of copper. To this amount must be added a further slight consumption of iron, due to sulphuric acid in the solution, and also some mechanical losses. Actual experience in Spain has demonstrated that copper can be recovered with a consumption of 1.15 to 1.50 lb. iron to 1 lb. copper. This was proved in several periods of six months' duration. In Nevada, also, copper has been recovered with a consumption of 1.15 lb. of iron to 1 lb. of copper. If due precautions are observed at Bisbee, there is no reason why the results obtained in Spain and Nevada cannot be duplicated in any work now under consideration. The first necessary steps will be seriously to consider the proposed treatment of the heap, paying particular attention to washing, and to the proper control of the ferric iron.

REDUCTION OF FERRIC SALTS

The aim should be to obtain the best product in the shortest time and at the least expense; to get the maximum amount of copper with the minimum volume of solution and as cheaply and quickly as possible. By circulating solution, or by pumping back the leach liquors from the heap to fresh ground, progress is made in the reduction of ferric salts which may be accumulating in liquors coming from portions of the heap under treatment. The return of these liquors is additionally desirable because of the increase in copper extracted per unit volume of solution; the high ferric salts are active in dissolving copper from the ore, the net result being an increase in copper extracted, with a low ferric iron content in liquor going to the cementation plant. Moreover, a powerful oxidizing agent goes to the heap, which ultimately means a quicker return. By returning liquors to the heap the efficiency may be increased up to 40 per cent, as has been demonstrated on Sacramento Hill ore.

Referring to the work done with solutions high in ferric salts, it must be borne in mind that here the returned liquor was delivered to ore that had been partly treated already, and was cold—two factors prejudicial to good results. The best results are obtained when the returned liquor can be delivered to fresh ore, or at least to dry ore.

By the proper circulation and distribution of solutions, it is possible to obtain an almost perfect liquor to send to the cementation plant. The maximum amount of copper is obtained with the minimum volume of solution, which is to be desired; for the plant should be designed to recover copper, rather than to treat immense volumes of solution that are low in copper. An increase in copper in the liquor means cement copper of higher grade, less iron consumed per pound of copper recovered, lower freight and a saving in smelting charges. Further improvements can be effected by the installation of reduction beds or filters. These filters may be made from ordinary sulphide ore (pyrite), or other reducing material.

UTILIZATION OF HEAP LEACHING ON A LARGE SCALE

The results obtained from the small pilot heap at Bisbee, and the general information derived therefrom, supplied the incentive for the large-scale operations now contemplated. Nearly 300,000 tons of ore, containing about 0.90 per cent copper, has been distributed, culverts and drains being carried on ahead of the heap and about 50 ft. in advance of the piling of the ore. A large proportion of the surface of the dump has also been laid out in 25-ft. squares in anticipation of leaching operations. This heap when complete will contain nearly 2,000,000 tons.

EFFICIENT HEAP LEACHING REQUIRES CARE AND EXPERIENCE

Although the application of heap leaching to the treatment of ores is simple, a large amount of care is required in preparing the heap. There is no necessity for crushing, as run-of-mine ore can be used throughout; pieces of 12-in. diameter come in useful for flues or culverts and for covering the floor of the heap so as to assist in the proper dissemination of air. The site for the heap should be cleared of all brush, scrub, and heavy rocks. It is sometimes advisable to put a layer of slime or mill tailing over the ground to prevent excessive loss by seepage, but this is not always necessary. After the floor has been covered with large pieces of ore, culverts (having an opening of 12 in.) are built at distances of about 25 ft., according to the depth of the heap and the coarseness of the ore. These culverts are connected with other intersecting culverts, so that the floor of the heap is exposed to direct air currents and consequent oxidation. The culverts act also as drains to convey the solution toward the precipitation plant.

To insure good oxidation, one should take into consideration the nature and character of the ore to be treated and the proposed depth of the heap. Great care must be exercised in building the heap so that the proper proportion of coarse ore is mixed with fine material to insure good percolation. The operation of the heap also calls for skill and experience; it is not merely a case of running on water and getting out copper. Indiscriminate washing is the forerunner of trouble. Leaching solutions should be distributed carefully, so that washing and percolation are always under control.

The amount of copper in the solution coming from the heap is always a good indication as to the desirability of continuing work on the section under treatment, or of changing the flow. The deposition of basic iron salts must also be taken into consideration, for the settling of these on the surface of the heap, if not checked from time to time, will interfere seriously with leaching. Treatment of the heap will last from three to five years, depending on various conditions, chemical and mechanical; as a rule, however, profitable extraction should be complete within five years. In Spain, after five years' treatment, when the copper content of the heap has been reduced to about 0.25 per cent, the leached residue, containing about 48 per cent sulphur, is shipped to England to sulphuric-acid and alkali works.

To be concluded in the May 6 issue

San Jose mine, Sierra Mojada, Coahuila

The Constancia Mining Properties in Coahuila

A Lead-Silver District With a Good Record—Product Shipped to Custom Smelters—Costs of Operation

BY S. F. SHAW

THE PROPERTIES of the Constancia Mining Co. are situated in the Sierra Mojada district, Coahuila, Mexico, at the end of the Mexican Northern R.R. which extends from Escalon, Chihuahua, to Esmeralda, Coahuila, a distance of 125 km. Another railroad is now being extended by the government from Cuatro Cienegas to Sierra Mojada, and lacks about 40 km. of reaching the latter place. This new road will afford much better facilities for freighting coal from the Sabinas coal fields and for shipping ore to the Monterrey smelters.

The district was discovered in 1878, since which time the mines have been in continuous exploitation. The principal ore mined for many years was an oxidized argentiferous lead ore, containing approximately 500 g. of silver, 20 per cent to 30 per cent lead, with considerable excess of iron over silica, and highly prized by the smelters. For many years the ore was shipped to the United States, but after a high import duty was placed on lead by the United States, it became profitable to erect smelters in Mexico to treat the ore, and the result was the creation of an important industry in Mexico. In this connection it may be remarked that the duty about to be placed on zinc ores entering the United States will probably result in the establishment of zinc smelters in Mexico, perhaps close to the coal district, thus depriving United States smelters of Mexican zinc. In all likelihood in the course of time industries for the manufacture of zinc products will be started in Mexico, permitting successful competition with the products manufactured in the United States.

No exact data are available covering the production of ores from the Sierra Mojada district, but it is probable that in excess of 3,500,000 tons of lead ore and 2,000,000 tons of copper and silver-lime ore have been shipped, yielding $10 to $15, United States currency, per ton, or a total of $55,000,000 to $80,000,000. The production from the Constancia properties alone has been probably 20 per cent to 25 per cent of this total amount.

The principal mines owned by the Constancia company are the Deonea, Esmeralda, Guadalupe, and Providencia mines, and the Tiro I and Monterrey mines have been worked under lease. The Constancia company also owns considerable interest in the Fortuna, Fronteriza, San Salvador, and other mines.

The principal rocks to be found in the Sierra Mojada district are Cretaceous limestone and a volcanic extrusive termed "agglomerate" by Garrey. Both of these rocks are covered in the valley by conglomerate, or closely cemented wash, which has been eroded from the higher elevations. The valley of the Sierra Mojada district was once occupied by the flanks of an anticline, the axis of which extended in a general east-west direction. The valley was formed by the erosion of the limestone along this axis, followed by the outpouring of volcanic material, in which in many places the angular fragments of granite and pieces of limestone can be seen. This agglomerate filled the valley and rose to a considerable height along the sides of the limestone cliffs. Erosion reduced the agglomerate to the level where it is now found, and in time there accumulated a considerable depth of conglomerate above the agglomerate, which has attained a known depth in the valley up to 500 ft. Along the contact of the lower surface of the agglomerate with the limestone a movement or slide of the agglomerate has taken place toward the valley, producing just below the agglomerate a zone of sheared or broken-up limestone, which varies from one foot to fifty feet in thickness.

The mineral solutions have arisen along a series of three known east-west fracture zones, the argentiferous lead ore having been deposited along two or three strata of limestone favorable for the reception of the solutions. These lead replacements form a bed or *manto* or *mantos*, covering a length from east to west up to 5 km. and varying in width from north to south from 100 to 175 m. The siliceous lead ore and the copper-silver ore were deposited within the sheared limestone or at its contact with the agglomerate, the sheared limestone having proved readily accessible to the solutions. Later, copper and silver dissolved by meteoric waters were precipitated at lower points in the sheared limestone and along minute fractures, thus forming the silver-lime impregnations, large tonnages of which have been mined.

Local Smelting Abandoned

In the early days of the camp, when the argentiferous lead ore was the principal or only ore produced, the Constancia company operated a lead smelter and handled a considerable tonnage, as attested by the large slag dump on the property. With the building of the railroad and reduction of smelter tariffs, the resulting lowered grade of lead ore that could be shipped, and the mining of large quantities of limestone, it was found more profitable to ship the ore to the various custom smelting plants.

There was little need for prospecting in the lead *mantos*, as it was found to be fairly easy to follow the ore. Vast tonnages of this lead ore were packed on the backs of peons from the working faces to the main haulage levels, and in many workings to the surface. Little foresight was exercised in the early days in laying out levels so that the transportation of ore could be done economically.

The so-called contact orebodies were not continuous, as were the lead *mantos;* therefore a large amount of prospecting work was necessary in finding the ore. As the contact dips from almost horizontal in a few places to 45 deg. or more in others, prospecting inclines driven were not suitable afterward for transportation of ore in mine cars; therefore the packing of ore on the backs of peons continued. Occasionally the distance for this means of transport became too great, and the mines were obliged to utilize haulage levels. At first glance at the various maps of underground workings one immediately receives the impression of an abundance of haulageways, but is soon disillusioned by a trip through the mines.

A careful study of the maps and underground workings of all of the mines in the district has brought out the fact that although the contact orebodies and silver-lime impregnations are not continuous and are apparently erratic in their occurrence, they are, nevertheless, found along certain east-west channels, and a careful plotting of the strike of these channels and the intersection with the contact will determine within close limits the position of the extensions of these orebodies. A careful search has revealed east-west striking fractures, or series of fractures, extending from the contact down into the bedded limestone under the orebodies, which fractures appear to have been the feeders of the ore deposits. By laying out haulage levels with reference to these lines or channels, the cost of handling the ore is materially reduced.

Fronteriza mine, Sierra Mojada, Coahuila

Sierra Mojada, Coahuila

Need for More Efficient Methods

Nearly all of the equipment for hoisting is of small capacity, and little thought has been given to economies in fuel and labor. The equipment at the operating mines of the Constancia company is as follows: The No. 11 shaft on the Deonea mine has a wood headframe 24½ ft. high, and Parker, Field & Mitchell 8 x 12-in. single-drum geared hoisting engine. The ore is hoisted in a 16-cu.ft. skip with ⅝-in. steel cable. Steam is generated in a Fraser and Chalmers locomotive-type boiler, which has no brick walls to produce radiation. At this shaft there are two zinc calcining furnaces, each with ten tons' capacity of crude ore in twenty-four hours.

The Zaragoza shaft of the Esmeralda mine is equipped with a Flory 8 x 12-in. single-drum, geared hoisting engine. The headframe is of wood, 23 ft. in height. The boiler is of the locomotive type.

The northeast shaft of the Esmeralda mine is equipped with an Ottumwa Iron Works 8 x 10-in. double-drum, geared hoisting engine and Fraser and Chalmers return-tubular boiler. The headframe is 34 ft. high. Ore is hoisted in a self-dumping skip of 18 cu.ft. capacity.

The headframe of the Buena Ventura shaft at the Guadalupe mine is 35 ft. high. This shaft is equipped with Flory 8 x 12-in. single-drum geared hoisting engine. Steam is generated in a Fraser and Chalmers boiler. The ore is hoisted in a 16-cu.ft. skip. The cable is one inch in diameter.

The Monterrey mine is equipped with 8 x 12-in. Fraser and Chalmers single-drum geared hoist using 1-in. steel cable. Steam is furnished by an Erie City locomotive-type boiler. The headframe is 30 ft. in height.

The Tiro I mine has an 8 x 12-in. single-drum geared hoisting engine using 1-in. steel rope. Steam is supplied from an Erie City locomotive-type boiler. The headframe is 30 ft. high. Ore is hoisted in a 16-cu.ft. skip.

Two Ingersoll-Rand Imperial Type B air compressors 10 x 16 in. and 15 x 9 in. with 12 in. stroke, each with capacity of 500 cu.ft. of free air per minute, have been purchased and are on the ground, but installation has not yet been completed.

The ore in nearly all of the mines eventually reached depths where hoisting became necessary. Mining is usually done by contract at a given price per ton delivered to the shaft. It is then hoisted and trammed to the patio, from which it is wheeled in barrows, trammed in mine cars or packed on the backs of peons to the railroad cars. In some instances the arrangements are such that the ore can be shoveled directly from the patio into the railroad cars, and at one property a bin of 600 tons' capacity has recently been built alongside the railroad track, so that the ore can be loaded directly into the cars.

No attempt is made to reduce the ore in the district. During recent years, since the mining of zinc ore began, four calcining furnaces have been built in the district, and the oxidized zinc ores, containing approximately 30 per cent Zn, have been calcined to a zinc content of approximately 40 per cent, resulting in lowered freight costs and in a higher smelter return.

COSTS OF OPERATION

Considering the ease with which the ore can be mined, strength of walls, and dryness of the mines, the operating costs in the Sierra Mojada district have been rather high. The following costs, obtained at the Esmeralda mine on a small tonnage, will illustrate this point:

Parreña calcining plant, Sierra Mojada, Coahuila

OPERATING COSTS AT THE ESMERALDA MINE IN 1911

Distribution	Costs per Metric Ton Mexican Currency (Pesos)
Development contract	0.46
Stoping	3.28
Timber	0.77
Coal...	0.05
Day's pay of men.	0.58
General expense	2.24
Taxes	0.34
Transport	0.23
Total	7.95

OPERATING COSTS AT THE ESMERALDA MINE 1919-1920

Distribution	Costs per Metric Ton Mexican Currency (Pesos) 1919	1920
Development	0.62	2.74
Stoping	5.82	7.69
Maintenance of way.	0.93	..
Hoisting	0.33	
Transport	0.62	0.02
Repairs		1.46
General expense...	3.98	7.57
Taxes	0.32	0.97
Total	12.62	20.45

The costs, especially those for 1919-1920, are excessively high, but with proper equipment, better discipline and better means for handling the ore from the stopes to the shaft, will be greatly reduced. It has been the observation of many engineers that cheap or so-called "pauper" labor does not necessarily make for low costs. This is well illustrated by the above costs and by the costs obtained in mining zinc ore from the Deonea mine during the year 1920, which were as follows:

COST FOR MINING ZINC ORE AT THE DEONEA MINE, 1920

Distribution	Cost per Metric Ton Mexican Currency (Pesos)
Development	2.24
Stoping	6.67
Maintenance of way	0.56
Transportation	0.22
General expense	5.68
Taxes.....	0.91
Total...........	16.28

The cost of calcining this ore was as follows:

Distribution	Cost per Metric Ton, Crude Ore, Mexican Currency (Pesos)
Labor. ...	1.96
Fuel......	2.12
Materials.. ..	0.12
Transport.. ..	0.61
Sampling and assaying.	0.18
Total	4.99

The gross value of this ore per metric ton, f.o.b. El Paso, with zinc averaging 8¼c. per lb., in United States currency, was 48.68 pesos.

Shipping and other charges were as follows:

	Pesos per Metric Ton
Freight to the border..	9.66
Border charges...	1.80
Mexican export duty.	1.30
Total......	12.76

This leaves a net value of 35.92 pesos per metric ton of zinc calcines, or 27.66 pesos per metric ton of crude zinc ore, or 25.08 pesos per avoirdupois ton. With mining and calcining costs amounting to 21.27 pesos per metric ton, the profit was 6.39 pesos. Costs during 1920 were at their highest point, and with lower labor cost, cheaper supplies, and increased output the costs would be greatly reduced. Even under these bettered conditions this ore cannot be shipped to the United States at a profit when zinc is selling for less than 6c., United States currency, per lb. The heavy charges in transporting the ore from the mine to the smelter absorb too great a proportion of the total value to permit a profit to be made unless the selling price of zinc is unusually high.

Recovery of Copper and Zinc by Leaching Pyrites Cinders

A method for the recovery of zinc and copper from roasted pyrites was recently described by H. Reisenegger. (*Z. angew. Chem.*, 1922, Vol. 35, p. 57; abstracted in *Journ. Soc. Chem. Ind.*) Copper is recovered by precipitation, by means of scrap iron, from the liquors obtained by leaching pyrites residues with water, either before or after a chloridizing roast. The ferrous salts in the solution are then oxidized by chlorine gas and the iron is precipitated by addition of zinc oxide, with the production of an equivalent quantity of zinc salt. Addition of ammonia results in a precipitate of zinc hydroxide, and the ammonium salts in solution are recovered for use as fertilizers.

The Trade Association and the Mining Industries

Metal Producers Partly Organized—Copper Companies Are Members of Several Trade Associations Interested in Exports, Statistics and Publicity —Business Depression Stimulates the Formation of Industrial Associations

By Felix Edgar Wormser
Assistant Editor, Engineering and Mining Journal-Press

ONLY A CURSORY EXAMINATION is necessary to show that the mining industries of the United States are not well organized as far as the individual groups of metal or mineral producers are concerned. The two most important branches, coal and iron, have trade organizations, the National Coal Association and the American Iron and Steel Institute, but non-ferrous mining and the non-metallic mineral producers have but a few scattered group representations. Copper mining, the greatest non-ferrous metal-mining industry, has no organization of national scope to consider its particular problems, but is peculiarly interested in the activities of several associations, as will be shown. The zinc producers are an exception, with their well-organized American Zinc Institute. The lead producers in the United States have each steered an independent course. Silver and gold miners have organized only locally, though often effectively.

It is true that the American Mining Congress represents almost all the mining industries, as its membership is made up of coal, copper, gold, tungsten, and other metal and mineral producers, but its range is so broad that it cannot hope to cover the interests of each industry as effectively as could individual trade associations. The American Mining Congress is more a Chamber of Commerce of the mining industries than a trade association and is well fitted to cement the various producing units of the mining industries into one large organization that is prepared to represent them in matters affecting their welfare as a whole, such as taxation and Federal legislation.

Depression a Stimulus to Organization

When an industry finds itself in some unusual predicament, when it faces difficulties which threaten its prosperity and very existence, organization is comparatively easy. Adversity has accounted for many trade associations. Thus the Copper and Brass Research Association was formed to promote the wider use of copper and brass products and to discourage the use of substitutes —admirable objects, which the copper industry, finding itself enveloped in the worst depression in its history, felt were necessary to insure its prompt and substantial recovery. If copper were selling today for 1919 prices I doubt whether the Copper and Brass Research Association would exist. Necessity is the mother of invention no less in economic than in industrial and technical affairs.

It is perhaps incorrect to say that the copper industry is unorganized, as organization has taken a different direction from that in other mineral industries. Instead of one large association capable of discharging the duties common to the group, copper producers are interested in three trade associations, all performing separate and important functions—the Copper Export Association, the Copper and Brass Research Association, and the American Bureau of Metal Statistics.

The Copper Export Association was formed solely for the purpose of selling the copper production of its members collectively to foreign customers. It took advantage of the liberalization of the Sherman Law permitting combinations of producers or manufacturers to engage in export business. Peculiarly enough, the Copper Export Association actually stifles competition among its members for export trade, as no member sells copper to a foreign customer except through the association, and as each participates on a pro-rata basis in each sale of that body. What a furore would be caused by an organization engaged in similar activities in domestic trade! The Copper Export Association is permitted by law to do that in foreign trade for which associations would be prosecuted in domestic business transactions.

Producers Attempting to Popularize Use of Copper

The second trade association in which the copper industry is interested, the Copper and Brass Research Association, does not employ extensive laboratory facilities, as its name would indicate, but attends to the publicity problems of the copper and brass industries—advertising, if you will. It is an organization for commercial research into effective publicity methods which will be of value to the entire group. It is noticeable that the Anaconda Copper Mining Co. is running an attractive series of advertisements in the New York papers directing attention to the merits of copper shingles. The Anaconda Copper Mining Co. is specifically mentioned in each advertisement and seems to be responsible for the campaign. Being the most important factor in the copper and brass trade of the country, it is powerful enough financially to undertake an independent course and benefit thereby. Its position parallels that of the New Jersey Zinc Co. in the zinc trade, whose advertisements in its own behalf popularizing the use of zinc are generally familiar to the mining industries.

Collective advertising is one of the great fields open to the trade association and is only now beginning to be used. It enables both large and small producers to profit by an intelligent and concentrated effort to enlarge the market for their product. Although large metal producers occasionally are willing to finance an advertising campaign from which smaller producers derive an indirect and sometimes direct benefit, it would seem to be more equitable to have this task performed by a representative organization of the industry rather than by the individual producer.

The third association which the copper industry aids is the American Bureau of Metal Statistics, which furnishes to producers monthly statistics of production, consumption, and stocks, thus covering one of the functions of the ordinary trade association. It supplies valuable statistical information to copper proditors promptly and efficiently, but takes great precautions that its reports do not become public. For this policy the copper producers themselves are probably responsible, but it is hardly in line with Secretary Hoover's ideas in regard to trade statistics. However, no matter how carefully this information is guarded, it is usually well known by anyone who is interested in it within a short time after it is distributed.

SEVERAL LARGE GROUPS CONTROL COPPER PRODUCTION

Through these three organizations, copper producers have been able to tackle separately three of their most important problems—export trade, the provision of promptly available statistics, and wider publicity. I know of no other metal industry so organized. However, they have no regular means of getting together for the discussion of matters not germane to activities of the three associations mentioned.

Copper producers in the United States or in the Western Hemisphere are organized into six large and financially powerful groups, with such a strong grip upon the world's production that perhaps they do not feel the need of further organization. Thus, the Hayden-Jackling-Guggenheim-Morgan group controls the Utah, Ray Consolidated, Nevada Consolidated, Chino, Chile, Braden, Kennecott, Butte & Superior, and American Smelting & Refining companies. Another, the Rockefeller-Ryan group, controls the Anaconda, Inspiration, North Butte, Utah Consolidated, and Mountain Copper companies. The Phelps Dodge, W. A. Clark, Calumet & Hecla, and Adolph Lewisohn interests are other important groups. Among all of them there is a certain amount of business rivalry and pride of organization. Each group usually has a definite sales policy for its product and is strong enough financially to carry out any of its business plans to further the welfare of its group. Nevertheless, they are all in the same boat when it comes to struggling against conditions that forced practically the entire industry to shut down. The last two years offered a splendid opportunity for the producers to organize an association that would represent them for years to come, but it has only been taken advantage of in the direction indicated above.

An American Copper Institute has much to recommend itself to the consideration of copper producers. For one thing it would give an opportunity for the members to know each other better and induce a more sympathetic attitude among them. The functions of the organizations having to do with statistics and publicity for the industry's products could be readily taken over by the new association and many others added to them. As for the Sherman Act, the present temper of the business administration in Washington and its desire to use the trade association in stabilizing business, with the strong probability that rules will be promulgated for their guidance, is an indication that the United States is emerging from a period of wastefulness to a period of intense but enlightened competition in which the trade association will play an important part. The legitimate trade association, playing with all its cards upon the table, never had anything to fear from the Sherman Act.

It may be difficult to convince some copper and other metal producers that the publication of statistical information will not jeopardize their own interest and that any fancied advantage they possess is largely illusory, but I have no doubt it will ultimately be done.

Zinc producers have a strong and well-organized trade association in the American Zinc Institute. It is one of the organizations formed as a direct outgrowth of the war conditions at the height of the conflict—July 29, 1918. No better example of the work of a trade association in the metal trades exists, and space will be devoted in another article to treat of its many accomplishments, trials, and tribulations. The zinc industry is now organized in a most thorough manner, and is adequately prepared to lend its influence upon any issue which affects the industry as a whole, be it the tariff, taxation, or transportation. Individual antagonism and the jealousy which were characteristic of some zinc producers before the war have given place to a much more wholesome spirit of "live and let live."

LEAD PRODUCERS UNORGANIZED

Individual rather than collective action has been the rule among lead producers on any issue affecting their interests. Unlike the situation in copper and zinc, no stimulus, such as overproduction or loss of markets, has encouraged the lead companies to form an association to improve their lot. The lead industry is not overbuilt; production and consumption generally strike a good balance and prices fluctuate slowly. Business has been steadier in lead than in any other non-ferrous metal during the period of deflation; and if business is good, why worry about a trade association? This seems to have been the reasoning. Another deterrent to organization is to be found in the charges that have been made against lead manufacturers' associations of maintaining prices and destroying competition.

A few lead companies in the United States control production. They are the American Smelting & Refining Co., the St. Joseph Lead Co., the U. S. Mining, Smelting, & Refining Co., the Bunker Hill & Sullivan Mining & Concentrating Co., the National Lead Co. and a few smaller producers such as the Eagle Picher, and the American Zinc, Lead & Smelting Co. Whenever any subject arises vital to their interest, individual action has been the rule. There is less reason to anticipate the formation of a lead institute than to expect the creation of any other non-ferrous metal organization. Statistics covering lead production, consumption, and stocks are gathered and distributed by the American Bureau of Metal Statistics. Fortunately for lead, the slogans "Make-it-of-lead" or "Buy-something-made-of-lead" have not had to be used in an effort to widen the market for the metal, with its excellently diversified market. Nevertheless, an unexpected predicament might conceivably suddenly involve the industry and encourage the formation of an organization to serve it. For that reason it would be well to be prepared.

LOCAL ORGANIZATIONS HAVE BEEN INFLUENTIAL

Although many local state and district associations of gold and silver producers exist, they have no national organization. The local gold and silver producers' associations have done yeoman service in promoting or opposing issues influencing their prosperity. One of them was the first to agitate for a gold bonus, a cry that was picked up and almost carried to a successful conclusion by the American Mining Congress. Other local associations have busied themselves with technical discussions, to the mutual benefit of the members and have been a splendid agency to inculcate a warm feeling of co-operation among them.

Gold and silver producers are generally uninterested in the disposal of their product beyond the mint. They have been content to let the banker concern himself with the use of the precious metal in commerce. During the war, the tremendous disorganization of prices and values presented an excellent opportunity for the study of the underlying causes of these changes, so that many a gold and silver producer is more familiar today with questions regarding exchange and premiums than he was before the war; but there is much room for further study of the gold and silver questions. The formation of an association of gold and silver producers —its title is secondary—would find a fertile field in the study of problems of the utmost importance to the restoration of sound currencies throughout the world. It could lend constructive assistance in introducing a sound metallic basis for the world's monetary systems and handle such a question as the establishment of an American silver exchange.

What will the silver producers do to meet the time, only two years hence, when the repurchase provisions of the Pittman Act will have been fulfilled? Surely that alone is a topic important enough to require the early attention of the entire silver-mining industry of the country. If the principal and minor silver producers believe the issue important enough to warrant the formation of an organization to consider their problems, they should be amply rewarded for the effort. In passing, were a silver association in existence today, would not it be an ideal means of combating the propaganda which occasionally appears seeking to repeal the Pittman Act? If no national association is formed the local bodies can continue their admirable work and they should receive support.

Trade Associations Can Accomplish Great Good in Non-Metallic Fields

When we come to the non-metallic industries, exclusive of coal, we find that those industries supplying building materials, sand, gravel, stone, and cement are fairly well organized, and in some trades too well organized, in that they have exceeded the functions of the legitimate trade association in attempting to maintain high prices, stifle competition, and indulge in other nefarious practices. Those associations have brought disfavor upon all associations, though many of them have been playing the game fairly. A few other non-metallic industries have their trade associations— the graphite, talc, phosphate, and several others, but a good opportunity exists among some of them to organize, particularly for the discussion of technical matters, in which there seems to be a lamentable secrecy.

The efficient exploitation of the non-metallic mineral resources of the United States, and the meeting of foreign competition, are partly contingent upon better technical processes, the elimination of waste, and a better understanding of marketing conditions. In some—one might say almost all—non-metallic industries a regrettable lack of standardization exists. A good method of clearing up these problems would be to organize the various units, small as they may be, into trade associations capable of acting for the entire group.

Whether the mining industries will remedy their lack of adequate organization in the near future is an interesting speculation. They have much to gain and nothing to lose by it. The tendency toward industrial co-operation as a means of effectuating an improvement in business methods is growing stronger every day. Manufacturers, to realize its advantages, have only to reflect upon the methods pursued by labor and agriculture, with their modern organizations. Magnanimity on the part of the strong producers and a sympathetic consideration of the position of the smaller ones will be required. Each will have to subordinate his own particular interest for the welfare of the entire industry, but that should not be a difficult condition to bring about, as it does not require great sacrifice.

If openly conducted, the trade association cannot help but command the respect and commendation of the American public, whose watchword in politics, athletics, and in practically every walk of life is teamwork— co-operation. Only lately has industry been applying the principles of organization, and the mining industries have played a part in the movement; but there is a good opportunity for further growth, and it is to be hoped that intensive development will follow.

Explorations in the Cuencame District, Durango

Alberto Terrones Benitez, of Durango City, Mexico, has recently been exploring near Pasaje, in the Cuencamé district, Durango. Here he found the remains of a mammoth at a place called La Cieneguita; the molar tooth with its ridged surface leaves no doubt as to the identity of the fossil. This was found close to the contact between the Quaternary formation and a conglomerate of the Upper Cretaceous. According to Mr. Terrones, it had not heretofore been considered probable that fossils of this kind could be found in this country, though subsequent investigation has shown that similar fossils have been found in the Nombre de Dios district, forty miles southeast. Exploration for more fossils is being continued. The country is said to be interesting. Great areas of level ground formed by conglomerates and limestones predominate, the latter showing schistose structure in some regions. This formation belongs to the Upper Cretaceous and has been cut at different places by extrusive volcanic flows, forming the mountain ranges where the mineralized zones have been discovered, like the Sierra de Yerbaniz (Orito mines), the Pozuelos mines, and the enormous deposits at Velardeña. Cerro Blanco, a huge mountain overlooking the country for hundreds of miles, seems to have been the focus of eruptive activity. The country around this mountain is entirely unexplored.

Comstock Lode Still Rich

Recently E. S. Bastin, of the U. S. Geological Survey, has made a microscopic study of the Comstock ores, and in his report, published as the Geological Survey's Bulletin 735-C, entitled "Bonanza ores of the Comstock Lode," he concludes that in the ores from depths greater than 500 ft., which include most of the bonanza ores of the lode, the silver is practically all in primary minerals. Descending solutions of surface origin produced a large increase in the silver content of certain ores obtained within 500 ft. or less of the surface, yet even at those depths a part of the silver is contained in primary minerals, and some rich ores taken from slight depths showed no secondary silver minerals. Gold, so far as observed, is primary in all the ores.

Although the deeper parts of the lode probably contain no orebodies comparable in size and richness to the great bonanzas of the past, the primary origin of some of the rich ores encourages deeper development.

USEFUL OPERATING IDEAS

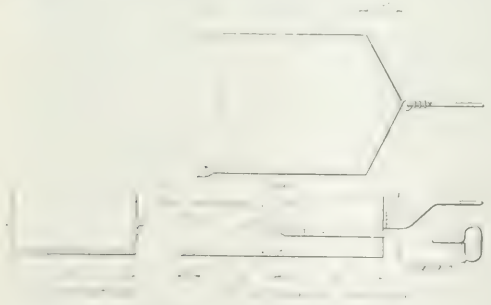
Use of Slip Scrapers in Carson Hill Mines

Cost of Spreading Stope Filling from Bottom of Finger Raises Cut About 60 Per Cent

By Frank S. Ferraris

ONE of the most important labor-saving devices ever put into successful operation along the Mother Lode was the slip scraper used in the Morgan mine of the Carson Hill Gold Mines, Inc., at Melones, Cal. The hanging-wall stopes of the mine were filled from a glory hole on the summit of Carson Hill. A series of raises connected each stope to the glory hole. This series consisted of one main raise along the foot wall in the center of the stopes and extending to the glory hole. Finger raises were run from each end of every stope intersecting this main raise.

When the filling was needed on the south end of the stope, a bulkhead would be put over the north finger raise, which would cause the filling to go to the south end. The filling was broken in the glory hole by churn-drilling 10 to 12-ft. holes in benches and blasting directly into the main raise, which allowed the filling to drop into the stopes.



Details of Carson Hill slip scraper

The foot walls of the stopes have an average pitch of about 50 deg. Much of the filling coming out of the finger raises piled up in the proper places, but the length and width of the stopes were such that it necessitated considerable hand mucking to fill the stopes so that the filling would parallel the roof of the stope. This system of filling was expensive, as high wages were paid to muckers, and labor was not only scarce but inefficient, owing to conditions incident to the war.

It was decided to experiment with a device such as the slip scraper, and one was made at the company's shops. Two Ingersoll-Rand Tugger hoists were placed on a platform made of 2-in. plank and anchored against the hanging wall by drilling two holes into the hanging wall and placing two eye-bolts in the holes. A short piece of cable was used to fasten the platform to these bolts. One of the tuggers was used for the forward pulling line and the other for the back line. Holes were drilled into the roof of the stopes and plugs inserted, to which snatch blocks were fastened for the cable to pass through. These blocks were moved whenever it became necessary to pull the filling to some other point in the stope.

The tuggers were set on the platforms so that one man could operate both of them from one position Cables ⅜ in. in diameter were used on both drums, which had a hoisting speed of 200 ft. per minute with a 90-lb. air pressure.

One man was required to handle the scraper. About half a ton of filling was moved every trip. A little difficulty was experienced at first in getting the bail fastened in the proper place. At first it was set back too close to the center, which allowed the scraper to turn over whenever it struck coarse material.

In building a scraper that is 3 ft. 2 in. in length (as shown in the illustration), it is necessary to have the bail fastened 1 ft. 4 in. back from the front end and 4 in. above the bottom. At this position it is easily dumped. A 50-lb. lift on the handle will dump the scraper when loaded.

The point or nose of scraper is the only wearing part. This is changeable and can be removed by cutting six rivets and a new point put on. The bail is made of 1-in. steel, and is 3 ft. 2 in. long. A shorter bail could be used, but if it is too short it tends to prevent the scraper from getting a full load within a distance of a few feet. The complete scraper, with its bail, weighs approximately 100 lb. if made of ¼-in. sheet steel.

With the two men which are needed to operate this scraper, about 100 tons of filling can be moved in one eight-hour shift to a distance of 50 ft. Use of the scraper has cut the filling cost about 60 per cent at this property.

Assay of Battery Chips for Gold and Silver

By John Watson

During the last two years I have often been called upon to make arbitration assays for a central reduction works on the Rand. The following notes may be useful to those who have to carry out such determinations:

The material assayed contains a miscellaneous assortment of chips from steel shoes and dies, pieces of old screening and the like from the mill, enriched often by beads of amalgam. At the reduction works, a fair average sample, taken in the presence of the vendor's representative, is ground fine enough to pass through a 10-mesh screen. The whole is then thoroughly mixed, after drying, if necessary, and portions are sealed for assay by the respective parties, who retain one or two extra parts for arbitration. If a greater difference than 5 per cent is found to exist between the assay values of buyer and seller, it is customary on the Rand to send a sample for arbitration.

The following charge will be found to give a good fusion:

Sample	½ A.T.	Borax, anhydrous	½ A.T.
Sodium carbonate	½ A.T.	Red lead	2 A.T.
Silica (free from gold or silver)	½ A.T.	Cornmeal, flour, or charcoal	1/10 A.T.

Owing to the coarseness of the sample and possible presence of amalgam, at least six different portions should be fused, and the average result reported. In weighing out the flux it saves time to weigh first six portions of ½ A. T. each or 3 A. T. of sodium carbonate and place in a clean shallow dish, following with six times the quantities given above of the other components. The whole flux is then put through a 40-mesh screen and thoroughly mixed.

In weighing out the charge 3.60 A. T. mixed flux is placed in a Wedgwood mortar, then ½ A. T. of the sample is added, the whole ground well together, then transferred to the fire-clay crucible, the mortar being cleaned out each time with a little Na_2CO_3, which can be added as a cover to the charge. About half an hour's fusion, at a fairly bright red heat, will be required, when the contents (if sufficiently fluid) may be poured into iron slag-molds, well cleaned and slightly greased. The weight of lead reduced will be of a convenient size for cupellation, in cupels of say 70 g. absorption. After cupellation, each bead of bullion is weighed, 2½ times its weight of pure assay silver added, rolled up in lead-foil and re-inquarted. The parting is carried out in nitric acid of 1.21 specific gravity, heated to boiling point or nearly so. The boiling must be continued until all silver is dissolved. In the treatment of very rich samples, it may be necessary to boil again in nitric acid of 1.31 specific gravity, though such operations are comparatively rare.

Shaft Arrangements for Hoisting

The prevailing rectangular timbered shaft is usually equipped with wooden guides. These are dressed timbers 4 x 4, 4 x 6, 6 x 6, or 6 x 8 in. in dimensions. They are three or four sets in length and are attached to the wall plates and dividers by countersunk lag-screws. Two guides are necessary in each compartment. In place of wooden guides, steel rails and iron channels are sometimes used. In shafts of circular section the guides are wooden or of wire rope. In German colliery shafts, the guides are placed at either end of the cage and have to be interrupted at the landings to permit entrance to the cage. They are exceedingly awkward in this position.

Rope guides are used in English collieries. The guide is 1⅛ to 1¼ in. in diameter and may be a locked-coil cable or a rope made of seven bars or wires. The locked-coil guide cable is made of seven large wires and an outer shell of round and lock wires. Three to four rope guides are required for each cage. The cages are given a clearance between each other of 12 to 18 in. and to prevent the possibility of their colliding, fenders are attached at the top and bottom of each cage and two guard cables placed in the shaft between the cages. The guides are attached to the headframe and hang free from all attachments in the shaft. At the bottom they are prevented from swaying by straps which hold them against buntons but leave them free to move up and down. Heavy cast-iron weights are attached to the guides and place them under sufficient tension to cause them to act like a rigid bar.

Safety catches cannot be used with metal guides, and wooden guides must be made of generous dimensions and securely fastened to make them effective. The Butte practice of placing studdles back of the guides in the shaft sets is excellent. In inclines, the skips are supported on a track fastened to the wall plates. A guard rail is not infrequently placed above the skip wheels in such a position as to prevent the skip from leaving the rails. Where this is not done, timber guides on the sides of the skip are advisable. Safety catches are occasionally seen in incline shafts, and are no doubt effective.

It was formerly the custom to equip with landing chairs all landing places in shafts used for cage hoisting, but practice has rendered them more or less obsolete except at the topmost or surface landing. When installed at levels they are an element of danger, as they may be left accidentally projecting into the shaft and be struck by the cage as it descends.

A manila or, preferably, a galvanized wire rope is installed in the corner of each compartment on the loading side of the cages. A ½- or ¾-in. manila rope or a ¼- or ⅜-in. wire rope, depending on the depth, is usually selected. It is held in place by cleats which prevent it from swaying (cleats are placed at 100 to 200 ft. intervals). The upper end is attached to a counterbalance bell crank and the vertical arm of the bell crank is attached to the wire leading to the bell. The manila-rope pull is satisfactory enough for shallow shafts, but for depths exceeding 1,500 ft. it is a clumsy device. The wire rope is efficient for much greater depths, but for depths exceeding 2,500 ft. the electrical signal system is preferable. Rope pulls are usually installed in shafts for emergency signaling purposes. Electrical signaling systems co-ordinated with lamp flashes and supplemented by a telephone have been developed, and are efficient and satisfactory for shafts of all depths.

The pneumatic whistle and bell are used in one-level shafts of moderate depth. The device can also be used from different levels, each level being similarly equipped. The installation consists of a 1½- or 2-in. pipe in each compartment. At the hoisting engine the pipe terminates in a whistle or pneumatically operated bell. At each station a short pneumatic cylinder and whistle or bell is placed. Striking the plunger of the cylinder a sharp blow with the hand sends a wave of air through the system, operating the whistles or bells. The pipe can also be used as a speaking tube. The system works satisfactorily and is used at many collieries.

Use of Spring Draw-heads in Hoisting

To reduce the shock of starting, spring draw-heads are sometimes used. In its simplest form the spring draw-head consists of a heavy coiled spring like a car spring. The draw-head extends through the spring, and a heavy plate bolted thereto compresses the spring against the main frame of the cage. Spring draw-heads are desirable, although not universally used in hoisting practice.

Wedge Fastenings for Attaching Ropes

Wedge fastenings are in use on hoisting ropes in some districts, and particularly in England and Germany. They have the advantage of providing a large contact surface, and can be readily changed when this is necessary.

THE PETROLEUM INDUSTRY

Petroleum Refineries Ran at 76 per Cent of Capacity in February—Gasoline Stocks Greatest on Record

THE 296 operative refineries in the United States ran a daily average of 1,361,000 bbl. of oil through their stills during February, 1922, this being 76 per cent of their rated daily average capacity. The daily average run for the 291 plants in operation during February, 1921, was 1,340,000 bbl. An average daily increase of 21,000 bbl. run to the stills is shown over February a year ago, according to figures compiled by H. J. Lowe, petroleum economist for the U. S. Bureau of Mines.

An increase of four plants in the number operating and a daily average increase of 42,000 bbl. in capacity is shown in the totals for the month. All figures are in gallons.

GASOLINE—COMPARATIVE STATISTICS

	February 1922	January 1922	February 1921
[illegible]	[illegible]	[illegible]	571,983,793
[illegible]	[illegible]	444,622,783	388,188,252
[illegible]	4,979,625	8,250,393	2,597,348
[illegible]	1,108,913,962	1,038,960,318	962,769,393
[illegible]	38,169,593	49,856,310	52,497,051
[illegible]	439,376	675,659	4,536,619
[illegible]	[illegible]	282,717,168	225,195,372
[illegible]	818,545,553	705,711,191	680,540,351
[illegible]	1,108,913,962	1,038,960,318	962,769,393
[illegible]	[illegible]	[illegible]	13,956,628
[illegible]	[illegible]	[illegible]	10,079,609
[illegible]	4,029,799	3,858,840	3,877,019

[illegible]

Gasoline stocks total 818,500,000 gal. and show an increase of 112,800,000 gal. over the reserve the last of January. This is the greatest reserve in the history of the industry, exceeding by 18,000,000 gal. the previous high figure set in May, 1921. At the present rate of increase in storage it is possible that the billion-gallon point may be reached in the gasoline reserve before the seasonal decline in stocks commences. The amount now in storage is 138,000,000 gal. more than on March 1 a year ago. Production during February totaled 46,000,000 gal. less than for January, but showed a 10,000-gal. increase over February a year ago.

KEROSENE—COMPARATIVE STATISTICS

	February 1922	January 1922	February 1921
[illegible]	[illegible]	[illegible]	163,081,918
[illegible]	5,972,151	5,577,972	5,824,354
[illegible]	[illegible]	[illegible]	436,045,193

Stocks of kerosene increased 5,000,000 gal. during January. Exports decreased from 81,100,000 gal. in January to 61,450,000 gal. in February.

GAS AND FUEL OIL—COMPARATIVE STATISTICS

	February 1922	January 1922	December 1921
[illegible]	[illegible]	[illegible]	865,769,078
[illegible]	[illegible]	[illegible]	27,928,035
[illegible]	1,314,740,284	[illegible]	1,331,265,439

The above table indicates a slight decrease in both output and stocks of gas and fuel oils during the last three months. Present storage, however, is 322,000,000 gal. greater than a year ago.

The daily average production of lubricating oils during February was 2,469,000 gal., this figure being an average of 71,000 gal. more per day that for January. Stocks also increased from 245,000,000 gal. to 260,000,000 gal. during the month. This figure is the highest since June, 1921, when a similar storage was attained, and lacks but 2,000,000 gal. of the high point reached in the storage of lubricating oils attained in May, 1921.

Cabinet Officials Explain Teapot Oil Lease

Replying to the Kendrick resolution for information as to details of the lease of naval petroleum reserves in California and Wyoming, Acting Secretary of Interior Finney and Secretary of the Navy Denby, in a joint letter to the Senate, explain that the action is in accordance with previous Congressional authority and that it is conducive to conservation.

They cite a provision in the naval law of 1920 which authorized the Secretary of the Navy, "to conserve, develop, use, and operate" the oil reserves "directly or by contract, lease, or otherwise, and to use, store exchange, or sell the oil and gas products thereof." They say their action is in accordance with the purposes for which the reserves were created—i. e., "not the sale of oil for commercial or other purposes, but the securing of a reserve of fuel oil for Navy purposes."

The officials point out that the contract with the Mammoth Oil Co., headed by H. F. Sinclair, covers the entire Wyoming reserve; and that royalties to the Government will be as high as 50 per cent, according to production and specific gravity of the oil. The contract calls for drilling twenty wells; the construction of a pipe line from the field to existing pipe lines in Missouri; for the exchange of crude for fuel oils, the latter for naval purposes; and for the delivery of Navy specific oil at points designated by the Navy, from Guantanomo, Cuba, to the northeast corner of the United States. It provides for a line of credit under which, in exchange for the crude oil, ample storage for the fuel oil is to be provided, without cash outlay by the Government, at any point fixed by the Navy Department along the coast described. It provides that the lessee shall at such or any other points, at its own expense and without obligation on the part of the Navy, provide gasoline, kerosene, lubricating, and cylinder oil at market prices. It provides prior right of transportation for all governmental oils from not only the Teapot (Wyoming) dome but from the Salt Creek field, even prior to the uses of the pipe line by the lessee. It makes the pipe line, when built, a common carrier for all Government oils. The pipe line already constructed, with which the new pipe line will connect, involved a present investment of $115,000,000, and this contract calls for an investment on the part of the lessee of not less than $26,000,000 additional. Furthermore, the contract will bring about immediate competition in the Salt Creek field and will add from 40c. to 60c. per barrel to the present prices of Government royalty oils, now amounting to more than 5,000 bbl. per day. This is secured by an option given the Government to sell royalty oil on basis of Mid-continent prices, if and when desired.

The production from the Salt Creek field at present is about 40 per cent of the capacity of existing wells, which will be immediately raised to 100 per cent, yielding to the Government for reclamation, state, and Treasury purposes approximately 12,000 bbl. of oil per day, with an added value thereto of from 40c. to 60c. per barrel or, in other words, that added price over and above the amount which the Government and independent producers are now receiving.

In connection with the Teapot Dome lease, attention is called to the fact that, under the terms of exchange, the Navy will secure its fuel oil at a rate 5 per cent more favorable than fuel oil has cost the Navy through a long term of years in the past. In addition, it is getting a mid-continental price in Wyoming. The prices differential has varied from 60c. to $1.25.

Kendrick Bill To Fix Wyoming Naval Oil Royalties

WASHINGTON CORRESPONDENCE

Under a bill introduced by Senator Kendrick, of Wyoming, that state will be given not less than 5 per cent royalty of all oil and gas produced from Naval Petroleum Reserve No. 3, Wyoming Reserve No. 1, known as the Teapot Dome. The royalty to the state will not be based on oil and gas used for production purposes on the reserve or unavoidably lost.

Admiral Robison, chief of the Navy Bureau of Engineering, recommended to the House Appropriations Committee that his bureau be given charge of the care and preservation of naval petroleum reserves, heretofore under direction of the Interior Department. He says this arrangement will be satisfactory to the Interior Department. He recommended appropriations of from $50,000 to $100,000 to supervise the reserves.

The Navy Department's bureau of experiment and research in investigations to reduce oil consumption is working on eliminating fouling, which it is said adds to the amount of fuel used.

Colorado Land Commissioners Encourage Oil Exploration

SPECIAL CORRESPONDENCE

The Colorado State Board of Land Commissioners is offering all possible encouragement to oil men for the exploration of state lands. Liberal concessions have been granted in allowing large areas to be attached to tracts on which drilling is being done. These concessions are made to encourage drilling on state land, with the hope of opening up an oil field, the royalties from which might greatly increase the state school fund to which all proceeds from state lands revert.

Among the wells now drilling on state lands are the Nee-No-She, midway between Eads and Lamar; the Flagler well, in Kit Carson County; the Wigwam, in El Paso County; the Midfields, in Yuma County, and the Frantz well, near Steamboat Springs.

Prospecting for Oil in Australia

SPECIAL CORRESPONDENCE

A number of discoveries of petroleum have recently been reported both in Queensland and other states of the Australian Commonwealth, but so far nothing definite has resulted. The latest report in Queensland was from the Tambo-Blackall district northwest of Roma, where distinct traces of oil were proved some time ago at a depth of 3,700 ft. The first newspaper reports of the so-called find near Tambo stated that oil had actually been found in four bores, but a government geologist who was sent out to make an examination considers that the oil present in the shales obtained from the bores has been produced from animal matter and has not migrated into those shales from a deeper source. Moreover, he is of the opinion that the geological structure of the region is not favorable to the formation of oil pools.

A report from the government analyst on a sample of slurry taken from the bore of the Queensland Oil Co., Ltd., at Woolston, near Brisbane, where operations have for some time been conducted upon the faith of a "diviner," states that this sample had a marked odor of kerosene. It contained many minute particles of black shale, which, on being collected, dried, and heated, gave off a little oil in the usual way. On a part of the sample being extracted with ether, instead of only traces of crude oil being found, as is usual, indications of a fairly clean oil were obtained, but there was not sufficient oil to determine its nature.

The federal government has expressed its readiness to co-operate with the Queensland government in boring for oil in the Roma district, subject to a favorable report from the geological experts of the Anglo-Persian Oil Co.

The task of boring past the obstruction in the Queensland Roma bore by deflecting from the old hole from a depth of about 2,500 ft. is being continued, but the work is reported to be proceeding slowly, on account of the difficult nature of the operation. It has been officially stated that if this method does not prove successful—and there seems to be every likelihood that it will not be—the petroleum gas previously discovered in this bore will be utilized for power and lighting purposes on a commercial scale, but in this connection it should be understood that the force and pressure of water in the original hole were so great that the gas could not be recovered after it had been shut off.

Both in Victoria and Western Australia government geologists have reported against the probability of oil being discovered in those states, but the companies which have taken up large prospecting areas in the hope of securing the commonwealth bonus of £50,000 are by no means content to be guided by these adverse opinions. One Victorian company holding leases in Western Australia, covering an area of 10,000 acres, and which must go on boring or forfeit them, five or six weeks ago decided to raise more capital and engage a Russian oil geologist (Captain E. de Hautpick), who was in Melbourne at the time, to examine and advise on the company's holdings. Presumably Captain de Hautpick, who is described as "a Russian scientist who has made a life-long study of matters associated with the discovery of petroleum," and who has had practical experience in both America and Russia, is now engaged in that work.

Further Prospecting for Oil In Southern Oklahoma Warranted

Geological Structure Is Complicated and Requires Careful Study — Test Wells Have Shown That Sundry Beds Are Oil Bearing

THE development of the Healdton pool, in Carter County, Okla., discovered in 1914, showed that the region between the Arbuckle and Wichita Mountains on the north and the Red River on the south undoubtedly contains great reserves of oil. The subsequent development of the Hewett and Walters fields and of a number of others of less extent proved that the Healdton was not the only highly productive pool in this region, but that it is reasonable to expect that others will be discovered. Numerous test wells scattered over Stephens, Cotton, Jefferson, Carter, and Love counties have struck oil and gas in some quantity. Many of these wells were drilled by companies whose funds were sufficient to complete only one well, so that even if a company obtained favorable showings in its single well it was unable to do further drilling, which might have found larger volumes of oil, according to a statement issued by the U. S. Geological Survey.

This region undoubtedly merits careful and thorough prospecting, but the business risk is great. The interpretation of the geologic structure by a study of the surface exposures is everywhere difficult and in many places impossible, and even where the structure can be determined approximately it may be impossible to select accurately the most favorable localities for drilling. In this connection the history of the discovery of the Healdton pool is instructive. The discovery well happened to strike the very edge of the pool, but if it had been drilled 300 ft. farther south this great pool probably would not have been opened. The development of this region has been retarded also by the nature of the beds, whose tendency to cave has caused prospectors to use rotary tools in many places and thus to increase greatly the danger that they might drill through oil-bearing sands without detecting the oil.

Wildcatting in this area should obviously be restricted, for the present at least, to territory that appears geologically more favorable than the average, and the few known geologic facts should be put to the utmost possible use. One area that merits the consideration of the oil operator lies in southern Jefferson County, in one of the bends of the Red River. It has been briefly described by Heath M. Robinson, of the U. S. Geological Survey, in Bulletin 726-F. Only a small part of the area considered in the report contains outcrops of beds that permit the determination of the structure, but such observations as could be made showed the presence of four anticlines. In his report Mr. Robinson suggests a number of locations for testing these anticlines, and other good locations may be inferred from a study of the map that is included in it. The area considered in the report is about eighteen miles southwest of the Healdton field, twenty-five miles southeast of the Walters field, and eighteen miles due east of the Petrolia field, in Texas. The beds that yield oil in the Petrolia field underlie the surface in the southern part of Jefferson County, at depths of 2,000 ft. or less, and the showings of oil obtained in the wells that have been drilled to these beds prove that they are oil bearing there.

Bituminous Shales of Western New York Are Too Low Grade for Exploitation

By Benjamin J. Hatmaker

In the course of a survey of the natural-gas fields of western New York the suggestion was made that an investigation be extended to cover the thick-bedded bituminous shales which outcrop in the Buffalo Quadrangle and in adjacent areas. This work seemed worth while, for the reason that in Kentucky the shales of the same age, the Devonic, yield commercial amounts of oil and gas. Gilbert and Pogue, in "America's Power Resources," map this region as one of the principal oil-shale areas of the United States. The five shales investigated were the Marcellus, the Middlesex, the Rhinestreet, the Hanover, and the Dunkirk. These were sampled at various points along typical outcrops and the samples assayed with an apparatus designed and recommended by the Bureau of Mines. The oil contained varied from 0.8 to 3.29 gal. per ton and an average of all the samples analyzed showed 2.36 gal. per ton.

For the purpose of checking the work and making further investigation into the amount and character of the gas yielded, a sample of 50 lb. of Marcellus shale, which showed the largest yield of gas, was shipped to the Pittsburgh Experiment Station of the Bureau of Mines. The report of this test showed these shales to yield 2,004 cu.ft. of gas, 5 lb. tar, 3.2 gal. oil, and 6.3 gal. of water, with a residue of 1,786 lb. per ton. No distillation tests were made from the small quantity of oil produced further than to determine the asphaltic character of the residue.

It is evident that the bituminous shales of western New York should be eliminated from our present fuel reserves.

Small Production From Fort Norman Well

Superintendent Jennings of the Mounted Police at Edmonton has received a report from Staff Sergeant Clay, in charge of the Fort Norman detachment dealing with oil operations. About 10 bbl. per week has been secured from the well of the Imperial Oil Co. The well will be put down deeper. The company has four drills in the field, with machinery in place—one west of Fort Norman, one at Bear Island, one on the Mackenzie River, and one a short distance from the mouth of Bluefish Creek.

The Fort Norman Oil Co. will this spring resume work on the well, put down 1,000 ft. last fall. This is situated seven miles above the Imperial company's No. 1 camp.

Oil Well Drilling in Arizona

Special Correspondence

Drilling about thirty miles northwest of Phœnix, Ariz., at a depth approximating 3,000 ft. is reported to have found oil sand, though the operations, conducted by the Tannehill interests of Bakersfield, have been with notable absence of publicity. A section of the bore has had to be cemented. The rig of the United States Oil & Refining Co., near Bowie, is being moved by a Nogales company to a new field, southwest of Tombstone, near Elgin.

Mining Engineers of Note

WALTER McDERMOTT

By Edgar P. Rathbone

FIFTY years ago the development of the mines of the American continent had hardly begun, and mining engineers of ability were scarce. Americans had to depend on some outside talent, and British engineers, with their background of centuries of mining experience, found here a fertile field for their endeavors. Walter McDermott was one of the most prominent of these. Born in London in 1851, he came to this continent twenty years later to report on some silver discoveries on the north shore of Lake Superior. He took special interest in the then famous Silver Islet mine, where he became assayer. This outcrop was just under the water-level of Lake Superior on a crag of diorite, about 70 x 80 ft., forming an islet three-quarters of a mile from the mainland. As any serious storm inundated the island, an artificial island had to be built up by wooden cribbing filled with rock blasted out on the mainland and transported by scows. A water-tight cofferdam was then built on the outcrop of the vein and a permanent shaft sunk. It is of interest to note that only recently this property has been reopened, but it is understood that the undertaking so far has been unsuccessful.

WALTER McDERMOTT

Among the other properties examined by Mr. McDermott two are worth mentioning. Several gold-bearing veins in the Jackfish Bay district were sufficiently promising to be worked for a short time. Tellurides of gold and silver were present, probably the earliest working of such ores on the American continent. The other property was also interesting as being responsible for the first American excitement about tin. A company had been formed in Detroit to develop a supposed discovery of tin made just before navigation closed. English capitalists heard of the project and suggested to Mr. McDermott that he take up claims around the discovery. With snowshoes and dog sleds, and accompanied by a surveyor and some Indians, he made the journey 150 miles east along the lake shore, where he found that some Cornish mining men from the Michigan copper country had supplied the omissions of nature by filling suitable crevices with a mixture of tinstone from the Cornish mines and tailings from the concentration mills. An Indian who had been working with the original discoverers mentioned that something was buried under the camp, and on digging, a barrel was found containing soluble silica.

The rich hand-picked Silver Islet ore, averaging 2,000 oz. per ton, was shipped during navigation to smelting works at Wyandotte, near Detroit. Experiments made at the mine by the manager, W. B. Frue, and Mr. McDermott, resulted in the joint invention of the Frue vanner. A fifty-stamp mill was then erected on the mainland, with twenty-four Frue vanners, which was highly successful. In introducing the Frue vanner, Mr. McDermott came into close relations with Messrs. Fraser & Chalmers, of Chicago. This connection resulted in his erecting and running ore-testing works in New York, and later in his appointment as managing director of Messrs. Fraser & Chalmers, Ltd., an English company which purchased the Chicago machinery business and built works in England. For several years Mr. McDermott traveled all over the Western states, examining mining properties for Detroit capitalists and purchasing lead and silver ores for the Wyandotte smelter. The purchase of two gold mines in Montana, the Penobscot and Belmont, resulted in his settling down for some time as manager of the last named.

Mr. McDermott took an active part in the formation of the Institution of Mining and Metallurgy, was president in 1898-99, and later was made a gold medalist. He has also represented the Institution on the Board of Governors of the Imperial College of Science and Technology ever since the reorganization of the Royal School of Mines, and designed and superintended the equipment of the "Bessemer" laboratory of the new school buildings, for the practical testing of ores.

Walter McDermott, with his partner the late P. W. Duffield, published a small book on "Treatment of Gold Ores" in 1890; also, a book on "Mining and Mining Investments" in 1904. He has contributed a number of papers to the *Transactions* of the Institution of Mining and Metallurgy, including one on "Mining Reports and Mine Salting," published Dec. 19, 1894.

SOCIETIES, ADDRESSES, AND REPORTS

Executives of Bureau of Mines Confer at Pittsburgh and Washington

The superintendents and principal clerks of the various experiment stations of the U. S. Bureau of Mines were in Washington during the week of April 17 to participate in a conference for the discussion of various problems of an investigative or administrative nature. The sessions, which were held in the Interior Department building, consumed the three last days of the week, and followed a three-day conference held the first part of the week at the experiment station of the Bureau of Mines at Pittsburgh, Pa.

Meeting of Bureau of Mines officials at Pittsburgh, Pa.

Dorsey A. Lyon, supervisor of stations, presided at the conference, and addresses were made by Dr. H. Foster Bain, Director of the Bureau, and the various division chiefs of the bureau.

Those present from the experiment stations included H. H. Hill, superintendent, petroleum station, Bartlesville, Okla.; O. C. Ralston, superintendent, Pacific station, Berkeley, Cal.; W. R. Crane superintendent, Southern station, Birmingham-Tuscaloosa, Ala.; R. T. Stull, superintendent, ceramic station, Columbus, Ohio; J. A. Davis, superintendent, Alaska station, Fairbanks, Alaska; C. E. Julihn, superintendent, north central station, Minneapolis, Minn.; A. C. Fieldner, superintendent, Pittsburgh station, Pittsburgh, Pa.; S. C. Lind, superintendent, rare and precious metals station, Reno, Nev.; Thomas Varley, superintendent, intermountain station, Salt Lake City, Utah; C. E. Williams, superintendent, Northwest station, Seattle, Wash.; C. E. Van Barneveld, superintendent, Southwest station, Tucson Ariz.; and J. J. Rutledge, superintendent, central district station, Urbana, Ill.

The principal clerks present were: John A. Rinehart, Bartlesville, Okla.; Mrs. Jessie Lamont, Berkeley, Cal.; Franklin Barr, Birmingham, Ala.; L. E. Geyer, Columbus, Ohio; Mrs. M. F. Gillett, Fairbanks, Alaska; Miss Susie Olson, Minneapolis, Minn.; Edward Taylor, Pittsburgh, Pa.; H. F. McCray, Reno, Nev.; Noel Hubbard, Rolla, Mo.; Albert L. Johns, St. Louis, Mo.; A. H. Clayton, Salt Lake City, Utah; Mrs. Edna S. Barrett, Seattle, Wash.; G. M. Babcock, Tucson. Ariz.; and Mrs. Mae Tulloch, Urbana. Ill.

Comptroller Urges Maintenance of Gold Basis

In the course of a public address on April 22, D. R. Crissinger, the Comptroller of the Currency, made the following statement:

"The United States continues the one first-class country that is maintaining its money system on a sound gold basis. To do this is the greatest immediate service we can do to the commercial world and to our own business. It is of the greatest importance that our currency and banking policies shall insure the maintenance of the high standard of American money in every financial center. If for a time, in order to accomplish this, the speculative interest rate shall be somewhat higher here than in some foreign markets, the ultimate results will be by no means unfortunate for our country. Better to maintain our position as the country with the soundest money system than to encourage any speculative movement which might threaten another era of inflation, and a consequent postponement of the day when the gold standard can once more be established and exchange permanently restored to its normal basis."

National Association Indicates Effective Aid to Slate Industry

To give the public greater knowledge concerning the advantages and economies in the use of slate, as well as to extend and promote the use of their product, a number of slate producers met at the Commodore Hotel, New York City, on April 20 and organized the National Slate Association.

Oliver Bowles, of the U. S. Bureau of Mines, pointed out some of the advantages that would accrue to the slate industry through the activities of such an organization. The ability to meet outside competition effectively is one of the most prominent advantages, for new competitors are constantly appearing.

W. A. Durgin, Chief of the Division of Simplified Practice of the U. S. Department of Commerce, outlined the service to industry his division was prepared to give. The report of W. H. Smith on the freight-rate situation showed that the production and marketing of slate are depressed more under a handicap of high freight costs than similar activities with regard to all other construction materials.

Sullivan W. Jones, chairman of the Structural Service Committee of the American Institute of Architects, on behalf of that body offered its co-operation to the producers of slate.

L. E. Kern, of the American Institute of Architects, also discussed co-operation among architects, producers, and the public. Mr. Couzins, of the Allied Wall Paper Industry; Mr. Darling, of *Rock Products;* Mr. Rockwood, of *National Builder;* Mr. James B. Stewart, of the New York *Times*, and several others discussed the various phases of the sound purposes of co-operative promotion of the use of materials.

The election of an executive committee to formulate an organization and the necessary details followed the unanimous decision to establish a national association. The following men were elected:

William H. Keenan, Bangor, Pa., chairman; G. H. Shinville, Fairhaven, Vt.; N. M. Male, Pen Argyl, Pa.; Roscoe C. Berlin, Slatington, Pa.; F. C. Sheldon, Granville, N. Y.; E. R. Norton, Granville, N. Y.; G. F. Barnard, Boston, Mass., vice-chairman; A. H. Morrow, treasurer, Pawlet, Vt.; W. S. Hays, secretary, Philadelphia, Pa.

The successful organization of this association is due largely to the untiring efforts, co-operation, and inspiration of Oliver Bowles, of the Bureau of Mines, who acted as presiding officer of the meeting, and also to the activities of William H. Smith, of Bangor, Pa.

MEN YOU SHOULD KNOW ABOUT

Seeley W. Mudd is in the Eastern states.

J. V. N. Dorr sailed for Europe on April 22.

H. V. Winchell and **L. W. Wickes** recently visited Randsburg, Cal.

A. H. Stebbins, of Los Angeles, was recently in Boston and New York.

A. H. Bishop and **R. H. Weir**, of Cleveland, recently visited the Gogebic Range.

W. R. Smith, of the U. S. Geological Survey, is working on an oil and gas map of Virginia.

H. C. George, of the petroleum division of the U. S. Bureau of Mines, is en route to Alaska.

Ernest Marquardt, chief geologist of the New York Oil Co., of Casper, Wyo., is in San Francisco.

L. D. Stewart, of the Ogleby, Norton & Co. staff in Ironwood, Mich., has gone to Hog Island, Philadelphia.

M. C. Lake, chief geologist for M. A. Hanna & Co., has been examining the Ashland mine at Ironwood, Mich.

F. L. Hess, of the U. S. Geological Survey, is in the field gathering data for the Division of Mineral Resources.

Frederic R. Weekes has returned to New York after a two months' trip to Venezuela on professional business.

B. B. Gottsberger has been appointed professor of mining at Yale University and is assigned to the Sheffield Scientific School.

Alfred James arrived in New York last week and will remain in this country for some time on professional business.

A. E. Fath, of the U. S. Geological Survey, has received the degree of doctor in geology from the University of Chicago.

F. E. Boyd, of Duluth is now in charge of the patent department of the U. S. Steel Corporation in the Lake Superior district.

R. J. Parker, mining engineer, who has been in the Belgian Congo for the last three years, is in New York, on his way to Denver, Col.

H. G. Ferguson and **S. H. Cathcart** are en route to Nevada to do geologic work in the Tonopah Quadrangle for the U. S. Geological Survey.

M. R. Campbell is acting as administrative geologist of the U. S. Geological Survey during the absence from Washington of **Philip S. Smith.**

M. M. Duncan, vice-president and general manager of the Cleveland-Cliffs Iron Co., has returned to Ishpeming, Mich., from an extended visit in Florida.

E. S. Henley, of New York, was in Toronto recently in connection with the purchase of two Kirkland Lake properties on behalf of New York capitalists.

A. C. Breaker, who has been examining mining properties in northern Mexico, is now in New York. He expects to leave for California in about a month.

E. L. Stenger, formerly assistant superintendent of the Mountain Copper Co., at Keswick, Cal., has joined the engineering staff of the Candelaria Mines Co.

W. L. Wimmler, of the U. S. Bureau of Mines, is in San Francisco investigating placer mining and gold dredging, particularly in Alaska, in respect to methods and costs.

Corey C. Brayton, of the American Manganese Steel Co., has returned to San Francisco from an extended trip in northwest Canada. He stopped at Edmonton, Calgary, Trail, and other points.

Dr. Charles Camsell, Canadian Deputy Minister of Mines, has been awarded the Murchison grant by the Royal Geographical Society of Great Britain, in recognition of distinguished service in exploration.

Kenneth A. G. Shearer and **Alberto Terrones Benitez** will soon undertake a survey of the Guanaceví camp, in Mexico, for the purpose of obtaining a map showing all the mining-claims, and topographical and geological features.

M. G. Edwards, assistant superintendent of the Cerro de Pasco Copper Corporation at Morococha, Peru, sailed from Peru for San Francisco on April 7. Mr. Edwards has been with this corporation in South America for the last five years.

Kurd H. Endell, professor of economic engineering at the Technical High School of Berlin, Germany, recently made an inspection of many of the open pits and underground properties on the Mesabi iron range in Minnesota and the iron-ore loading docks at Duluth and Superior.

R. C. Lane, who has been connected with the subsidiary operations of the United Verde Copper Co. for twenty years, has resigned and will go to the Pacific Coast. He was the honored guest at a dinner at Clarkdale, the host of which was **R. S. Condit**, of New York, auditor for the company.

C. M. Haight, mine superintendent of the New Jersey Zinc Co. at Franklin Furnace, N. J., on April 20 delivered a lecture on the mining methods of the company before the senior class of the Columbia University School of Mines. He was assisted by **A. G. Watt**, mine foreman, and **R. H. Seip**, safety engineer of the company.

H. A. Cardoza, vice-president of the Dives Refining & Copper Manufacturing Co., of Paris, France, was a guest recently of **J. S. Douglas, president** of the United Verde Extension Mining Co., and with him motored from Jerome to Miami, where the mill of the Inspiration Co. was inspected. Another visitor to the Inspiration plant was **M. B. Gentry** general manager of the Santiago Mining Co., an Anaconda property in the Andes back of Valparaiso, Chile. Mr. Gentry will sail soon from New York for South America.

Mining and metallurgical engineers visiting New York City last week included: **Albert L. Colby**, of Bethlehem, Pa.; **J. S. Fried**, of Pittsburgh, Pa.; **W. A. Schmidt**, of Los Angeles, Cal.; **H. W. Gillett**, of Ithaca, N. Y.; and **C. E. Van Barneveld**, of Tucson, Ariz.

SOCIETY MEETINGS ANNOUNCED

The annual meeting of the **Iron and Steel Institute** will be held at the Institution of Civil Engineers, Great George St., Westminster, London, on May 4 and 5.

The annual dinner and meeting of **The Alumni Association of the Schools of Mines, Engineering and Chemistry** of Columbia University will be held at the Columbia University Club, 4 West 43d St., New York, on May 4.

The regular monthly meeting of the New York Section of the **American Institute of Mining and Metallurgical Engineers** will be held on May 3, at the Machinery Club, New York City. **E. P. Mathewson** will give a talk on India, China, and Japan. **C. W. Van Law** will speak about Peru. Both talks will be illustrated with lantern slides.

OBITUARY

William H. Dahneke, of North San Juan, who went to Alaska a few years ago, died on March 31, in the Dawson region.

John Richards, mine superintendent of the Alaska Juneau Mining Co., died on April 10. Mr. Richards was connected with the Alaska Treadwell and other mines for more than twenty-five years. He was a former president of the Alaskan Society of Mining Engineers.

William Newton Best, president of the **W. N. Best** Furnace and Burner Corporation, died on April 11 at his home in Brooklyn, N. Y. He was in his sixty-second year. Mr. Best was born in Quincy, Ill., and had devoted the greater part of his lifetime to the invention of devices for burning oil for heat.

Henry Monell, veteran prospector and mine operator, died at Boulder, Col., on March 7. Mr. Monell was born at Bellvale, N. Y., on July 15, 1847. In 1872 he settled in Boulder, where he became interested in the local mines and in ranching. He also had mining experience in Mexico, Arizona, and the northwest.

New Books

The Commercial Side of Petroleum

The Economics of Petroleum. By Joseph E. Pogue. John Wiley & Sons, Inc., New York, 1921. $6.

This is a valuable volume, and illuminates the fundamental conditions of the petroleum industry. Twenty-nine short chapters develop succinctly the following subjects: The economic organization of the petroleum industry; the resource situation; the trend of oil production; the transportation of crude petroleum; the trend of refinery practice; the analyses of refinery capacity; the outlook for oil refining; gasoline; kerosene; fuel oil; lubricating oils; petroleum byproducts; natural gas and natural-gas gasoline; marketing of petroleum products; analyses of the exports of petroleum products; prices of petroleum and its products; relation between price and production of crude petroleum; the bearing of automotive transportation upon the oil industry; the economic significance of cracking; composite motor-fuels; the motor-fuel problem; the city-gas problem; international aspects of petroleum; Mexico as a source of petroleum; the relation of the coal industry to the oil industry; oil shale; full utilization of petroleum; and the function of statistics in the petroleum industry. The book is well illustrated and well written, and mining engineers and others who keep in touch with the petroleum industry will be interested in reading this volume and having it close at hand.

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The German Iron Industry

Die Eisen und Manganerze Osteuropas (The Iron and Manganese Ores of Eastern Europe). By George Behagel. B. G. Teubner, Leipzig, 1922. $8.

This volume is one of a series dealing with the mining and smelting of metallic ores, but the present book concerns especially the industrial problems of Germany relative to other states, with respect to iron and manganese. In the preface, the author states: "The justification, perhaps also the necessity, of the present volume, arises from the need to which Germany has been brought by the War, to survey the world market for new sources of raw materials." The author adds that, industrially, Eastern Europe is the first field to survey, as is evident "from the nature and the development of German industrial life, and from the present position of Germany relative to other states, and their relations to one another." Thus the volume deserves a place with the increasing list of works on "political and commercial geology"; and it shows clearly the current trend of German thought toward an industrial alliance with Russia.

The first part of the volume has to deal with the occurrence and mining of the ores, considered by regions, including Russia and the Caucasus, Poland, the Balkan territories, and Asia Minor. The second part considers the industrial distribution and the utilization of the ores.

The author concludes (p. 346) that the main question "Germany must keep her eye on the Russian iron ores and take an active part in their further attainment," although it will not be possible to draw from these very soon, and at the moment it is impossible. In the meantime, the author finds that the German iron-furnace industry is sure of the superfluous ores of Austria; that Czecho-Slovakia will need all her supplies for home consumption; but that Jugo-Slavia is a very important region for Germany to develop, for immediate relief. Next to Jugo-Slavia, the prospective supplies of Greece rank in importance. "But, together with the pursuing of these earlier attainable ends, must be kept in mind, now and later, when the situation clears up, the great problem of the future, which finds its solution in Russia." J. E. S.

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Petrography Up to Date

Petrographic Methods and Calculations. By Arthur Holmes. D. Van Nostrand Co., New York, 1921. $6.

This is a handbook which geologists and students of geology will be glad to add to their library, embodying, as it does, the most advanced methods and conclusions in the study of rocks. The various chapters treat of petrology, its scope, aims, and application; the specific gravity of minerals and rocks; the separation of minerals; the optical examination of crushed and detrital minerals; the examination of detrital sediments; the preparation of thin sections; microchemical and staining methods; the examination of thin sections; textures and structures of igneous and metamorphic rocks; chemical analyses and their interpretation; and the graphical representation of chemical analyses.

The author also points out that "the value and importance of petrographic methods in relation to industries have not been forgotten; and while exigencies of space have prevented more than passing reference to economical applications, I hope that these may prove sufficient to indicate to chemists, engineers, and others that the methods of work devised by the petrologist are competent to attack many of the problems with which they are faced, and are worthy of greater recognition than they have received in the past."

J. E. S.

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American Mining Congress—Vol. 25 of the *Proceedings* of the American Mining Congress is now available as a 863-page book from the American Mining Congress, Munsey Building, Washington, D. C. The volume is a report of the twenty-fourth annual convention held in Chicago last October.

Technical Papers

Industrial Research Laboratories—A list of practically all of the more important industrial research laboratories in the United States, together with the name of the chief of the research staff and the number of assistants employed, the character of work done, and the equipment, is contained in the December *Bulletin* of the National Research Council (Washington, D. C.; price, $2). The book is thoroughly cross-indexed and will prove valuable to those who have problems which they wish to solve and who desire a list of names of research laboratories where their work may be done. About seventy firms are listed which carry on investigations in the realm of metallurgy and metallography.

Magnesite in Washington—The State of Washington came to the fore in the production of magnesite during the war, when foreign supplies were cut off. Though the largest user of magnesite in the world, only about 4 per cen was produced in this country before 1914. The Washington Geological Survey has issued a most informative monograph on the entire subject, discussing the deposits of the state, the reduction of magnesite for refractory and other uses, and research work in the application of magnesite in new fields. The economic situation is also mentioned. Two bibliographies, one on the geology and occurrence of magnesite and the other covering the preparation and utilization of this mineral, are appended. The book may be obtained from the State Librarian, Olympia, Wash., for $1.

Mongolian Gold Placers—A group of gold placer claims on the Kudara, Kuitun, and Iro rivers, in Mongolia, China, are described in a twelve-page paper issued by the U. S. Department of Commerce. (Obtainable on request for Trade Information Bulletin No. 4, Far Eastern Division, from the Bureau of Foreign and Domestic Commerce, Washington, D. C.) The placers lie in an area extending about fifty miles northeast and southwest by thirty miles northwest and southeast, with the southeastern end of the area about 100 miles north of Urga, and the northeastern end ten miles from the Siberian border.

Drop Shaft Sinking—Details of the sinking of a solid timber shaft on the Cuyuna Iron Range at Woodrow, Minn., are described in an eight-page paper in the February *Bulletin* of the Canadian Institute of Mining and Metallurgy (503 Drummond Building, Montreal). The price of the separate is 25c.

Helium—The April issue of *Natural Gas* (Cincinnati; 25c.) contains an exhaustive article by R. B. Moore on the history, production, and use of this element.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

COAL stocks are decreasing faster than was anticipated. The I. C. C.'s failure to pass on freight rates is said to be hurting business.

Navigation has opened on the Great Lakes, and iron ore is beginning to move. Conditions look better, though ore prices are not yet set. Birmingham continues active.

Underground employees of the United Comstock Mines Co., in Nevada, struck recently because of proposed changes in working conditions.

Six new radio-active minerals have been determined by Professor Schoep, of the University of Ghent, Belgium.

The Hollinger company has been sued by the Northern Canada Power Co. to prevent it from developing its own power.

The Schlesinger Estate interest in the Steel & Tube Co. of America has been sold.

Mining activity in the State of Durango, Mexico, is described by Alberto Terrones in this issue.

Reorganization of the Prince Consolidated Mining Co., at Pioche, Nev., is planned.

United Comstock Co.'s Employees Go on Strike

Demand $5 Flat Scale for Underground Work and Eight Hours Collar to Collar

Workmen employed underground by the United Comstock Mines Co., in the Virginia City district, Nevada, struck on April 18, demanding a flat wage scale of $5 per day for underground work and an eight-hour day from collar to collar. Previous to April 16 underground operations had been conducted on three eight-hour shifts, muckers being paid $4.50 and miners $5 per day. On April 16, the company notified the men that one shift would be discontinued, that the half hour for lunch would be on the men's time, and that wages would be unchanged.

About 80 per cent of the men are said to be out. The company reports that underground work is several weeks ahead of surface operations, and that the latter are progressing satisfactorily.

Elko Prince Co.'s Cyanide Mill Burned

Fire destroyed the fifty-ton cyanide mill of the Elko Prince Mining Co. at Midas, Nev., early on the morning of April 11. An explosion of gasoline in the crank case of an oil engine which was being started is given as the cause. The mill was entirely destroyed, the other buildings being saved. Lee D. Dougan, resident superintendent for the Dorr Company, which manages and acts as consulting engineers for the Elko Prince, was in California at the time. Leslie L. Savage, president of the mining company, and Mr. Dougan are now at Didas.

Anaconda To Smelt Davis Daly's Ore, It Is Reported

By Telegraph to "Engineering and Mining Journal-Press."

Butte, Mont., April 24—It is unofficially reported that the Davis-Daly and Anaconda companies have concluded a contract for the treatment of the ore from the former's Colorado mine and that the mine will resume about May 1.

Butte & Superior May Settle With Minerals Separation

Conversations are understood to be under way between Minerals Separation, Ltd., and the Butte & Superior Mining Co., with the object of effecting a compromise in the accounting due.

Sues To Prevent Hollinger Developing Own Power

An attempt to block the Hollinger Consolidated Gold Mines, of Porcupine, Ont., from developing its own power on the Abitibi River has been launched by the Northern Canada Power Co. in an action entered by the last-named company for "specific performance," the performance being the signing of contracts alleged to have been agreed upon ten years ago. and which call for the supplying of "electrical energy for all the requirements of the mining company for the life of the mines." If this action is successful it will, in all probability, prevent the Hollinger from developing its own private power supply. Negotiations for that supply have been in progress for more than a year, and conferences have been held recently between Hollinger, the Abitibi Power & Paper Co., and the T. & N. O. Ry. Commission, but without resuts.

Coal Stocks Decreasing Fast as Strike Continues

Consumers Still Indifferent — Chances of National Meeting Between Miners and Operators Appear Slight

All of the initial tendencies of the coal strike were intensified further during its third week. The indifference of consumers was more marked. Unbilled coal on tracks reached a total of 1,500,000 tons on April 8, and at this writing had decreased but slightly. Coal continues to be consumed at the rate of 5,000,000 tons per week in excess of production. The country is approaching the end of its reserve at a more rapid rate than anyone had conceived to be possible. The draft on coal stocks is twice that predicted.

One of the disquieting features of the situation to the operators is the steady progress being made by representatives of the United Mine Workers in non-union territory of central Pennsylvania. The fear is expressed that the union may be able to annex this territory permanently. The additional mines which have closed in central Pennsylvania are more than offset by those which have opened in northern West Virginia, but the strategic value to the union is important.

Observers in Washington believe that if there had been any possibility of a national meeting between operators and mine workers it has been dissipated by the statement of the Attorney General. As he does not name the illegal things which he seems to believe have been taking place at former meetings. operators would probably be less inclined than ever to enter into a conference without a knowledge as to what would be regarded as illegal.

United Eastern Co. Equipping Mexican Property

In January, 1922, the United Eastern Mining Co., of Oatman, Ariz., took over a controlling interest in the El Tigre group of mining claims. They comprise sixty-three pertinencias and are situated in the municipality of Huajicori, district of Acaponeta, state of Nayarit. The property is about fifteen miles from Acaponeta, which place is situated on the line of the Southern Pacific of Mexico, about one hundred miles southeast of Mazatlan. It is practically a prospect, although the *gambusinos* have taken out a considerable amount of gold at various times. The agreement provides that the United Eastern shall complete the purchase price and provide funds for development and equipment. The funds advanced are to be repaid out of the first net profits from operation.

The final payment of the purchase price has been made, and machinery is now en route to the property for prosecuting the development, which is in charge of P. A. Wickham. This is a gold mine; as far as known, the ore contains no other metal. The vein is 5 to 8 ft. wide and averages about $20 per ton. Water and timber are abundant, and with present labor conditions it should be possible to operate economically and earn a substantial profit if the enterprise develops as anticipated.

Schlesinger Estate Interest in Steel & Tube Co. Sold

Announcement has been made of the sale to a syndicate of New York bankers of the interests of the Ferdinand Schlesinger estate in the Steel & Tube Co. of America, the Milwaukee Gas & Coke Co., the Newport Chemical Co., and other concerns. Ferdinand Schlesinger as principal owner of the Newport Mining Co. and the Anvil Mining Co. was active in developing the Newport and Anvil-Palms-Keweenaw mines. These later became the principal source of ore for the Steel & Tube Co. of America, which was formed a few years ago, and they are the largest underground iron mines in the Lake Superior district, if not in the world. It is understood that Armin A. Schlesinger, president of the Steel & Tube Co., will remain in active management, although the other heirs have sold their interests in the company.

Embargo on Quebec Asbestos Under Consideration

Efforts are being made by the Canadian Manufacturers' Association to have the Quebec government adopt legislation levying an excise tax or royalty on raw asbestos shipped to the United States. This step is being taken in retaliation for the proposal in the Fordney tariff bill to place a tariff on manufactured asbestos. Some talk of a possible embargo on raw asbestos is heard.

Newport and Anvil Iron Mines To Go on Full Time

By Telegraph to "Engineering and Mining Journal Press."

Ironwood, Mich., April 24—Operations will be conducted on full time as soon as possible at the Newport and Anvil mines, on the Gogebic Range, by the Steel & Tube Co. of America. About 900 men will be employed. Announcement to this effect has just been made by R. P. Zinn, manager of the company.

Transvaal's Gold Output Small in First Quarter

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, April 21—The Transvaal Chamber of Mines advises that the total gold production in the Transvaal from January to March was 639,728 fine ounces.

Spanish Graphite Company Seeks Loan

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, April 22—A message from Madrid states that a Spanish company Minas de Grafito de Espana, has requested a loan of 500,000 pesetas for the purpose of developing its graphite mines more vigorously than it has been doing.

Tariff on Manganese Ores Urged by Colorado Assembly

Fourteen-Fold Increase in Production Since 1914 Cited as Reason for Protection

On April 20, the Colorado Assembly passed a joint resolution calling upon the state's representatives in Congress to exert their best efforts to secure a duty of 1c. per lb. on the manganese content in all imported ores.

The resolution referred to the increase in production of high-grade manganese ore in the United States from 2,635 tons in 1914 to 305,869 tons in 1918 and a total increase of both high and low-grade ores from 100,900 tons in 1914 to 1,474,674 tons in 1918, as evidence that the manganese reserves of this country are ample and sufficient to meet all industrial needs of the country.

As worded, the resolution protesting against the placing of Colorado miners in competition with the cheap labor of China, India and Brazil reads as follows:

"Resolved: That in order to add to the revenues of the nation, to furnish adequate business to the railroads of the West, to stimulate Western mining production, and particularly that the manganese ores of the State of Colorado can be mined and furnish employment for the miners of the West, the Senators of the State of Colorado are hereby earnestly urged to exert their best effort to secure the adoption by the United States Senate of the tariff rates proposed in the Fordney Bill for the protection of the manganese industry of the West."

Six New Radio-active Minerals Determined

Occur in Specimens of Uranium Ores Found in Belgian Congo—Discovered by Professor Scheep, of Ghent

Six new uranium minerals, all of them radio-active, have been determined by Prof. Alfred Schoep, of the University of Ghent, Belgium, in specimens of ores from Kasolo, Katanga, Belgian Congo, about 30 km. south of Kambove. Preliminary notes relating to the properties of four of them have already been communicated to the Académie des Sciences, Paris. They are:

Curite, named after P. Curie, $2PbO.5UO_3.4H_2O$.

Kasolite, named after Kasolo, the place of origin, $3PbO.3UO_3.3SiO_2.4H_2O$.

Dewindtite, named after Dr. Jean De Windt, a young Belgian geologist, who died in the Congo, $4PbO.8UO_3.3P_2O_5.12H_2O$.

Stasite, named after J. S. Stas, the Belgian chemist; it has the same formula as dewindtite but is of a different class of symmetry.

The fifth and sixth minerals are, respectively, an hydrous silicate of uranium and an hydroxide of uranium. The notes on these are to be read at the Academie, in Paris, in a few weeks.

Professor Schoep prospected in the Belgian Congo for two years prior to 1913 without finding anything of special interest. But in April, 1920, he bought of Butler Brompton, in London, the specimens from Kasolo above noted.

Against Colorado & Southern's Proposal To Abandon Branch

The special examiner for the Interstate Commerce Commission who held a hearing in Denver, Col., on Feb. 2, 1922, upon the application of the Colorado & Southern R.R. for permission to abandon a twenty-nine-mile branch line extending from Buena Vista to Romley, Col., has recommended to the commission that the petition be denied.

The examiner reported that prospects for increased traffic are fairly good, and that the protests of municipalities and mining companies along the line made a sufficient showing that the operation of the road was necessary for the public convenience. The report stated that the revival of mining in the district should be sufficiently profitable to justify continuance of service.

For Lower Potash Tariff

Senator Dial, of South Carolina, has introduced an amendment to the Tariff bill decreasing the duties on potash from those carried in the bill as reported to the Senate by the Finance Committee. He proposes that the duty during the first two years of the new tariff shall be 1c. per lb., instead of 2½c. per lb.; during the third year ¾c. per lb., instead of 2c.; ½c. per lb. for the fourth year, instead of 1½c. per lb., and ½c. per lb. instead of 1c. per lb. during the fifth year. Thereafter he proposes the duty shall be removed, as is also proposed by the committee.

News from Washington

By PAUL WOOTON
Special Correspondent

Foreign Valuation Favored in Senate

Bill Said To Be So Framed as to Prevent Loss of Markets and Yet Permit Competition from Abroad

Initial discussion of the tariff bill in the Senate reveals that there is practical unanimity of opinion in that body that the ad valorem rates in the bill should be based on a valuation made in the country of origin. Sentiment in the Senate seems to be as strongly opposed to American valuation as that of the House is in favor of it. Approximately 60 per cent of the commodities covered by the dutiable list take ad valorem rates. The remainder of the articles on the dutiable list are covered by specific rates. Every effort was made by the Finance Committee to apply specific rates wherever possible. The difficulty is that specific rates are impracticable in many instances.

Many in the Senate are in favor of passing over American valuation without dignifying it by discussing the plan in the Senate. It seems probable, however, that it will be necessary to debate the whole subject, as the bill reported to the Senate provides for the application of American valuation if the President should deem it necessary.

Chairman McCumber of the Senate Finance Committee agrees that of all times in our history this is the very worst to formulate and put into effect a new traiff measure, but at the same time he declares there never has been a time when it is more necessary to protect American industry against abnormal situations abroad which give special advantage to the foreign producer. He points out that wages in Germany declined enormously immediately following the Armistice. In the other countries, he said, measured by the only stable currency in the world, the American dollar, the spread between American cost of production and foreign cost of production has been growing greater and greater. On the other hand, costs of production increased in this country until January, 1921.

In the bill which the Finance Committee has reported, Senator McCumber believes there is no rate so low that it will compel the American producer to surrender the American market to the foreign producer, if he exercises proper economy in the manufacture and marketing of his product. On the other hand, he believes, no rate is so high as to prevent reasonable foreign competition.

In Senator McCumber's opinion, the recognition in this bill of greater degree of protection for the agricultural industry will mean a great deal toward stimulating business, in that the prosperity of the farmer is radiated to all other activities. In discussing the bill in the Senate, he took occasion to rap the "back-to-the-farm" movement.

"We already are producing such a surplus of farm products," he said, "that our prices are low, yet many are preaching a policy of inducing more people to go into the farming business, thereby decreasing the number of consumers and increasing the number of producers. What a fallacy. What a short-sighted theory. What the farmer needs is the greatest number of consumers of his product. If he can make home production, even though the deficit the home consumption greater than the does not exceed 1 per cent, with the proper tariff wall, he can secure a just price for his product."

Comparisons between the present bill and the Underwood act or the Payne-Aldrich law are of little value, in the opinion of Senator McCumber. He declares his committee gave but casual attention to either of these acts. The whole industrial, commercial, and economic world has changed since those bills were enacted, he contends.

Under the bill as amended by the Finance Committee, Senator McCumber expects to see the Tariff Commission become a forum in which any complaints may be lodged as to the unfairness or the injustice of any rate. With the powers given the President, it will be possible to rectify any injustice that may be worked by reason of rapidly changing conditions.

Senator McCumber contends that two-thirds of the bread-winners in the United States have an income not greater than that which they received before the war. In many cases they are receiving less than their pre-war income. This takes into consideration the increased amounts which are being paid for rents and taxes. As nine-tenths of all American products are sold at home, he urges on manufacturers the necessity "of bringing down the production cost of their commodities until they are within the purchasng reach of American farmers and American wage-earners—a reach that cannot extend one inch beyond the limit of their earnings." He suggests that manufacturers be satisfied with the most meager returns upon their investment for a while. At the same time he urges employees to increase their efficiency to the highest possible degree. He says efficiency is being increased, but that it has not yet reached its pre-war standard. He also urges the retailer to cut his profits to the bone so as to add his contribution to the return to prosperity.

The tariff bill as reframed in the Senate is expected to yield $350,000,000 annually.

Government's Silver Purchases

Purchases of silver by the Bureau of the Mint during the week ended April 22 amounted to 103,700 fine ounces. This brings the total purchases under the Pittman Act to 103,380,308 oz.

I. C. C.'s Failure To Pass on Rates Hurting Business

Increasing Pressure Expected to Speed Up Decision—Only Four Members Have Heard Case

It has been called forcibly to the attention of the Interstate Commerce Commission that the delay in handing down a decision in the freight rate reduction case is having a serious bearing on the business situaton. It is believed that the commission has been doing all within its power to expedite the consideration for this case, and the gradually increasing pressure for an early decision is expected to accelerate the straightening out of the snarl in which the commission finds itself. There are eleven members of the commission, but only four of these heard all of the case. The leadership in the diverging opinions within the commission is thought to come from this group of four. Regardless of the pressure which is being exerted, the importance of the case is such that each commissioner is being especially careful of his ground.

Preparing for Hearings on Mine Law Revision

Final arrangements were completed early last week for the extended hearings before the Committee on Mines and Mining of the House of Representatives at which revision of the mining law will be discussed. W. R. Ingalls, the chairman of the committee that drafted the revision of laws bill which now is before the committee, was scheduled to be the first witness. He probably will be followed by Horace V. Winchell, a member of the Ingalls committee.

Shasta County Takes Appeal in Assessment Case

The County of Shasta, Cal., has appealed to the Supreme Court to reverse the decisions of the Northern District of California Court and the Circuit Court of Appeals, Ninth Circuit, which reversed valuations of the mines of the Mountain Copper Co., and the Balaklala Consolidated Copper Co. The county contends that the valuation assessment of the properties by the county authorities was proper and that the decision of the lower courts that their assessments were excessive was based on conjecture and not evidence. The county assessor valued the Mountain Copper Co. mines at $125,000, which was increased to $549,000 by the Board of Supervisors, taking as a basis 30 per cent of the gross value of the proved ores, estimated at $1,830,440. The Balaklala company's mines were assessed by the county assessor at a valuation of $180,000 which was increased by the Board of Supervisors to $327,700, also based on 30 per cent of the gross ore value.

News by Mining Districts

London Letter

Burma Corporation Shareholders Want More Information—Tharsis Passes Dividend—Wit. Deep's Report Notable

By W. A. Doman

London, April 11—A [illegible] [illegible] is heard that the head office of the Burma Corporation has been transferred from London to Rangoon. A large amount of capital has been sunk in this great undertaking, for the shares touched £14 at one time, and although there existed good reasons for taking the management on the spot, so to speak, shareholders have a feeling that they are cut off from information. To a certain extent the directors are filling the gap by the issue of quarterly reports, the first of which appeared a few days ago. This report, for the three months to Dec. 31, is interesting up to a point, but its usefulness could be increased. Shareholders receive financial details, but the technically inclined man is always keen on learning something of ore values. Possibly when the report for the first quarter of the current year makes its appearance an improvement may be shown. For the December period the estimated gross revenue was £404,600, and the estimated operating expenditure £253,733, giving a surplus of £150,867. From this must be deducted debenture interest, estimated income tax, depreciation, and capital expenditure, amounting to £97,733, leaving a balance of £53,134.

A determined effort is now being made to get the Bwana M'Kubwa on its feet. For years there has been more promise than performance, due, of course, to the refractory nature of the ore. Minerals Separation, Ltd., have come to the rescue with a new process for treatment, and they have been appointed consulting metallurgists to the new company. Above the 450 level there is a large body of oxidized and mixed oxide-sulphide copper ore, and with low-cost open-cut mining methods, profitable operations at an early date are expected. What is meant by an early date is not quite clear, for "it is intended to proceed as rapidly as sound engineering will permit to elaborate plans for the working of the oxidized portion of the mine and the construction of a plant to treat these ores by the new process, probably on a basis of not less than 1,000 tons per day." Simultaneously, the sulphide ore is to be opened up below the 450 level. The increased capital is £400,000, in 5s. shares, the new shares carrying an assessment of 2s. 6d. per share, payable in instalments of 6d.

It is certainly an event for the Tharsis Sulphur & Copper Co. (in Spain) to pass its dividend. In the course of [illegible] [illegible] it was established at the end of 1866 the company has distributed approximately £11,000,000 to its shareholders. For last year, owing to the small world demand for pyrites, on account of the great depression of trade, no dividend is to be paid. The ore raised from the Tharsis and Calañas mines was 260,758 tons, as compared with 313,918 tons in 1920, a decrease of 53,160 tons, though the mines can supply any quantity of pyrites for which a demand arises. The actual net profit was only £45,945, in contrast with £134,949 in 1920. The value of the mines in Spain, originally about £785,000, has been written down to £4[illegible],512, and the works, buildings, machinery, and plant, which cost £1,[illegible]36,772, are written down to £272,207. The stock in trade amounts to £1,039,[illegible]5, and the company has securities and cash totaling £342,485.

Whatever criticism may be leveled against the directors of the Witwatersrand Deep, who captured the company from the Central Mining Corporation, it cannot be said that they are niggardly with information as to the condition of the mine. In one sense they give a greater wealth of detail than many other and more important companies, and it is in this detail that the weakness of the position is revealed. The total revenue last year was £610,981, and the total working costs were £526,093, leaving a working profit of £84,888. It is shown, however, that of the revenue £133,077 was contributed by gold premiums, so that, apart from the premiums, there would have been an actual loss. During the current year to date, gold has fetched a lower price than last year, so that unless working costs can be substantially reduced, the profit will not be so large. One gathers, too, that large capital expenditure will be necessary in the near future at the cyanide works and boiler plant at the east shaft.

PHILIPPINE ISLANDS

Benguet Consolidated Mining Co. Shows Improvement

Antamok—In 1921, the Benguet Consolidated Mining Co. treated 40,941 tons of ore averaging $16.585 per ton, with a recovery in gold and silver bullion of $600,997.05, or $14.68 per ton, equivalent to 88.5 per cent of the contents. Gross receipts were $622,036.86, operating expenditures $259,906.03, leaving $362,130.83 gross profit, or practically $8.85 per ton. Net profit, after writing off $62,559.89 for development and depreciation and after paying $11,982.83 in bonuses, was $287,588.11 or practically [illegible] per ton. Of this profit, $[illegible]38 was spent for extensions to plant and for development and exploration. Capital distribution of $150,000 was made to stockholders. Results in 1921 showed an improvement, especially in cost of mining. Development work yielded a considerable tonnage for the mill. Supplies cost less and labor conditions were better. A slight falling off in recovery is explained as due to crowding the mill. Additions are to be made this year to remedy this. Good ore apparently continues with depth, and the company's finances are in excellent condition. Conditions are now stable.

MEXICO

Durango

Situation Quiet; Prospectors Unmolested—Activity in Santiago Papasquiaro, Cuenacame and Other Districts

By Alberto Terrones Benitez

Durango—In general, the situation in the State of Durango is quiet. Prospectors and engineers of all nationalities go about unmolested. The bandits have disappeared. The state government is doing its best to facilitate mining exploration.

Santiago Papasquiaro District—The Bacis Gold & Silver Mining Co., Ltd., has been operating uninterruptedly its mines and mill at Bacis. **W. R. Bewder** is superintendent. Large quantities of milling ore have been treated at the concentrating-cyaniding plant. On an average the company is exporting thirty-five bars of bullion monthly, through Juan Leautaud's firm, of Durango City, the only firm doing banking business in Durango for all important mining companies. As soon as the mill capacity is increased, this production will be increased to forty-five or fifty bars of bullion per month.

The Sauces Mines & Milling Co. is still operating at Sauces, near the Tepehuanes railway terminal. L. H. Siegler is the manager. The company is shipping ores to the Asarco smelter of the American Smelting & Refining Company.

The Santa Cruz Mining Co., operating the Santa Cruz y Anexas mines, near Otaez, has just finished its new 25-ton concentration-flotation mill, originally designed by the Mine & Smelter Supply Co. **S. W. Loving**, general manager, has recently gone to the mine to take charge of operations. The principal offices of this company are at Beeville, Tex.

George Stinson has been in San Andres de la Sierra, his purpose being to erect a modern smelter in place of the old one. Lead-silver ores are abundant in this camp.

Lino Rodriguez e Hijos have decided to sell their Prieta mine at the Huajupa camp. A party of American engineers went to examine the property.

Max Damm has personally taken charge of operations at the Promontorio mine. This company has recently been treating the dumps and the mill ores extracted from the upper levels (above the water level) using the mill, which has been adapted for flotation. Ores and concentrates are being shipped to Asarco.

Durango District—Open-cut operations at the Cerro de Mercado have been continued under the direction of Manuel Rangel. Ore is being shipped to the Monterrey smelter of the Cia. Fundidora de Fierro y Acero de Monterrey, owner of the part of the Iron Mountain that is being exploited. The operator's have just partly suspended work on account of the large tonnage of ore on hand, as they have extracted more than they can ship.

A prospector by the name of Hosmer has recently been studying the Coneto and the Potrillos camps. The former produces lead silver ores and the latter is in the stream-tin country. These camps are now abandoned and should be important places for exploration. The bandits have now disappeared.

The Avino Mines Ltd., which owns mines at Avino, has been working recently on a small scale and is shipping ores to Asarco. Its mill is being rebuilt. Gerald E. Norton is in charge.

Dr. T. E. Moore, Joseph B. Crawford, George D. Wolfe, Howard Foster, and "Billy" Brown, recently went to the Pueblo Nuevo country to check up some mining properties near Pueblo Nuevo for a Texas syndicate. Dr. Moore and Mr. Crawford have since returned to Fort Worth, the rest of the party remaining in Pueblo Nuevo to finish the examination.

The Guadalupe Mining Co., operating in Pueblo Nuevo and owner of the Guadalupe mine, is getting ready to start work. The La Cruz-Providencia Mining Co. has also begun the extraction of small quantities of high-grade ores. It is rebuilding its mill, at which the ratio of concentration is 20 to 1. Ore below 5 kg. silver per ton is mill ore; the rest is shipped direct. Freighting is done on mule-back to El Salto, the nearest railway station on the Durango-Mazatlán line, at the rate of 70 pesos per ton. Gerald E. Norton is president of both companies.

Nombre de Dios District—The Parrilla camp, where the Vacas Mining & Exploration Co. worked for so many years, still remains idle. Negotiations have been recently started to revive this camp. The company is represented by F. MacCaughan.

Enrique Nájera has acquired a large extent of mining claims at the Sacrificio Mountain and plans to erect a smelter for the Sacrificio ores.

Mapimi and Lerdo Districts—For reasons of economy the Cía. Minera de Peñoles decided to move its Peñoles smelter to Torreón. It is working its mines at Ojuela. Heath Steele is general manager.

J. W. Deland, manager of the Pasadena Oil Crown Co., has started negotiations to lease some oil lands in the Lerdo district. Explorations for oil have been already started under the direction of Roy A. Reynolds, and traces of oil have been found at a place called Goma, near San Carlos Station. The exploration work is still going on.

Cuencamé District—Senator Severino Ceniceros has resumed work at his smelter near Cuencamé. He has been smelting ore from the Pozuelos lead-silver mines.

The Asarco smelter and the Velardeña mill and mines of the American Smelting & Refining Co. have again resumed. At Asarco they have blown in two furnaces. As the ores produced in the camps tributary to the Asarco smelter have been scarce, the smelter could not run at capacity.

Chihuahua

Erupcion Mining Co.'s Ore Deposit Interesting

The properties of the Erupcion Mining Co. and the Ahumada Lead Co. are situated in Los Lamentos mountains, about forty miles east of Villa Ahumada. The values consist of lead carbonates carrying silver; also, zinc carbonates which are formed in separate bodies and carry neither lead nor silver. The peculiarity of this deposit is that it averages much higher in lead than any other similar large deposit in this section of the country. The ore follows the bedding planes in limestone which has an average dip of about 17 deg. The main extraction and development tunnel has a length of 2,200 ft.

Development done in 1921 totaled 5,039 ft. The Marjorie, or main extraction tunnel was completed last year to the property line, a distance of 2,235 ft. At this point a winze was started, and after a cave was broken into at 156 ft. the ore was found at the bottom. The cave extends 84 ft. north of the Erupcion line and about 50 ft. back into the company property. The ore disclosed is an high-grade anglesite. The winze was sunk to 204 ft. following a pipe of low-grade iron ore and a small *manta* 5 ft. thick was discovered. This appeared to have its own cave system. The ore was somewhat different from the Erupcion, being mixed with high-grade lead carbonate and running higher in silver. Further development was impossible owing to the mine closing down.

A broad-gage railroad is being built to connect this property with the Mexican National line at Lucero, a total distance of forty-eight miles. The grading has been completed and the company expects to complete the construction within the next few months and to be shipping ore by early fall. The road is being built jointly by the Erupcion and Ahumada companies.

CANADA

Ontario

Conditions in April—Kerr Lake to Start Work on Goldale Property

Conditions at Sudbury remain practically unchanged, but prospects for resumption of operations look brighter. The British America Nickel Corporation has allowed practically all remaining members of its staff to go.

At Cobalt, the production in April was somewhat lower on account of the closing down of the Bailey and Silver Cliff properties and the interruptions due to floods. The spring freshets were exceptionally severe, and the Princess mine was completely flooded; the Kendall shaft of the Nipissing was partly flooded, and the O'Brien mill forced to close. Nipissing and La Rose paid dividends. O'Brien bought Bonsall property in Gowganda.

Kirkland's output continues to increase, the Tough-Oakes mill being started. Rich ore was found on the lower levels of the Wright-Hargraves. The amalgamation of the Ontario and Montreal Kirkland was completed.

Porcupine should show slight increase on account of increased power available. The recent floods will provide plenty of power for present demands.

Labor is still plentiful and efficient, with fewer men unemployed.

Cobalt—Nipissing has stopped work once more on the Rochester property at Porcupine, supposedly while assaying catches up with diamond drilling. The company's option on this property expires in June, but no official announcement has been made as to the management's attitude in this connection.

The gross earnings of the Bailey custom mill for March were approximately $14,936.52. The mill treated 4,978 tons of ore, the Bailey mine supplying 650 tons.

According to a statement by F. L. Culver, at the annual meeting of the Beaver Mines, the present low price of silver, labor conditions, and the slump in the demand of silver do not warrant the reopening of the Beaver mine at present. He stated, however, that as soon as the price of silver was such that operations could be carried on with a fair profit, the mine would be reopened.

Developments at the Castle-Trethewey, at Gowganda, continue satisfactory. The high-grade is running up to 3 in. wide of 3,000 to 4,000-oz. ore. There is a possibility that this is an entirely new strike, but the management is assuming that it is the downward extension of the rich vein cut in the shaft at the 185 level.

The shaft at the Victory Silver Mines is down a little over 400 ft. and will be continued another 50 or 75 ft. before a station is cut and a new level opened up, which will be in the course of about a month.

Two veins were cut on the Silverado property, adjoining the Hudson Bay property at Gowganda, while driving to the No. 1 vein on the 200 level, the first vein showing a width of 4 in. and the second vein a width of 7 in. The property has a crew of about twenty-five men working, and two drills are in operation.

Kirkland—The annual report of the Kirkland Gold states that although the mill was not run at capacity, owing to the fact that so much ore was tied up on account of the possible rock slide, 25,717 tons of ore was treated, giving a production of $147,654.83 in gold bullion for the year.

At a meeting of the Hunton Kirkland shareholders, held April 19, the merger of the Hunton and Minaker Kirkland companies was ratified.

Porcupine—Work is to be started at once by Kerr Lake on the Goldale property, lying south of the Plenaurum property. This is one of the groups totaling fifty claims that the Kerr Lake company has under option in the Porcupine district. No other development or exploration work will be carried on by the company in this district until summer.

Schreiber—Much attention has lately been directed to the gold deposits [illegible] found in the town of Schreiber, in the Port Arthur district, where options were taken by Toronto interests on the [illegible] Jackson and McKellar-Longworth properties, which are stated to have shown up well as far as developed. A large number of prospectors have gone in, and much staking is being done.

Ottawa—The Canadian government, in anticipation of a rush of gold and oil prospectors early in the season, is preparing for extensive surveys in the Northwest. A survey party, including B. H. Segree, A. H. Miller, and A. H. Swinburn, is leaving Edmonton for the Mackenzie River district. One of the most important objects in view is the locating of a point on the sixtieth parallel where it crosses the Liard River from which other lines can be run so that if a strike of gold is made on the Liard and tributary streams it can be determined whether the claims lie in British Columbia, the Yukon, or the Mackenzie River district, as all three converge at this point. A number of surveys will also be made in the Great Slave Lake area.

British Columbia

Increase of Cork-Province Capitalization Proposed—Hedley Gold Resumes

Rossland—Possibility of a coke shortage in the future as a result of the coal strike in the Crow's Nest Pass region is reflected in some curtailment of local operations of Consolidated Mining & Smelting Co. Some of the men laid off have found employment with the company at Kimberley and Trail.

Hope for a solution of the transportation problem affecting the Velvet mine is held forth in the possibility that lumbering interests may arrange with the Great Northern Ry. to operate on their own account the abandoned Red Mountain line, between Rossland and Northport.

Kaslo—Legal details in connection with a plan for refinancing the Cork-Province Mines, owning a silver-lead property on the South Fork of Kaslo Creek, are being worked out. It is planned to increase the capitalization of the company from 1,250.000 shares to 1,500,000, and bonds will be issued in the amount of $75,000. A part of the bond issue will go to creditors of the company, retiring indebtedness, and the remainder will provide the capital required for development work to place the mine in a position to produce a regular tonnage.

Trail—Ore received by the Trail smelter of the Consolidated Mining & Smelting Co. from April 8 to April 14 totaled 8.089 tons, of which 7,927 tons came from the company's mines. The No. 1 mine at Ainsworth shipped 78 tons and the Silversmith at Sandon 84.

Hedley—Work has been resumed at the Nickel Plate mine by the Hedley Gold Mining Co.

ARIZONA

Arizona & Swansea Plea Denied—C. & A. Board Re-elected—Shannon Co. Abandons Yaeger Canyon Mine

By James H. McClintock

Phoenix — United States Judge Maurice Dooling, at Tuscon, has signed a judgment that gives Hoval A. Smith only $145,775.01 from Henry B. Hovland, something less than $900,000 under the findings of E. F. Jones, master. Exception was taken to the decree by both parties. The decision commands that all the business of the Smith-Hovland partnership be wound up at once, and the court retains jurisdiction until this has been accomplished.

Charges against M. T. Frasier and George Mitchell in connection with the affairs of the Jerome Superior Copper Co. have been dismissed.

The Arizona Corporation Commission has denied the application of the Arizona & Swansea R.R. Co. for permission to abandon and dismantle its twenty-one-mile road from Bouse to Swansea, in northern Yuma County, Ariz. The only prospective patron is the Swansea Lease, which is preparing to ship ore to Humboldt. The railroad is delinquent for $5,745 taxes, for which the state has entered suit in Yuma.

In Mohave County, executions have been taken against the Midway-Moss Mining Co., the McCracken Silver Lead Mining Co., and the Nevada-Arizona Mines Co., with sheriff's sales advertised.

Globe—Only one furnace of the Old Dominion smelter is to be operated for the present, according to W. G. McBride, general manager. A few additional men have been employed, the smelter being worked mainly by men transferred from other departments. Production will be about 800,000 lb. per month.

The new stack of the Inspiration power house, erected eighteen months ago, has been put into use.

Superior & Boston, in developing the Rigby vein, has drifted 500 ft. on the 400 level. For the last 80 ft. the ore has averaged 10 per cent copper and 23 oz. silver, for the drift width of 4 ft. The same vein is being opened on the 600 level. Rich small lenses occasionally are struck.

Bisbee—At the annual meeting of the Calumet & Arizona Mining Co., the old board was re-elected; also the old board of the New Cornelia. It is denied that the company has abandoned hope of finding ore in the Gadsden property in the Jerome district. Thus far no decision has been reached as to the inclusion of the Shea property in the C. & A. development work at Jerome.

Ore production is increasing, as high as sixty-eight carloads a day being sent to the Douglas smelters.

Hayden—Smelting is to be resumed at Hayden about May 1, and the copper stack of the El Paso smelter is to be blown in at the same time. Most of the work of the Hayden plant is in handling Ray concentrates.

Prescott—The Yaeger Canyon mine, between Prescott and Jerome, has been abandoned. The pumps have been pulled, and the mechanical equipment is being sold. For about six years the property has been under development by the Shannon Copper Co., it being one of the two Arizona mines retained by that corporation. A. L. Ferris, who has been in charge, will go to new work in Mexico, for the Shannon interests.

NEVADA

Rochester Silver's Reserves Increasing—Simon Mine's Orebody Found on 450 Level

From Our Special Correspondent

Rochester—The March output of the Rochester Silver Corporation was 5,033 tons of ore, with a gross yield of $50,000. Mine conditions are said to be excellent, with ore reserves growing. On the 250 level south the south drift on the Springer vein is in ore of good grade, with virgin territory below and for 250 ft. to the south. An old tunnel, 50 ft. lower than the 250 level, is being advanced and should cut the vein within 60 ft.

Mina—The main orebody in the Simon Silver-Lead mine has been found on the 450 intermediate level. The ore is stated to be 12 ft. wide, 8 ft. being above milling grade and 4 ft. high grade.

Tonopah—The Tonopah Belmont Development Co. has taken over a part of the Buckeye Belmont ground on lease and option, and is repairing the 1,200-ft. vertical shaft of the latter company preparatory to starting underground work. The Buckeye property is well situated, being bounded by the Halifax on the north and the Belmont and Rescue on the west and northwest, but no commercial ore has ever been discovered in its ground. Limited development work has been done on the 900 and 1,200 levels, but the property has been closed down for several years, owing to lack of money. It is reported that the ore recently discovered on the 1,200 level of the Midway mine continues to show commercial values in the drifts, although not so high as at first reported.

Divide—Tonopah Divide's March production was 1,841 tons, average value being $35.19 per ton. Net returns, after deducting losses and milling costs, were $47,000. This is a record monthly production for the company. The Gold Zone is developing a promising orebody above the 600 level and has started shipments to the Belmont mill at Tonopah.

Pioche—The property of the Home-Run Copper Co. was purchased last week by the Bristol Silver Mines Co. for cash. The claims adjoin the Bristol and have produced a large tonnage.

The directors of the Prince Consolidated plan to reorganize in Utah, making the stock assessable, and later to levy an assessment of 10c. per share. With these funds, the mine will be further equipped and developed. Indebtedness approximately totals $43,000.

CALIFORNIA

W. J. Loring Takes Bond on M. C. Meeker Claims—Hydraulic Mining Active in North

San Francisco Correspondence

San Francisco—The bonding of a new group of mining claims between the Carson Hill group and Melones and Angels Camp by W. J. Loring is of considerable interest to Mother Lode miners. The claims are owned by the heirs of M. C. Meeker. Their acquisition by Loring gives him in a single unit a length of the Mother Lode variously estimated at about seven miles. The bond is a working bond to run for three years and allows considerable discretion to Mr. Loring in the amount and distribution of the work. The stipulated price, if the bond is exercised, is $400,000. Little work has been done on the group.

Northern California, particularly in Siskiyou County, is active in hydraulic mining which centers at Cecilville, Oak Bar, Forks of Salmon, Sawyers Bar, Scotts Bar, and Fort Jones. At Cecilville, the Jefferson Consolidated, Conzetti, and other properties are in operation. The Shasta Dredging Co. has taken over its option on the Van Matre ranch, near Minersville.

At Grass Valley, a bond on the Spring Hill property, near the Idaho Maryland, has been secured by Harry James. The claim adjoins the Golden Gate. It is planned to explore the property through the Golden Gate.

The Pittsburgh Syndicate is developing a gravel mine at Iowa Hill, Placer County.

The Elephant Deep mine, near Jackson, is operating three hydraulic giants and washing practically 2,000 cu.yd. of gravel per day.

The Vanderbilt mine, in the New York mining district, San Bernardino County, has been sold to a Los Angeles syndicate and is to be reopened.

OREGON

Huntington—Sampling of a car of crude ore shipped from the Bay Horse mine to Salt Lake City gave gross returns of $2,500 for 96,686 lb. The property is now in condition for regular production of crude ore on a considerable scale. The directors recently decided upon a plan of development, which in the main will consist of a further driving of the main tunnel on the orebody. Camp accommodations are to be enlarged and the working force is to be increased.

Baker—The mill at the Imperial mine, in Cable Cove, has resumed operations, after being shut down for a short time.

Eugene—The Oregon & Ohio Mining Co., in which Cleveland, Ohio, capital is interested, has purchased about twenty claims in the Bohemia district. It is reported that considerable money will be spent. Hugh M. Henton, of Cleveland, is to be put in charge of development work.

IDAHO

Sandpoint—The Falls Creek Mining Co. plans to resume development early in May.

Cabinet—The Cupric Mining Co. will resume development of its copper property near Cabinet, and continue shaft sinking to at least 500 ft.

Hope—The Bonner Mining Co. has resumed work on the Marguerite, up Trestle Creek.

The King Solomon's Mines Co., a reorganization of the old Rebecca Mining Co., maintained development all last winter. Some stringers showing gold and silver ore have been cut.

UTAH

Several Companies Ready to Ship to Tooele—Ores from Alta Soon—Vipont Mining Co. Active

From Our Special Correspondent

Tooele—Preparations for the resumption of operation at the International smelter, which is expected to start up about July 1, are being completed. Ores are now received from a number of Tintic and Pioche properties. Milling has been resumed at the Ophir Hill, which will furnish lead concentrates. Ores from the Utah Consolidated, at Bingham, which, shortly before its closing down, completed a 1,000-ton flotation mill, are expected when the smelter starts. At present eighty men are employed on repairs and when the furnaces are blown in 450 men will be put to work.

Marysvale—The Bully Boy property, covering 120 acres and situated about six miles southwest of Marysvale, is reported to have been acquired by Pittsburgh men, and there is talk of a 100-ton mill being built.

Oakley (Idaho)—The Vipont Silver Mining Co., which owns a mine and mill in Box Elder County, Utah, near the Idaho line, and ships its concentrates to Oakley, Idaho, over a twenty-six mile wagon road, is driving an operating tunnel and at the same time continuing mining and milling. The tunnel is being driven to reach the ore at depth and to afford more economical mining. It is now in 1,300 ft. and when a length of 2,000 ft. has been attained it will be turned to the north and connected by approximately 200 ft. of drifting and crosscutting with the inclined shaft from the upper workings, which is now producing about 100 tons of ore daily. This shaft bottoms 350 ft. below the so-called "A" workings, and is expected to connect with the tunnel at 745 ft. The present depth on the vein is 1,350 ft., and the silver content is increasing with depth.

Park City—Shipments for the week ended April 14 amounted to 2,158 tons, as compared with 2,179 tons the week preceding. Shippers were: Judge Allied Companies, 982 tons; Silver King Coalition, 676; Ontario, 495.

Alta—The mines of this camp, which was cut off during the winter, are preparing for the shipping season.

COLORADO

Leadville More Active — Tonopah Placers Dredge Ready Soon — Bonanza in Spencer Mine at Caribou

From Our Special Correspondent

Carbondale—A large force has been put to work on the Crystal River railroad, getting the track in condition for traffic. The road extends from Carbondale to the town of Marble, where the old Yule marble quarry is situated. For two years or more the quarry has been idle, and, save for a watchman, the little town of over 1,000 workmen was abandoned. Several hundred cars of marble are ready for shipment.

Leadville—Mining activity continues to increase. John Cortellini, manager of the Garbut, announces that on May 1 operations will be resumed at the mine, giving employment to about twenty-five men. When work ceased, about one year ago, the mine was producing approximately a car of ore daily. The Louisville mine, after four years of inactivity, will resume this month. Operations have been resumed by leasers on the old Tabor property, and an increasing number of leasers are employed on the Ibex. A promising strike of lead-silver ore has been made on the Lydia mine, in Iowa Gulch, where the ore is accumulating awaiting the opening of the roads.

Breckenridge — Repairs on dredge No. 1 of the Tonopah Placers Co., which was disabled early in February, are nearing completion, and it is expected that the dredge will begin operating early in May. The dredge of the Blue River Gold Dredging Co., which is operating in the main valley of the Blue, has continued shipments of bullion throughout the winter.

Boulder—A bonanza strike of ore is reported in the old Spencer mine at Caribou. A large body of ore which assays from 200 to 500 oz. in silver has been broken into from a crosscut from the old Caribou mine, and drifting is being pushed with all speed to ascertain the extent of the oreshoot.

Georgetown—The Neshota mill has been remodeled by the East Butte Copper Co., and is now in operation with three shifts on a twenty-four-hour schedule. Seven men are employed on each shift in the mill. Considerable underground development work is in progress at the mine, and the crew of miners has been increased.

The Sunburst Mining Co. is installing a fifty-ton Ruth flotation plant to treat ore from the Sunburst property and custom ores from adjacent mines.

Cripple Creek—The Roanna property is being developed by L. F. LeBrun and associates through the Atlanta shaft, which is 360 ft. deep.

In the South Burns mine, a station is being cut between the fourth and seventh levels, preparatory to development work at this horizon which was not opened by former operators. The Shurtloff vein is the first objective of the new development.

MICHIGAN

The Copper Country

Rail Movement of Copper Heavy—C. & H. Reclamation Plant Running—Repairing Conglomerate Shafts

By M. W. Youngs

Houghton—Large sales of copper are being made by Lake producers. The present rail movement of metal, in fact, is the heaviest in two years and compares favorably with the movement by boat last year. During the first half of April, Calumet & Hecla shipped approximately 3,000,000 lb. of metal. Copper Range shipments also have been large, copper on the docks awaiting shipment by water having been sent forward by rail to satisfy the demand. The biggest month Copper Range has had for several years was February, when 5,000,000 lb. was shipped. March sales also were heavy, and Copper Range at present has comparatively little metal on hand—not more than a two months' supply.

The Champion mine of the Copper Range Consolidated Company has lost some men to the Calumet & Hecla—former employees of the latter company—and to the farms, as is usual in the spring of the year, but not a sufficient number to cut into production seriously Trimountain and Baltic have held their own in man-power. Champion is now producing at the rate of 58,000 tons of "rock" per month; Trimountain, 14,000 tons; and Baltic, 17,000 tons. This is a slight loss for the Champion and a slight increase for the Baltic. Trimountain's production has been unchanged for several months. Present production for the three properties is approximately 3,250,000 lb. of refined copper per month.

Calumet & Hecla's reclamation plant on the conglomerate sands at Lake Linden is again in operation.

Marquette Range

Navigation on Lakes Opened—Ore Prices Not Set—Freight Rate Decision Awaited—Outlook Better

By William H. Newett

Ishpeming—Navigation has opened on the Great Lakes for the 1922 season, and ore carriers are now arriving at Lake Superior and Lake Michigan ports for ore. The movement of ore will be light for the time being because the season's prices have not as yet been determined and will not be announced until after the Interstate Commerce Commission hands down decisions on several rail cases now pending. The shippers have asked for lower rates from the mines to the docks, and the question of rates from lower Lake ports to Eastern furnaces has yet to be decided, although the latter case has no bearing on the ore price. It is expected that the new ore prices will show a reduction of 50 or 75c. a ton over the 1921 schedule, and a reduction in rail rates from the mines to the docks and in vessel rates is also expected. Despite the fact that the prices have not been designated, some ore contracts have been entered into, the price to be whatever is set later. There is little talk regarding the coal strike in the Lake Superior region, as there is plenty of coal at most of the mines, and many operators are now using little coal because of the power made available by numerous hydro-electric plants. The shippers expect, if the pig-iron price continues to advance, that ore will sell at higher prices.

Early estimates place the amount of ore to be moved down the Lakes this year at about 45,000,000 tons—double the amount moved in 1921. There is still considerable ore in stock at most of the underground mines, and there is little likelihood that the underground properties will be worked to the limit this season. The open pits will do their share of the shipping and some of them are now preparing for operation.

The Marquette Range is working on the same basis as last fall, with a number of mines still idle, but several of the Menominee Range properties which were closed all winter are again producing ore. The outlook is far more bright than it was a year ago this time, and the shippers are looking forward to cleaning up some of the surplus which they have been carrying.

Gogebic Range

Newport Mine Shipping—Two Fatal Accidents on Range—Wakefield Pit to Ship

From Our Special Correspondent

Ironwood—The Newport mine of the Steel & Tube Co. has started shipping ore to the Ashland docks. Orders for the shipment of but one cargo have been received. The Ironton mine expects to ship at the rate of 25,000 tons per month, and a steam shovel is being put on the stockpile.

Two fatal accidents occurred recently. At the Yale mine a miner was electrocuted while retimbering a haulage drift. At the Montreal a miner was struck by falling ground, receiving fatal injuries.

The Wakefield pit of M. A. Hanna & Co. has orders to ship 100,000 tons of ore. Sixty men are at work laying tracks and stripping. One steam shovel and two locomotives are now in use, and will soon be manned by a night crew also.

MINNESOTA

Mesabi Range

St. James Mine To Be Reopened—Lamberton Dryer Being Remodeled—Webb Mine to Resume

Aurora—Ore from the stockpile at the Meadow-Fowler mine, formerly operated by the Cleveland-Cliffs Iron Mining Co. is being shipped daily to the docks.

Preparations for reopening the St. James mine, operated by the McKinney Steel Co., are being pushed to completion. No work of any magnitude has been done since last summer.

Virginia—The Poco Iron Co. has contracted with the Cole and McDonald Exploration Co. for drilling its property in S. 17 T. 58 R. 17.

Chisholm—The Oliver Iron Mining Co. is preparing to build a concrete and steel bridge over the highway between Chisholm and Buhl to serve the stripping trains from the Frazer pit and for the ore trains later.

Hibbing—The drying plant at the Lamberton mine, operated by Butler Bros., is being remodeled. All of this work has been in charge of the engineering department of the Allis-Chalmers Manufacturing Co.

The Webb mine, of the Shenango Furnace Co., will resume operations May 1. Preparations for reopening are under way. It is planned to ship from the stockpile. About 150 men will be employed.

Buhl—The Interstate Iron Co. will drill some of its property in this locality, which was recently acquired from the state under the new law which provides for granting leases to the highest bidder.

ALABAMA

Sloss Sheffield's Mine at Bessemer Preparing to Resume—Raimund Mine Increasing Work

By George Huntington Clark

Birmingham—As the third quarter of April is ended, iron production in Alabama continues on a steady, upward trend, at a rate of increase called for by an again advanced sale price, and more active market demands, together with heavier reduction in accumulated stocks.

As against five active furnaces in July of 1921. there are now eighteen stacks in blast, an increase of about 265 per cent, carrying a corresponding increase of employment.

Reflecting these conditions, the second furnace of the Republic Iron & Steel Co. at Thomas, is now being dried out, and will be making iron on or before May 1, making that company's second active stack there.

The blast furnace of the Sloss-Seffield Steel & Iron Co. at North Birmingham is again in operation, and it is stated that the Philadelphia furnace of the same company at Florence, on the Tennessee River, is being made ready to go in as soon as possible.

Work is said to have started getting the slope ready at the Sloss red ore mine at Bessemer, which will be the last of the major red-ore mines of the district to resume.

Work has also been resumed preparing the second slope of the Raimund red ore mine of the Republic Iron & Steel Co., indicating a much more rapid return to normal than was anticipated earlier in the year.

The bituminous coal strike seems not as yet to have affected the state as regards operation, and no considerable amount of outside business has been so far attributed by operators to strike conditions existing in outside territory.

THE MARKET REPORT

Daily Prices of Metals

Apr.	Copper, N. Y., net refinery* Electrolytic	Tin		Lead		Zinc
		99 Per Cent	Straits	N. Y.	St. L.	St. L.
20	12.625	30.00	31.00	5.10@5.35	5.05	4.925
21	12.625	30.875	31.75	5.10@5.35	5.10@5.15	4.95
22	12.625	30.75	31.50	5.10@5.35	5.10@5.15	4.95@5.00
24	12.625	30.25	31.125	5.25@5.40	5.15@5.20	5.00
25	12.625	30.375	31.125	5.25@5.50	5.20	5.025
26	12.625	30.375	31.125	5.25@5.50	5.25	5.05

*These prices correspond to the following quotations for copper delivered: 12.875c. for the week.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Apr.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
20	59⅛	59¾	64	153⅛	154½	23⅛	22⅝	26⅞	27
21	59⅝	60¼	64	155¾	157¼	23¾	23¼	27	27⅛
22				.	....	...	...	...	...
24	59⅜	60⅛	64½	153¼	154¼	24⅛	23⅝	27¼	27½
25	59	59⅝	64½	151½	153	24⅜	23¾	27¼	27⅜
26	59¼	59⅞	64½	152½	154	24⅛	23¼	27¼	27½

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Apr.	Sterling Exchange "Checks"	Silver			Apr.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
20	441½	99⅝	68	34¾	24	442	99⅝	68⅜	34¾
21	441¼	99⅝	68¼	34¾	25	442¾	99⅝	68	34½
22	441¼	99⅝	67⅜	34⅜	26	442	99⅝	67¾	34½

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, April 26, 1922

The metal markets have been characterized by a firm tone during the last week, though business generally has not been of large proportions. Producers are encouraged by the continued evidences of returning business prosperity, and no longer feel inclined to sacrifice their product. Metal prices are still away below the general level and could reach much higher figures without being out of line with other commodities.

Copper

Despite reports of large sales of copper at prices as high as 13c., delivered, the market has been at 12⅞c. all week, and few large orders have come to our knowledge. Inquiries were unusually numerous on Saturday and Monday, but they were generally for small tonnages and indicated a desire on the part of consumers not to contract for copper farther ahead than July. Encouraged by the seeming activity, some producers raised their prices to 13c., delivered, on Monday or Tuesday, but plenty of copper remained available at the 12⅞c. level. In fact, some consumers situated near New York, or where the milling-in-transit rate applies, have bought copper for 12.75c. delivered; one fairly good sized order was placed at that level. The undertone is strong, and it would not be surprising to see slightly higher prices soon. Forward delivery commands a premium, and last quarter copper could probably not be obtained for less than 13c., with most producers disinclined to quote.

The export market has continued satisfactory though quiet. Prices have ranged from 13@13⅛c., c.i.f. Europe.

Lead

The American Smelting & Refining Co. advanced its official contract price of lead from 5 to 5.10c., New York, on April 20; and to 5.25c. on April 24.

Conditions which have existed for the last two or three weeks in the lead market continue. Prompt lead is even harder to obtain than before, but, on the other hand, consumers are quieting down and are not so insistent that they be immediately supplied. With practically all producers sold out of current production, and unwilling to contract for delivery later than May, the producers' market may be said to be largely nominal, and it is particularly difficult to establish quotations which represent average sales. The market has largely been set by small lots, many of the transactions being made through dealers. The price of lead has advanced faster than most of those who have the good of the industry at heart would like to see, but the advance has been a genuine one and caused entirely by a large and insistent demand.

The St. Louis price has strengthened along with that in the East and is so high that it does not pay, in most instances, to ship lead to New York. Some of the high-cost lead which has been held in stock for the last year or so has been sold, but has in no sense dampened the demand, and consumers appear ready to take all that is released. Lead was obtainable in Chicago during almost all the week at 5.25c.

Zinc

The advance in zinc carried the market above 5c., a level that has not been reached since almost exactly a year ago. Some producers have been active in the market, whereas others report no sales for the week. A feature of the market was the recurrence of export business, metal being sold to Japan and to Europe. Zinc sold to Europe from St. Louis is shipped by rail to Gulf ports. In general, sales were all for fairly prompt shipment during the next thirty days. June delivery commanded a 2½-point premium, though some producers asked 5 points. Today it would be difficult to secure prompt metal below 5.05c. High-grade zinc has been moving in satisfactory volume at 6c., with 30c. per 100 lb. freight allowance. The New York market is 35 points above St. Louis.

Tin

Tin has been in somewhat better demand, especially from the platers, who are making bids for prompt delivery. Reports to the effect that some of the Far Eastern banks were released caused a slight recession in London, but the drop was largely offset by American buying. At the beginning of the week, the New York price for Straits was about at London parity, but the market is now back to import basis. The tin market seems likely gradually to move to higher levels.

Arrivals of tin, in long tons: April 19, Liverpool, [illegible]; 24th, Straits, 1,155; 25th, London, [illegible].

Gold

Gold in London: April 20th, 93s. 6d.; 21st, 93s. [illegible]; 24th, 93s. 5d.; 25th, 93s.; 26th, 93s. 3d.

General stock of money in the United States April 1: Gold coin and bullion, $[illegible]; standard silver dollars, $[illegible]; subsidiary silver, $272,[illegible]; United States notes, $346,681,[illegible]; Federal Reserve notes, $2,[illegible]; Federal Reserve Bank notes, $[illegible]; National Bank notes, $752,[illegible]; total, $8,[illegible]. Circulation per capita, $[illegible], compared with $[illegible] a year ago. Gold and silver stocks increased during the month by about $37,000,000 and outstanding notes decreased by about $5,000,000.

Foreign Exchange

Foreign exchanges have been generally stronger during the last week, and some new high points were reached, among these being Norwegian and Canadian currencies. On Tuesday, April 25, francs were 9.31c.; lire, 5.405c.; marks, 0.37875c.; and Canadian dollars, [illegible].

Silver

Silver reacted somewhat after the sharp advance of April 19, but has steadied at a new high level for the year. The market continues uncertain, with Far Eastern speculation the chief factor. Under these conditions it is impossible to forecast the future of silver.

Mexican Dollars—April 20th, 52[illegible]; 21st, 52[illegible]; 22d, 51[illegible]; 24th, 52[illegible]; 25th, 51[illegible]; 26th, 51¾.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, [illegible]c. for the week. Market firm, difficult to obtain metal below [illegible].

W. C. C. brand, 6@6½c. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at [illegible]c. per lb. White antimony oxide, Chinese guaranteed 99 per cent Sb_2O_3, wholesale lots, [illegible]@7c.

Arsenic—6.75@7c. per lb.

Bismuth—$2@$2.10 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Iridium—Nominal, $160@$170 per oz.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Small tonnages, spot, nominal at 30@33c.

Palladium—Nominal, $55@$60 per oz.

Platinum—$85@$90 per oz.

Quicksilver — $55@$57 per 75-lb. flask.

The prices of **Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of April 8.

Metallic Ores

The prices of **Bauxite, Chrome, Manganese, Tungsten, Molybdenum, Tantalum, Uranium, Vanadium, Titanium,** and **Iron Ore, Zircon and Zirkite** are unchanged from the prices in the issue of April 8.

Zinc and Lead Ore Markets

Joplin, Mo., April 22 — Zinc blende, per ton, high, $31.75; basis 60 per cent zinc, premium, $31; Prime Western, $30@$29; fines and slimes, $28@$26; average settling price, all grades of blende, $27.41.

Lead, high, $69.55; basis 80 per cent lead, $69@$70; average settling price, all lead ores, $67.62 per ton.

Shipments for the week: Blende, 9,927; lead 1,332 tons. Value, all ores the week, $362,130.

Purchases this month have taken up approximately 10,000 tons of reserve blende, all that could be secured on the price level prevailing. Demand is strong enough to present an acute competition for the weekly production. Though price quotations are reported lower than last week on some grades, purchases at the prices quoted were limited, the bulk of the transactions being close to the figures of last week. Sellers took it as an attempt to show a weakness where none exists, and some declined to accept the lower offerings, later selling as last week.

Platteville, Wis., April 22—Blende, basis 60 per cent zinc, $30. Lead ore, basis 80 per cent lead, $69 per ton. Shipments for the week: Blende, 421 tons. Shipments for the year: Blende 5,028; lead ore, 720 tons. Shipped during the week to separating plants: 752 tons blende.

Non-Metallic Minerals

Prices are unchanged from those in the issue of April 8, on **Asbestos, Barytes, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, Talc.**

Mineral Products

Sodium Nitrate—$2.90@$3 per 100 lb., ex vessel, Atlantic ports.

The prices of **Copper Sulphate, Potassium Sulphate** and **Sodium Sulphate** are unchanged from the issue of April 8.

Ferro-Alloys

Ferromanganese — Domestic prices have advanced $5 to $67@$69, f.o.b. furnace.

Ferrosilicon—50 per cent grade, $56@$58 per gross ton, f.o.b. works.

Ferrovanadium—$3@$3.50 per lb. of V contained.

The prices of **Ferrotitanium, Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrotungsten,** and **Ferro-uranium** are unchanged from the issue of April 8.

Metal Products

Copper Sheets — New York base, 19.25c. per lb.; wire, 14@14.25c.

Lead Sheets and **Zinc Sheets** are unchanged from the prices quoted April 8.

Nickel Silver—26.25c. per lb. for 18 per cent nickel, Grade "A" sheets.

Yellow Metal—Dimension sheets and sheathing, 16.75c. per lb.; rods, 13.75c.

Refractories

Magnesite Brick—First quality, 9-in. straights, $55 per net ton, f.o.b. Pennsylvania works.

Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, and Silica Brick are unchanged from the prices quoted April 8.

The Iron Trade

Pittsburgh, April 25, 1922

Until Thursday or Friday of last week the tide of non-union striking in the Connellsville coke region seemed on the whole to be increasing slightly, but since then production has probably increased a trifle, and a common view is that by about May 1 the strikers will begin returning in increasing numbers. These non-union workers are not accustomed to long strikes, as are the regular members of the United Mine Workers. The steel industry as a whole is producing more steel than on March 31.

Anticipation of the coal strike produced extra buying of steel products in February and March, and now the realization is producing more buying, making the steel market strong. Sheets were recently advanced $3 a ton, and there is now a considerable volume of buying at the new prices, despite the heavy covering that occurred at the old prices.

Curtailment in supplies of Connellsville coke has affected production of sheet bars in particular. Despite the fact that sheet bars were $29 in March, it is impossible now to buy at under $33, if at that price.

Pig Iron — Merchant furnaces are nearly all out of the market, and no regular prices can be quoted. It is established that pig iron cannot be bought at less than $22, Valley basis, for any grade, an advance of $3 to $4 a ton since April 1. Several furnaces are banked.

Coke

Connellsville—Furnace, no offerings; foundry, occasional sales at $6.25.

Transvaal Gold Production

The following table summarizes Transvaal gold production since 1917. Production in 1922 was seriously affected by labor trouble.

RAND GOLD OUTPUT 1917-1922 IN FINE OUNCES

	1922	1921	1920	1919	1918	1917
January		[illegible]	[illegible]	676,059	[illegible]	[illegible]
February	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
March		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
April		[illegible]	686,979	[illegible]	[illegible]	[illegible]
May		[illegible]	[illegible]	[illegible]	[illegible]	729,388
June		678,490	[illegible]	[illegible]	[illegible]	[illegible]
July		[illegible]	736,099	725,497	[illegible]	[illegible]
August		[illegible]	[illegible]	706,669	[illegible]	756,650
September		[illegible]	682,173	[illegible]	[illegible]	[illegible]
October		707,000	[illegible]	[illegible]	679,764	[illegible]
November		[illegible]	633,737	[illegible]	[illegible]	722,839
December		681,847	[illegible]	[illegible]	[illegible]	[illegible]

The Trend of Canadian Gold Production

In the current year Canada should produce a million ounces of gold for the first time in her history. This compares with a normal production in the United States of from two to five million ounces per year, depending upon industrial conditions. The trend of gold production in the territory occupied by our northern neighbor is interesting. Data for the three leading gold-producing provinces for the last twelve years is shown in the table below.

In 1910, British Columbia was the leading producer, though closely seconded by the Yukon that being the time when the placer deposits of the Far North were being worked with great intensity. Both the British Columbia and the Yukon production began to recede after the high figures of 1913, owing first to a dearth of miners caused by war demands, and then by high costs and the gradual depletion of the developed deposits. However, the Porcupine district, in northern Ontario, began to come to life about 1912, and rapidly assumed its present commanding lead among the Canadian provinces. It is now producing about three quarters of the total dominion output. Most of the gold so far has come from Porcupine, but the Kirkland Lake district is becoming of importance, and other regions are almost sure to demand consideration within a few years. The Ontario gold production is likely to increase for many years to come. Without the discoveries in this province, the gold output of Canada would have been as disappointing in the last five years as have been the figures for this country.

Mining Dividends for April, 1922

The following dividends were paid by mining and metallurgical companies during April, 1922:

Companies in the United States	Situation	Per Share	Total
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Arizona Copper	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Homestake Mining	[illegible]	[illegible]	[illegible]
Iron Blossom Consolidated	[illegible]	[illegible]	[illegible]
Phelps Dodge Corporation	[illegible]	[illegible]	[illegible]
St. Mary's Mineral Land	[illegible]	2.00	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	64,636
[illegible]	[illegible]	[illegible]	[illegible]
United Eastern	Ariz.	0.15 Q	204,450
U. S. Smelting, Ref. & Min. pfd.	U. S.-Mex.	0.75 Q	[illegible]
Companies in Other Countries			
[illegible]	[illegible]	1.50 Q	[illegible]
[illegible]	Quebec	1.75 Q	[illegible]
Dome Mines	[illegible]	1.00	[illegible]
Hollinger Consolidated Gold	Ontario	[illegible]	[illegible]
Kerr Lake	[illegible]	0.125 Q	[illegible]
La Rose	[illegible]	0.10	[illegible]
N. Y. and Honduras Rosario	[illegible]	[illegible]	[illegible]
Nipissing	[illegible]	[illegible]	180,000
Wright-Hargreaves	[illegible]	[illegible]	[illegible]

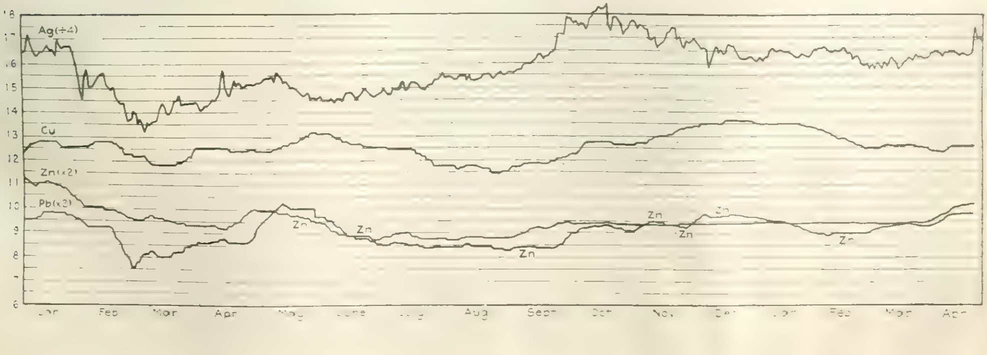
[illegible] silver [illegible]

The April list of dividends again shows some additions over that for January, thus reflecting the better conditions which the mining industries in general are enjoying. The dividend on Arizona Copper is a $1 distribution made on the 50,000 shares of unissued Phelps Dodge stock which was turned over to the Arizona Copper Co., Ltd., in return for the properties of that company. Iron Blossom again paid 2.5c., following its resumption of dividend disbursements last December. The St. Mary's Mineral Land dividend indicates that the Michigan copper country is again coming to a profitable operating basis. The Dome distribution of $1 is a capital disbursement made in lieu of the regular quarterly dividend of 25c. La Rose paid 10 per cent, resuming payments after a lapse of three years. The New York & Honduras Rosario company's last dividend was in January, 1921. Wright-Hargreaves, the latest of the Ontario gold producers to enter the dividend ranks, seems to be on a quarterly basis, though this second dividend is only half of that paid in January. The stock has recently been listed on the Standard Stock Exchange in Toronto. It has always been closely held.

GOLD PRODUCED IN CANADA IN OUNCES

	1910	1911	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921
British Columbia	261,386	238,496	251,815	297,459	252,730	273,376	219,633	133,742	180,163	167,252	124,808	[illegible]
Yukon	221,091	224,197	268,447	282,838	247,940	230,173	212,700	177,667	102,474	90,705	72,778	65,991
Ontario	3,089	2,062	86,523	[illegible]	268,264	406,577	492,481	423,261	411,976	[illegible]	564,995	[illegible]
All Canada ..	493,707	473,159	611,885	802,973	773,178	918,056	930,492	738,831	699,681	766,764	765,007	924,374

Prices of New York Copper, Silver and Lead, and St. Louis Zinc 1921 and 1922



COMPANY REPORTS

Phelps Dodge Corporation

A report of operations of the Phelps Dodge Corporation for 1921 shows a loss of $8,539,068.22, according to the following income account:

[illegible]	$18,491,602.06	
[illegible]	280,720.37	$18,772,322.43
[illegible]		
[illegible]	$21,313,031.18	
[illegible]	1,825,746.07	
[illegible]	2,512,414.89	
[illegible]	838,193.50	
[illegible]	822,005.01	27,311,390.65
[illegible] year 1921		$8,539,068.22

Balance sheet as of Dec. 31, 1921, follows:

ASSETS

Mines and mining claims	$158,635,915.12	
[illegible] and miscellaneous properties	33,861,019.48	$192,496,934.60
[illegible] expense chargeable to [illegible]	$7,098,317.47	
Ores and concentrates...	3,692,552.41	
[illegible] copper at cost, silver and gold [illegible]	3,752,056.89	
[illegible] Copper Export Association, Inc. [illegible]	2,873,045.50	
[illegible] and other expenses [illegible]	447,966.64	
Materials and supplies	4,163,030.47	
Merchandise (P. D. Mercantile Co.)	1,286,317.26	
Accounts receivable	3,351,134.16	
[illegible]	5,205,095.26	
[illegible]	3,292,037.97	35,161,554.03
		$227,658,488.63

LIABILITIES

[illegible] stock, authorized and issued, 500,000 shares at $100		$50,000,000.00
[illegible] 330 outstanding preference stock of the Arizona Copper Co., Ltd., to be retired prior to Sept. 30, 1926		1,540,446.00
Accounts payable, taxes and interest accrued	$17,003,303.84	
Dividend payable Jan. 3, 1922	500,000.00	17,503,303.84
Reserve for depletion	$46,255,404.88	
Reserve for depreciation	11,773,655.17	58,029,060.05
Surplus: Balance Dec. 31, 1920	$120,027,172.91	
Less adjustment of mines and depletion reserve to Government valuation	20,722,294.36	
	$99,304,878.55	
Surplus acquired through purchase of the Arizona Copper Co., Ltd., properties	11,669,868.41	
	$110,974,746.96	
Loss for year 1921, per income account	8,539,068.22	
	$102,435,678.74	
Dividends	1,850,000.00	100,585,678.74
		$227,658,488.63

Production amounted to 28,639,995 lb. of copper, 5,303,846 lb. of lead, 852,925 oz. of silver, and 5,741 oz. of gold from ores of the company; 134,999,025 lb. of copper was sold (includes copper from other sources) and delivered at an average of 12.959c. net f.o.b. New York.

North Butte Mining Co.

A report of operations of the North Butte Mining Co. for 1921 shows a deficit of $326,575.70 according to the following statement:

INCOME

[illegible] copper, silver, and gold		$96,097.34

EXPENDITURES

Mining and development	[illegible]	
[illegible] ore	[illegible]	
[illegible] smelting, freight [illegible], refining and selling expense	[illegible]	
[illegible] expenses and taxes	[illegible]	422,673.04
[illegible]		$326,575.70

Balance sheet as of Dec. 31, 1921, is given as follows:

ASSETS

Mining property	$9,184,801.19	
Liberty Loan Bonds	120,000.00	
War savings stamps and certificates	1,082.60	
Granite Mountain shaft construction	150,260.15	
East side development	494,931.52	
Deferred development	368,608.27	
Cash	55,123.87	
Accounts receivable	18,370.02	
Supplies at mine	19,763.71	
Copper to company's credit with United Metals Selling Co. and Copper Export Association, Inc.	1,577,176.30	
		$11,990,117.63

LIABILITIES

Capital stock		$6,450,000.00	
Dividends unclaimed		1,033.15	
Accounts payable		15,289.54	
Copper Export Association, Inc		489,398.60	
Advances on metal		672,112.92	
Reserve for ore depletion		3,075,188.02	
Surplus		1,287,095.40	
Balance Jan. 1, 1921	$1,750,626.17		
Deficit for year	326,575.70		
	$1,424,050.47		
Deduct for ore depletion	136,955.07		$11,990,117.63

Production for the year amounted to 1,229,600 lb. of copper, 34,535.76 oz. of silver and 78 oz. of gold. A total of 4,565,169 lb. of copper was sold at 13.753c. per lb.

Inspiration Consolidated Copper Co.

A report of the operations of the Inspiration Consolidated Copper Co. for 1921 shows a net loss of $1,790,421.18 according to the following income account:

Sales of copper		$8,636,498.34
Expenses		
Mining, including development	$728,919.34	
Reduction, including transportation	850,719.67	
Refining, selling, transportation	492,627.83	
Administration and Federal taxes	166,223.95	
Copper on hand at beginning of year	9,746,476.63	
	$11,984,967.42	
Less copper on hand at end of year	2,799,021.35	9,185,946.07
		$549,447.73
Depreciation on buildings and equipment		166,593.33
Interest paid		97,414.90
		$813,455.96
Income from investments		112,101.00
Operating loss		$701,354.96
Expenditures during suspension of operations		1,089,066.22
Balance, net loss for year		$1,790,421.18

Balance sheet as of Dec. 31, 1921, follows:

ASSETS

Fixed		
Mines, mining claims and lands	$16,934,268.04	
Buildings and equipment	9,519,619.21	
Investments in sundry companies	902,670.01	
		$27,356,557.26
Current		7,055,473.78
		$34,412,031.04

LIABILITIES

Capital stock			
Authorized 1,500,000 shares of $20 each			
Issued 1,181,967 shares			$23,639,340.00
Reserve			
For depreciation			3,413,945.23
Current			
Accounts and wages payable and taxes accrued			1,112,516.25
Surplus			
Balance, Dec. 31, 1920		$8,036,650.74	
Net loss for year			
Operating loss	$701,354.96		
Expenditure during suspension of operations	1,089,066.22	1,790,421.18	6,246,229.56
			$34,412,031.04

Production amounted to 15,174,768 lb. of copper at a cost of 15,208c. per lb., excluding depletion, Federal taxes and shutdown expenses. The company closed down March 31, 1921, and reopened Feb. 15, 1922.

New Cornelia Copper Co.

A report of the operations of the New Cornelia Copper Co. for 1921 shows a net deficit of $360,102.80. No dividends were paid. Production amounted to 20,198,382 lb. of copper. A statement of income and expenditures follows:

INCOME		
Total earnings on metals	$2,643,127 87	
Dividends	5,590.00	
Interest	73,321 90	
Other income	15,101 33	
		$2,737,141 10
EXPENDITURES		
Operating expenses	$1,422,315 40	
Salaries, office and general expenses	43,098 41	
Freight, refining and marketing	297,138 19	
State and Federal taxes	492,439 57	
		$2,254,991 57
Operating profit.		$482,149 53
Less		
Depreciation	$372,420 40	
Ore depletion...	469,831 93	
		$842,252 33
Net deficit.......		$360,102 80

Balance sheet, Dec. 31, 1921, follows:

ASSETS		
Mining property	$28,075,880 55	
Less reserve for ore depletion..	3,680,692 07	
		$24,395,188.48
Construction.......	$6,728,076 03	
Less reserve for depreciation....	2,793,796 02	
		3,934,280 01
Investments (at cost)		
New Cornelia Co-operative Mercantile Co. stock......	$100,000 00	
Ajo Improvement Co. stock.	60,500 00	
Liberty Bonds, Treasury certificates and W. S. stamps...	650,184 00	
Ajo School District bonds	94,500.00	
Other securities.	61,200 00	
		966,384 00
Notes receivable.		147 000 00
Accounts receivable		940,300.17
Cash.........		746,887 19
Supplies..............		571,858 30
Copper on hand...		3,521,518 13
Deferred charges to operations.		248,661.99
Items in suspense........		28,188 49
		$35,500,266.76
LIABILITIES		
Capital stock..........		$9,000,000.00
Accounts payable..........		1,661,310 58
Reserve items......		54,842.84
Surplus..........		24,784,113.34
Earned surplus, Dec. 31, 1920..............	$2,948,600.04	
Deficit year 1921 ...	360,102 80	
Earned surplus, Dec. 31, 1921..............	2,588,497.24	
Paid-in surplus, Dec. 31, 1921	22,195,616 10	
		$35,500,266.76

Copper on hand estimated at 12½c. per lb.

Copper on hand Dec. 31, 1921, amounted to 16,246,819 lb., exclusive of metal held by Copper Export Association.

Callahan Zinc-Lead Co.

A report of the operations of the Callahan Zinc-Lead Co. for 1921 states that no production was made during the year. Financial statement follows:

INCOME		
Miscellaneous income, rent and interest...		$10,117 69
EXPENDITURES		
Property maintenance and development.......	$115,580.89	
General and administrative expenses ..	50,815.60	166,396 49
Operating deficit for the year.		$156,278 80
Cash proceeds of sales of treasury stock..........		381,792.84
		$225,514.04
Current surplus, Dec. 31, 1920		279,055 18
		$504,569 22
Deduction from current surplus		
Patenting of claims..........		525.03
Current surplus at Dec. 31, 1921..........		$504,044.19

Current assets Dec. 31, 1921, were $257,334.07, and current liabilities, $12,134.63. Capitalization, 500,000 shares, $10 par value, of which 464,990 shares have been issued.

To facilitate operations, it was deemed advisable to effect a consolidation of the Chicago-Boston and the Kill Buck properties. The Galena Mining Co. was therefore incorporated, with a capitalization of $2,500,000 (par value $1), and its stock was exchanged, on a share-for-share basis, for Chicago-Boston and Kill Buck stock. The Callahan Zinc-Lead Co. owns 1,551,058 shares.

Nipissing Mines Co., Ltd.

A report of the operations of the Nipissing Mines Co., Ltd., for 1921 shows dividend payments of $969,199.26. Production was 3,156,775 oz. of silver, which cost 28.5c. per oz., compared with 37.4c. in 1920. Reserves stand at 3,004,939 oz. Nipissing Mines Co., Ltd., is a holding company for the Nipissing Mining Co., Ltd., and is capitalized at $6,000,000.

The Nipissing Mining Co., Ltd., account shows shipments of 3,016,760 oz. of silver, of net value $1,745,411.07. Cost of production was 28.534c. per oz. Operating account follows:

Gross settlements:			
1920 ore and bullion (shipments paid for in 1921			$724,493 06
1921 ore and bullion (shipments paid for in 1921			1,837,143 32
Gross settlements for the year			$2,561,636 38
Gross value of ore, bullion and residue at mine, Dec. 31 1921			1,031,047 07
			$3,592,683.45
Less gross value of custom ore purchased.		$93,406 25	
Gross value of inventory Dec. 31, 1920.		1,629,710 79	1,723,117 04
Gross value of 1921 ore—Nipissing production .			$1,869,566 41
Cost of mining and all other expenses (including smelter deductions and treatment on settlements of 1921 ore and accrued charges on ore, bullion and residue at mine)..		$1,015,622 70	
Less other income at Cobalt			
Ground rents	$13,581 15		
Interest, discount and exchange	101,217 23		
Miscellaneous income.........	44.42	114,842 80	
Net cost of production..........			900,779 90
Net income for 1921 production..			$968,786.51
Add interest on bonds..........			130,954.49
			$1,099,741 00
Less cost and work on outside properties			130,541 74
Net profit......................			$969,199.26
Surplus, Jan. 1, 1921.			3,817,043 68
			$4,786,242.94
Less dividends declared and paid during 1921.		$575,000 00	
Dividend payable Jan. 1922........		360,000 00	935,000.00
Net surplus......			$3,851,242 94

Current assets on Dec. 31, 1921, were $2,536,504.33; current liabilities, $568,880.41.

Jim Butler Tonopah Mining Co.

A report of the operations of the Jim Butler Tonopah Mining Co. for 1921 shows a net profit of $15,384.07. Receipts and disbursements follow:

Balance of cash in banks, Dec. 31, 1920			$918 03
Receipts			
On account of shipments of ore by lessees.		$69,955.31	
Interest received on bank deposits ..		15.79	
Secured loan made by Tonopah Belmont Development Co:			
Sept. 28, 1921...........	$28,044 11		
Dec. 31, 1921	17,858 73		
		45,902 84	
Other collections		2,283.18	
			$118,157 12
			$119,075 15
Disbursements			
Operation of mine and conduct of business...............		$62,104 25	
Income tax for 1920 and additional income tax for prior years		17,160.98	
Net disbursements in respect of quarter interest in:			
Belmont Shawmut Mining Co.	$26,054 84		
Less one-quarter net proceeds of ore during 1921	9,851 60		
		16,203 24	
Belmont Wagner Mining Co...	$31,749 16		
Less one-quarter net proceeds of ore during 1921	13,140 09		
		18,609 07	
			$114,077 54
Balance of cash in banks Dec. 31, 1921			$4,997 61

The ore production of the property was entirely from leases and aggregated 8,518.3 dry tons, with a gross metal content of 1,306.145 oz. of gold and 129,630.84 oz. of silver. The gross value of the ore was $156,613.83.

MINING STOCKS

Week Ended April 22, 1922

Stock	Exch.	High	Low	Last	Last Div.	
COPPER						
[illegible]	Boston	[illegible]	[illegible]	[illegible]	Sept. '20, Q	$[illegible]
[illegible]	N. Y. Curb	[illegible]	[illegible]	[illegible]		
[illegible]	Boston	2[illegible]	2[illegible]	2[illegible]	Mar. '19	1.00
[illegible]	New York	14[illegible]	[illegible]	14[illegible]	Nov. '20, Q	1.00
[illegible]	Boston	3[illegible]	3	3[illegible]		
[illegible]	Boston	[illegible]	[illegible]	[illegible]	Oct. '18, Q	0.50
[illegible]	N. Y. Curb	25	19	20		
[illegible]	Boston	15[illegible]	15[illegible]	15[illegible]	Sept. '19, Q	0.25
[illegible]	Boston	60	58	59	Mar. '22, Q	0.50
[illegible]	Boston	278	275	275	Dec. '20, Q	5.00
[illegible]	N. Y. Curb	*55	*46	*50		
[illegible]	[illegible]	12	12	12	Dec. '18, SA	1.00
[illegible]	New York	37[illegible]	[illegible]	37¼	Mar. '21, Q	0.50
[illegible]	New York	19[illegible]	18[illegible]	19[illegible]		
[illegible]	New York	29[illegible]	28[illegible]	28[illegible]	Sept. '20, Q	0.37½
[illegible]	[illegible]	53	51	53		
[illegible]	N. Y. Curb	10	4	10	Dec. '18, Q	0.05
[illegible]	N. Y. Curb			1[illegible]		
[illegible]	Boston	44½	43	44	Mar. '22, Q	1.00
[illegible]	Boston Curb	1[illegible]	1[illegible]	1[illegible]		
[illegible]	Boston	8[illegible]	7[illegible]	8[illegible]	Mar. '20, Q	0.25
[illegible]	Boston	12	11[illegible]	11[illegible]	Dec. '19, A	0.50
[illegible]	Boston Curb	*95	*85	*86	Feb. '19, SA	0.15
[illegible]	Boston	3	2[illegible]	2[illegible]		
[illegible]	Boston Curb	[illegible]	[illegible]	1[illegible]		
[illegible]	[illegible]	27	[illegible]	27	May '19, Q	1.25
[illegible]	[illegible]	[illegible]	[illegible]	32	Nov. '20, Q	0.50
[illegible]	Boston	[illegible]	2	2[illegible]		
[illegible]	N. Y. Curb	3[illegible]	[illegible]	3[illegible]	Jan. '21, Q	0.05
[illegible]	New York	42[illegible]	4[illegible]	41[illegible]	Oct. '20, Q	1.00
[illegible]	Boston Curb	[illegible]	[illegible]	7	Sept. '20, K	0.25
[illegible]	Boston	25	2[illegible]	24	Sept. '19, SA	0.50
[illegible]	New York	32[illegible]	[illegible]	32[illegible]	Dec. '20, Q	0.50
[illegible]	Boston	3	2	2[illegible]		
[illegible]	Boston	5[illegible]	4[illegible]	4[illegible]		
[illegible]	Boston	2	1[illegible]	1[illegible]		
[illegible]	N. Y. Curb	2[illegible]	2[illegible]	28¾	Jan. '19, Q	0.50
[illegible]	Boston Curb	[illegible]	[illegible]	15		
[illegible]	Boston	2[illegible]	2	2		
[illegible]	Boston	4[illegible]	3	3[illegible]	Nov. '17, Q	1.00
[illegible]	New York	2[illegible]	2[illegible]	2[illegible]	Feb. '22, Q	0.50
[illegible]	Boston	[illegible]	2[illegible]	3		
[illegible]	Boston	59	[illegible]	58[illegible]	Feb. '22, Q	1.00
[illegible]	N. Y. Curb	[illegible]	7[illegible]	7[illegible]		
[illegible]	New York	18[illegible]	[illegible]	17[illegible]	Sept. '20, Q	0.25
[illegible]	Boston	18[illegible]	17	18[illegible]	Feb. '22, K	0.25
[illegible]	Boston	14	12[illegible]	13	Oct. '18, Q	0.25
[illegible]	Boston	*50	41	40		
[illegible]	N. Y. Curb	*14	12	*13		
[illegible]	Boston	26	25[illegible]	25[illegible]	Dec. '18, Q	1.00
[illegible]	Boston	37	36[illegible]	36½	June '20, Q	0.50
[illegible]	[illegible]		†1[illegible]		Apr. '22, Q	1.00
[illegible]	Boston	46	45	45[illegible]	Mar. '20, Q	1.00
[illegible]	New York	17	16½	16[illegible]	Dec. '20, Q	0.25
[illegible]	N. Y. Curb	1[illegible]	1[illegible]	1		
[illegible]	Boston	46[illegible]	45	46	Dec. '21, K	1.00
[illegible]	Boston	14	14	14		
[illegible]	Boston	1[illegible]	1	1[illegible]	Nov. '17, Q	0.25
[illegible]	New York	9[illegible]	[illegible]	[illegible]	Jan. '20, Q	0.25
[illegible]	Boston	*80	*75	*75		
[illegible]	Boston	2[illegible]	1[illegible]	1[illegible]		
[illegible]	New York	12	1[illegible]	12	May '18, I	1.00
[illegible]	Boston	1	*60	*60	[illegible] '13	0.10
[illegible]	Boston Curb	28[illegible]	28	28	Feb. '22, Q	0.25
[illegible]	Boston	[illegible]	2[illegible]	2	Sept. '18	0.25
[illegible]	New York	68	65	67	Mar. '22, Q	0.50
[illegible] Metal & T	Boston	1[illegible]	1	1[illegible]	Dec. '17,	0.30
[illegible]	Boston	2[illegible]	[illegible]	2		
[illegible]	Boston	2[illegible]	[illegible]	1[illegible]		
[illegible]	Boston	12	12	12		
NICKEL-COPPER						
[illegible]	New York	1[illegible]	[illegible]	[illegible]	Mar. '19,	0.50
[illegible] pfd	New York	79[illegible]	73	7[illegible]	[illegible] '22, Q	1.50
LEAD						
[illegible]	New York	94	[illegible]	[illegible]	Mar. '22, Q	1.50
[illegible] pfd	New York	110	110	110	Mar. '22, Q	1.75
[illegible]	New York	[illegible]4[illegible]	[illegible]	14	Mar. '22, Q	0.25
QUICKSILVER						
[illegible]	Boston	1[illegible]	[illegible]	1[illegible]		
ZINC						
[illegible]	New York	17[illegible]	[illegible]	[illegible]	[illegible]	1.00
[illegible] pfd	New York	44[illegible]	44	44[illegible]	[illegible] '20, Q	1.50
[illegible] & Z	New York	7½	[illegible]	[illegible]	[illegible]	0.50
[illegible]	New York	31[illegible]	27	[illegible]	[illegible]	1.25
[illegible] Z.-Ld.	New York	7[illegible]	[illegible]	[illegible]	[illegible]	0.50
New Jersey Zi.	N. Y. Curb	146	145	145	[illegible] '22, [illegible]	2.00
[illegible]	Los Angeles	*45	*40	*4[illegible]	[illegible]	0.03

Stock	Exch.	High	Low	Last	Last Div.	
GOLD						
Alaska Gold	New York	[illegible]			....	..
Alaska Juneau	New York	1½	1	1⅛		..
Carson Hill	New York	15	13	13		..
Cresson Consol. G.	N. Y. Curb	2[illegible]	2½	2 9/16	Apr. '22, Q, X	$0.10
Dome Extension	Toronto			*85		
Dome Mines	New York	27	25	27	Apr. '22, Q	1.00
Florence Goldfield	N. Y. Curb	*30	*20	*26		
Golden Cycle	Colo. Springs	*70	*67	*70	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*14	*8	*10	Dec. '19,	0.05
Hollinger Consol.	Toronto	9.75	9.50	9.70	Apr. '22,	0.05
Homestake Mining	New York	75	72½	73	Mar. '22, M	0.25
Kirkland Lake	Toronto	*49	*46	*47		..
Lake Shore	Toronto	2.45	2.30	2.38	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	19.00	18.25	18.75	Jan. '22, K	0.05
Porcupine Crown	Toronto	*29	*26	*27½	July '17,	0.03
Porcupine V. N. T.	Toronto	*32¼	*31	*31		.
Portland	Colo. Springs	*30	*30	*30	Oct. '20, Q	0.01
Schumacher	Toronto	*55	*52½	*55		.
Silver Dies	N. Y. Curb	*17	*14	*17		. .
Teck-Hughes	Toronto	*57	*50	*56		.
Tom Reed	Los Angeles	*60	*58	*58	Dec. '19,	0.02
United Eastern	N. Y. Curb	1[illegible]	1 7/16	1 7/16	Jan. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*12	*10	*12	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*9	*6	*9		..
Wright Hargreaves	Toronto	3.00	2.85	2.95	Apr. '22,	0.02½
Yukon Gold	N. Y. Curb	1[illegible]	*96	1⅛	June '18,	0.02½
SILVER						
Batopilas Mining	New York	1⅛	1	1	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*36	*34¼	*34¼	May '20, K	0.03
Coniagas	Toronto	1.30	1.25	1.30	May '21, Q	0.12½
Crown Reserve	Toronto	*20	*17	*19	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	4	3	4	Apr. '22, Q	0.12½
La Rose	Toronto	*35	*31	*33	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*24	*23	*24	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.10	1.00	1.10	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6[illegible]	6	6¼	Apr. '22, Q, X	0.30
Ontario Silver	New York	8	7	7	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb			*12	Jan. '12,	0.10
Temiskaming	Toronto	*35	*33	*34	Jan. '20, K	0.04
Trethewey	Toronto	*6	*4	*4	Jan. '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*23	*19	*20	......	....
Cash Boy	N. Y. Curb			*4	......	....
Dolores Esperanza	N. Y. Curb	2⅛	2	2⅛		
El Salvador	N. Y. Curb	*5	*4	*5		
Jim Butler	N. Y. Curb	*8	*8	*8	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	*5	*5	*5	June '16,	0.05
MacNamara M. & M.	N. Y. Curb	*12	*8	*12	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1	1⅝	1	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*85	*71	*81		
Tonopah Extension	N. Y. Curb	1 9/16	1½	1 9/16	Apr. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1⅞	1	1⅞	Apr. '22, SA, X	0.07½
West End Consol.	N. Y. Curb	1 3/16	1⅛	1 3/16	Dec. '19, SA	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*6	*6	*6	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*95	*95	*95	Dec. '20,	0.15
Chief Consol.	Boston Curb	4	3½	4	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	24	23½	24½	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†2.35	†1.50		July '20, Q	0.10
Daly-West	Boston	2	2	2	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†3	†2	2½	Apr. '21, K	0.05
Electric Point	Spokane	*9	*7	*8	May '20, SA	0.03
Federal M. & S.	New York			11	Jan. '09,	1.50
Federal M. & S. pfd	New York	40	39½	40	Mar. '22, Q	1.00
Florence Silver	Spokane	*24	*23	*24	Apr. '19,	0.01½
Grand Central	Salt Lake	†*68	†*56	*57	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	6⅛	5⅞	6⅛	Mar. '22, Q	0.15
Iron Blossom Con.	N. Y. Curb	*22	*19	*20	Apr. '22, Q	0.02½
Judge M. & S.	Salt Lake	2.50	†2.00	2.60	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*7	*7	*7	June '21, I	0.02
Prince Consol.	Salt Lake	*5	*3½	*3½	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*4	*4	*4	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*10	*8	*10		
South Hecla	Salt Lake	†*65	†*35		Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*16	*13	*14	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*15	*13	*13	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.37	2.25	2.37	Jan. '21, K	0.04
Tintic Standard	Salt Lake	1.80	1.77½	1.81	Dec. '21, Q	0.05
Utah Apex	Boston	3½	3¼	3¼	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb			*2	Nov. '17,	0.01
VANADIUM						
Vanadium Corp.	New York	44¼	41½	43¾	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	62	62	62	Apr. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	80	80	80	Apr. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	17½	16½	17	Nov. '19, Q	1.00
Texas Gulf	New York	43¾	41½	42	Mar. '22, QX	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	59	56	58½	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	97½	97	97½	Mar. '22, Q	1.75
Am. Sm. Sec. pf. A	New York	92½	92	92¼	Apr. '22, Q	1.50
U. S. Sm. R. & M.	New York	41½	38	41½	Jan. '21, Q	0.50
U. S. Sm. R. & M. pf.	New York	45	44½	45½	Apr. '22, Q	1.75

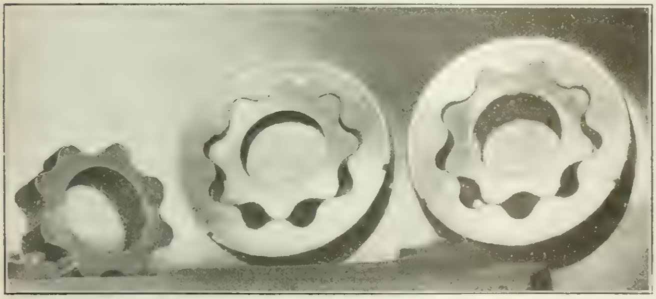
* [illegible] share. †Bid or asked. Q, [illegible] M, Mon[illegible] K, Irregular. I, Initial. X, Inc[illegible]

T[illegible] Investment Co.; [illegible] Stock and Mining Exchange; [illegible] Chamber of Commerce; [illegible] Colorado Springs, The Financial Press.

NEW MACHINERY AND INVENTIONS

New Rotary Gear Movement Has Many Applications

A number of efforts have been made to devise a motor or compressor movement based on the rotary principle, but until recently all of these have resulted in failure. However, a type of gearing, built on an entirely new principle in mechanics, has been designed by Myron F. Hill, and it is stated that this overcomes the objections that have been presented by other designs. The construction is simple and extremely durable, because it involves only two moving parts, one rolling inside the other.


Hill rotary motor gear

The design comprises two gear wheels; one, a pinion, and the other an annular gear, the latter having one more tooth than the pinion, so that the teeth of one is always in theoretical engagement with the teeth of the other. The gears are mounted on eccentric axes so that the teeth mesh at one point and clear at the opposite point.

To assure contact between the teeth during compression the annular gear is driven, and as a result the gears will maintain efficient compression until the teeth have worn off. This construction steps pressures up through several stages in one mechanical movement between the suction and discharge ports. Used as a pump, the device is stated to be capable of creating a vacuum as nearly perfect as can be measured by a mercury column.

Liquid, preferably oil, is used for sealing purposes. The liquid seal is so applied as to enter the gear spaces as a mist and in such quantities as to keep down the heat of compression substantially and save considerable power in compression. The liquid mist, after discharge, is removed by a centrifugal baffle-plate separator incorporated in the housing with the compressor. The extraction of oil from the air is so complete that no oil can be detected on a cigarette paper held over the discharge port for long periods of time.

The gears appear to be just as tight after long and hard usage and some wear and lost motion as when new. Quantities of sand, scale, and indentures in the teeth have produced no appreciable effect. In other words, treatment that would put a piston and cylinder out of business fails to effect the gears.

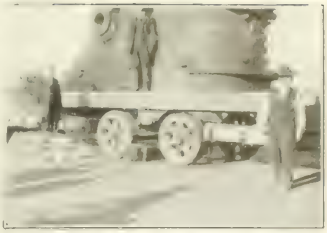
The maximum speed at which the pump can be run has not yet been determined. Those built thus far have operated satisfactorily at 4,200 r.p.m. A tiny air compressor supplied with Hill gears and mounted on the end of a one third horsepower electric motor was stopped at 370 lb. pressure per square inch to prevent the pipes from bursting.

The gears have been adapted not only to air compressors but also to the following: steam engines; oil and gas engines for autos, airplanes yachts, ships, and power plants; liquid pumps having a uniform delivery; and ice-making machines. There are many other uses to which the gears may be put, such as providing air for laboratories, gage-testing apparatus and portable air tools, and air pressure pumping. The gears have proved adaptable for any purposes for which the usual piston and cylinder are used, so far as is known and to many uses for which pistons and cylinders are not suited.

The Hill Engineering Co., 163 Remsen St., Brooklyn, N. Y., owns the patent rights upon all these developments, and purposes licensing others for their use and manufacture.

Trucks and Tractors Haul Thirty-Three-Ton Crusher Up 9 Per Cent Grade

The transportation of heavy machines and machinery parts is of considerable interest to mining engineers. A thirty-three ton rock crusher frame (36 x 48 in. jaw crusher) made by the Traylor Engineering & Manufacturing Co., was purchased by Dudley and Orr for their rock quarry on Mount Franklin near El Paso, Texas. The distance from the railroad unloading point to the quarry was five miles and the altitude over 800 ft. above the railroad. The stripped frame of the crusher was loaded on two special rubber tired trucks and was hauled by two five-ton trucks and two caterpillar tractors. A five-ton truck was in the rear pushing the load. The load was transported in twelve hours over the road leading to the quarry. The steepest grade was 9 per cent.


Rock crusher frame ready for transportation

Repairing a Car Axle Press

A job that is typical of the work being done by oxy-acetylene welders and cutters at mines and smelters is depicted in the accompanying illustrations, which show a 300-lb. hydraulic car axle press before and after being repaired.

Fig. 1 indicates the seriousness of the fracture, showing the broken press in two pieces, and Fig. 2 depicts the press after it was reclaimed by the welder. The latter view might easily be mistaken for a reproduction of an entirely new press, so well executed is the outer finish of the weld, and that its excellence is more than "skin deep" is attested by the satisfactory service the press is now giving under heavy working pressures.

The press shown is the property of the United States Smelting, Refining and Mining Co., at Midvale, Utah. The weld measured from 3½ in. to 6 in. in depth and was about 6 ft. 3 in. long. The job was executed with one blowpipe and required about 200 lb. of filling material. Oxweld equipment and materials were used.

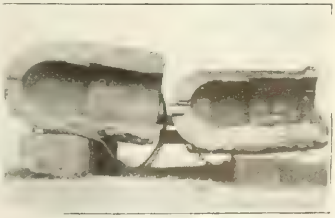


Fig. 1. Fracture of car axle press

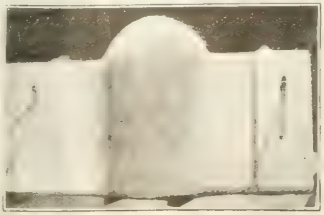


Fig. 2. Reclaimed car axle press

Gasoline-Driven Shovel Offers Low Fuel Cost

The development of a gasoline-operated shovel is distinctly novel, particularly when it embodies the Bucyrus method of operating the thrust without the use of an independent engine mounted on the boom whereby even more power is obtainable than with a steam shovel of the same size. After a period of experimentation, the use of a Diesel-type engine has been applied to this shovel. The importance of this announcement lies principally in one outstanding fact, the fuel cost.

It is claimed that the shovel, manufactured by the Bucyrus Co., of South Milwaukee, Wis., and known as the Bucyrus 30-B oil shovel, will use as fuel any cheap, low-grade oil of high heat value which will flow freely. Tests have shown that with fuel oil at 6c. per gallon this machine will consume 1¾ to 2¼ gal. of fuel oil per hour. This amounts to a fuel cost of 10½c. to 13½c. per hour, or, roughly, between $1 and $1.25 per day of average operation.

The economies thus made possible to a shovel or drag-line operator may be realized by comparison with a steam shovel of the same size. All practical men who read this know that the fuel cost of any shovel differs widely in different sections of the country. Conservatively stated, however, such a shovel will burn about 1½ tons of coal in ten hours. With coal at $6 per ton delivered, this means a daily fuel cost of not less than $9. A saving of $8 per day on fuel alone is thus possible. To this figure may be added several other items thus eliminated—notably, the saving made possible in not having to pay the cost of a team to haul water and coal.

The engine is of the full Diesel type, not the semi-Diesel. It is what is known as a mechanical injection engine, developing 55 hp. at the conservative speed of 360 r.p.m. Its cylinders are 8 in. x 10½ in. It is a heavy-duty, slow-speed engine of rugged construction, adapted well to the severe service which it must undergo in excavation work. This Diesel type engine differs from the gasoline engine principally in that it is a constant-pressure engine, the fuel being burned directly in the cylinders without the aid of a carburetor, spark plug, or outside heating appliances. In the gasoline engine the mixture is taken into the cylinders, compressed, and then ignited by some auxiliary mechanism. The pressure then rises in the nature of an explosion. In the Diesel type engine the fuel is injected into the cylinders at a constant pressure in an atomized state. It is fired by the heat developed by the compression of air in the cylinders on the previous stroke. Thus the sudden pressure due to the explosions in the gasoline engine is eliminated, making the engine operate more steadily.

The machine is furnished as a shovel, a drag line, a clamshell or a crane.

INDUSTRIAL NOTES

Herbert B. Wolcott was recently appointed representative of the American Manganese Steel Co. in the northern part of Mexico and El Paso County, Tex. He maintains an office in the First National Bank Building, El Paso, Tex.

The General Engineering Co. has received instructions from the Stargo mines of Morenci, Ariz., to proceed at once with the design and construction of a 100-ton plant to treat the ore from the Stargo mines at Morenci. Construction work will start at an early date, and it is expected that the plant will go into operation next September.

Contracts have been awarded by the Metals Refining Co. for the erection of an addition to its plant at Hammond, Ind. The Metals Refining Co. entered the field as a manufacturer of antimonial lead, babbitt and type metals three years ago. Its requirements of lead- and tin-bearing materials, battery plates, lead, tin and solder drosses are 150 tons per day.

The Tennessee Coal, Iron & Railroad Co., after a thorough investigation of the use of pulverized coal in steam generation, has decided to use it in conjunction with blast-furnace gas on new boiler installation at Ensley, Ala. The company has just closed a contract with the Fuller Engineering Co., of Allentown, Pa., for the installation of the complete coal drying, pulverizing, and conveying systems to serve this plant. Also, the burners and feeders for five 834-hp. Stirling boilers designed to operate at 200 per cent of rating.

The pulverized-coal equipment comprises the following:

One 5 ft., 6 in. x 42 ft. indirect-fired rotary coal drier, using blast-furnace gas for heating.

Two 46 in. Fuller-Lehigh gear driven, screen-type pulverizer mills, direct connected to motors.

One Fuller-Kinyon pulverized coal transport system, together with five take-off valves and six bin indicators.

Twenty-five Fuller S-H feeders.

Twenty-five Fuller-type vertical burners.

The boilers will be situated approximately 600-ft. from the pulverizing plant, and the fuel will be conveyed directly from the pulverizer to the boiler bins by means of the Fuller-Kinyon transport system. The fuel will be diverted from the main line to the individual service bins through distributing valves and branch lines. The bins will be equipped with automatic bin indicators which will keep the operator advised at all times as to the fuel conditions in the service bins.

The feeders will be similar to the Fuller S-H type which have proved satisfactory in a number of installations in other steel plants.

TRADE CATALOGS

Oil and Asphalt Testing Apparatus—The Braun Corporation, Los Angeles, Cal., has just issued catalog 189, "Oil and Asphalt Testing Apparatus," which illustrates, describes, and gives prices on various devices used in the testing of these minerals.

Steel Axles—The Pollak Steel Co., with general offices at Cincinnati, Ohio, has issued a 194-page data book relative to the specifications for industrial and mine car axles. A number of useful tables and general rules are included.

Forging and Heating Furnace—The need for better heating in forging and forming practice has led to the preparation of Bulletin No. 241, "Forging and Heating Furnaces," issued by the W. S. Rockwell Co., 50 Church St., New York City. Illustrations of typical equipment are shown.

Rolled Steel Products—The Pollak Steel Co., Cincinnati, Ohio, has issued a 136-page "Rolled Steel Products Book," which contains profiles, tables, and data appertaining to the manufacture of angles, I-beams and other various shapes of rolled-steel products that are used for general industrial purposes.

Thrust Bearings — The Kingsbury Machine Works, of Philadelphia, Pa., have recently issued Catalog C, "Kingsbury Thrust Bearings." The catalog has been completely rewritten and includes much new matter of considerable value to engineers in general and to users of thrust bearings.

Crushing Rolls—C. G. Buchanan Co., Inc., 90 West St., New York City, has issued Bulletin No. 13, which contains descriptions of Type C Buchanan crushing rolls. Several tables showing the capacity in cubic feet per hour of rolls of different width of face and at various speeds are also given.

Material Handling Machines—A thirty-two-page catalog, No. 4, issued by The Barber-Greene Co., Aurora, Ill., illustrates and outlines the specifications of the Barber-Greene material-handling machines, which consist of self-feeding bucket loaders, portable belt conveyors, and permanent belt conveyors for the handling of all kinds of bulk material.

Power Transformers—The Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has issued bulletin No. 1108 on "Power Transformers." There has been a steady increase in the size of power transformers, and with the growth of large transmission systems, voltages which a few years ago were considered impracticable are now generally employed. The bulletin, comprising thirty-two pages, details and illustrates the various types of apparatus.

T. A. RICKARD
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Volume 113 New York, May 6, 1922 *Number* 18

Are the Non-Metallic Mineral Industries Unprogressive?

THE IMPRESSION PREVAILS pretty generally that one particular branch of the mining industry is inclined to be less progressive than the others; that branch is the one devoted to the production and preparation for the market of those minerals that for convenience may be grouped under the classification of non-metallic. The tendency, it seems, is to perpetuate the methods and mechanical devices of fifty years ago and to frown upon suggestions that more effective and more economical operation could be accomplished by the introduction of more modern methods and equipment. We make no blanket indictment, but merely direct attention to the fact that experienced investigators, working from an entirely disinterested point of view, have concluded in various instances that whole industries are suffering from the failure to appreciate the value of, or at least to apply, up-to-date methods, machinery, and policies.

We are reminded forcefully of this by reading a rather satirical communication written by the manager of a large firm engaged in the mining and grinding of one of the important non-metallic minerals. Speaking in behalf of the industry at large, he makes some pointed rejoinders to sundry criticisms contained in a report made by an engineer for the U. S. Bureau of Mines who recently undertook an investigation of the industry. We have no intention of taking either side on this particular controversy; but in discussing it we find an opportunity to make some pertinent suggestions that may be useful.

Frank Criticism from the Bureau of Mines

The report in question is indeed critical—adversely critical. If the representative of the Bureau found anything commendable in the conduct of the industry he failed to mention it. The only attempt to mitigate the force of his condemnation was the willing admission that inherent conditions make it impracticable to correct some of the faulty and inefficient practices. With respect to the technical side of operations he says that "there is a great need of more adequate engineering and chemical control in mines and mills" and that "out-of-date, inefficient methods and equipment for mining and grinding are in common use." He says that "secretiveness" on the part of many companies tends to the "preservation of obsolete methods," and he offers some concrete detailed advice as to changes that ought to be made. Lack of co-operation among producers is assigned as the cause for sundry inexcusable practices in the grading and the marketing of the product; the economic administration of the industry is as inefficient as the technical, in the estimation of the critic.

We can appreciate the feelings of a manager who has devoted thirty years to the study of a particular process, when he reads a sweeping criticism of the entire operation by a man whose direct information on the subject has been acquired in thirty days. We give the executive credit for more than reasonable self-restraint when he protests that "whereas there may be instances that give color to all of Mr. ———'s assertions, we feel that they do not apply to our industry as a whole." Some of the sarcasm that follows is less mild. We surmise that the condemnation is too sweeping, and are inclined to believe that the facts do not justify the hopelessly gloomy picture painted by the engineer of the Bureau.

Good Medicine Is Sometimes Bitter

Nevertheless, the reply reminds us of the accused colored gentlemen who declared that, in the first place, he didn't borrow the frying pan; second, that he returned it in perfect condition; and third, that it was already cracked when he took it. The defender of the industry avers that his company is not secretive, but adds that it feels under no obligation to throw open its plant to visitors; he disclaims a tendency to stick to obsolete machinery in the design of new plants, but adds that his company is spending its own money and has an inalienable right to spend it as it wishes. To which no one will demur.

As a detached observer we half suspect that careful introspection on his part may have revealed the fact to this particular manager that the harsh criticisms were not wholly inapplicable to his own company. However that may be, it seems reasonable to conclude that some of those engaged in this particular industry need stirring up. The obvious and platitudinous advice from the Bureau may be irritating, but most of it is sound and deserves consideration. If a man needs medicine he should not refuse it simply because it is bitter.

An industrial enterprise of any size that depends for success upon secret methods of technical manipulation is unstable at best. Too many workmen are going from one plant to another to permit such veils of mystery to survive. The time was when metallurgists in Western smelters guarded their operations jealously, but that attitude no longer prevails. A frank exchange of experiences and views, and of the result of research, has been found mutually beneficial. Rivals compete with each other in the open; they strive for improved methods, machines, and organization, and the result is increased efficiency all around. Where the attempt is made to preserve secrecy, initative and efficiency and progress are stifled; the inevitable result is economic waste.

It is trite to say that progress in the development of processes and of machinery for the mining and treatment of ores has been phenomenal during recent years. Those engaged in the exploitation of metallic mineral deposits have usually been willing to try new plans, and the result has been a remarkable decrease in the cost of mining ore and preparing the metal for market. Have the producers of non-metallic minerals been less progressive? And have they suffered as a result? We make no charge. We ask a question. We want the producers to answer the question to themselves—and to answer it honestly. Many of their problems of mining and of ore dressing are essentially the same as those that present themselves to the producers of copper, lead, zinc, silver, gold and tungsten. The fact that their final product is not a metal does not make them any less a part of the mining industry.

A Confession and a Pledge

And this brings us to a confession that we make willingly in behalf both of the *E. & M. J.* and of the *M. & S. P.* Heretofore neither paper has accorded to the nonmetallic mineral industries the attention that their importance warrants. They were not ignored; neither were they given deserved recognition. The policy of the *Journal-Press* is to be different. We desire especially to serve those engaged in these branches of the mining industry, and to this end we invite them to make use of our pages as a medium for exchanging views regarding the economic and technical phases of their work. Possibly the unconscious and unintentional inhospitality of the technical mining press has been responsible in part for the apparent reticence of producers of nonmetallic minerals. If so, we have been guilty of contributory negligence. We regret it. Moreover, we have reformed.

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Preventing Accidents

STATISTICS have been accused of mendacity, but the verity of some of them is apparent, although it is possible to obfuscate facts by the omission of essential information. The recording of accidents, however, offers little scope for an evasion of the truth; hence it is encouraging to be able to record, with little fear of contradiction, the satisfactory progress made during comparatively recent years in this important feature of industrial operations.

Our larger corporations are setting an excellent example in this respect. The annual report of the American Smelting & Refining Co. is accompanied by several brochures for the information of stockholders, but the data given are worthy of a wider publicity. Informative statistics on the progress of accident prevention in the company's smelting and refining plants in the United States are given in one of these, from which it is to be noted that a steady decrease in the number of disabling accidents has taken place since the initiation of the safety-first campaign. The accident rate per 300,000 man-shifts—an arbitrary figure taken to represent the employment of 1,000 men for one year—has been reduced from 264 in 1913 to 63 in 1921. The actual number of disabling accidents occurring during the same period has fallen from 2,746 to 318, a decrease of 76 per cent.

The proportionate increment to the payroll, as measured by the expenditures in connection with the safety-first campaign, depends, of course, on the extent of operations; the total for 1921 amounts to $66,000, which is abnormal. However, it is reasonable to assume from the data supplied that in the absence of the safety-first campaign the number of such accidents during 1921 would have totaled about 1,345. Thus it is seen that about 1,000 accidents have been prevented at a cost of $66,000, or about $7 per accident. This is a small sum in comparison with the actual harm arising from such occurrences, such damage including the effects of disorganization and uncompleted tasks, and the cost of delays, labor turnover, and idleness.

Statistics are proving that the prevention of accidents is good business. When it is realized more fully that the safety-first campaign benefits the employee as well as the employer, the mining community as well as the stockholders, it will cease to be regarded in some quarters as a paternalistic interference with the so-called right of the workman to continue to act as he was accustomed to act before the industrial world awoke to the need for the efficient utilization of labor and the conservation of man-power.

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Melons and Metallurgic Efficiency

THE FIRST STEP toward the payment of a dividend is to secure the maximum amount of valuable material from the ore before it is discarded as waste. In this connection it is interesting to note that "melons" are seldom absent from the financial statements of companies in which the results of the metallurgic practice in vogue are worthy of especially favorable comment.

The wisdom shown in the selection of methods of operation in isolated localities is often undiscernible, but there are exceptions. The Mysore Gold Mining Co., of India, has realized gold to the value of over £20,000,000 from about 6,000,000 tons of ore since the beginning of operations in 1884. Until the end of 1921 the dividends paid by the corporation aggregated over £9,000,000. The management is in capable hands; the technical control of operations has been commendably conservative in refusing to disregard the advantages of following proved practice. Stamp mills are used, and 65 per cent of the gold is obtained by amalgamation.

Thanks to efficient impoverishment, the tailing going to the cyanide plant is low grade, and an average residue of 4.25 grains (about 18c.) is obtained at small expense. The cost of milling and amalgamation is about 6s. per ton; the cost of cyanidation, including the re-treatment of tailing, is under 2s. per ton.

Neither the high recovery of gold nor the low cost of treatment would have been possible had a more complicated scheme of treatment been selected. The finding of a gold mine is often due to good luck; the payment of so high a proportion of the gross income in the form of dividends is an evidence, *inter alia*, of good management.

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Physical Condition and Individual Efficiency

EFFICIENCY AMONG INDUSTRIAL WORKERS depends on personal desire and personal ability. The urge to do well is a subject that will not be considered now; it has been discussed elsewhere. The ability to achieve, however, depends to a large extent on the physical condition of the worker. He must neither be dyspeptic or choleric; he must have good hearing, sound teeth, and, most important of all, he must have good eyesight. The most hardworked and most neglected organ of the human mechanism is the eye. Nature has provided us with two eyes, which is an insurance against complete disaster; but the evolution of man has led to an abnormal increase in the amount of work the eyes are called upon to perform—an increase that has not been equaled by any other part of his anatomy.

The treatment accorded to one's eyes is seldom fair or logical. The diversity of tasks involving what is called close work has proceeded at a rate ahead of the evolution of a fool-proof optic, and much distress has occurred in consequence. We are unusually dependent on our eyes. None but those who have suddenly become temporarily or permanently blind can gage the realization of dependence on sight and the immensity of the catastrophe that for a time at least appears overwhelming. Luckily such happenings are rare, but nevertheless it does not absolve us from paying particular attention to our own eyesight as well as to the eyesight of those in our employ.

There is little occasion for undue strain in mining and metallurgical work, for the average duties of an engineer involve a broad vision in all the accepted definitions of the phrase. Nevertheless, tasks involving study and reading, mapping and drawing, are as essentially a part of the duties of the mining engineer, as they are of other technical workers. Specialists in sundry branches of the industry are obliged to use the microscope, to manipulate a balance of unusual sensitiveness, or to observe with great care the reactions that depend on infinitesimal changes in the color of solutions during chemical analysis and control. These operations require good sight. Consulting engineers, and others who would leave their mark behind them, are obliged to write extensively, for professional purposes or because they realize and appreciate their obligations and duties to the industry at large. It is becoming more generally recognized that ability to write is the one essential feature that distinguishes man from the lower animals. He should take full advantage of that superiority, and to do so effectively he should conserve his eyesight.

Sooner or later a general or local physical defect usually leaves a heritage of trouble that will lead to the development of weakness in the eyes, with a reflex action on the general health. The change may come so suddenly that it is difficult to believe that any extraneous assistance to sight is needed; but generally it is. In considering the question one must admit that there are two extremes of opinion: the one emanates from the man who believes that as long as he can see at all he need take no steps to correct failing vision; the other comes from the dealer in glasses who seldon lets anyone leave his store without having been fitted with artificial aid to vision. The subject should not be sidetracked because both extremes are abnormal. It is evident that there is much neglect, and that those interested in the sale of glasses are sometimes too hasty in prescribing corrective measures without paying due attention to the antecedent physical condition, which may have been the cause of the trouble. Much distress has resulted from the attempts of so-called oculists to correct defective vision by means of glasses that are designed suddenly to jerk the eyesight back to normal.

Industry as a whole needs more light on the subject. It needs facts, based on a scientific interpretation of conditions and results. Employers must go behind the scenes and educate their men on important matters such as the conservation of general health and the preservation of eyesight. The primary essential is that lighting conditions should be adequate and satisfactory, and that everything should be done before recourse to an artificial aid to sight is accepted as inevitable.

The use of exceptionally small type is seldom necessary; it is the cause of much premature blindness. Religious manuals, to be read in badly lighted interiors, should be printed in type of reasonable size. To ruin deliberately so wonderful a mechanism as the eye is an act from which every engineer should recoil. Individuals who spend their time at a task such as the engraving of the Lord's Prayer on the head of a pin should be placed under observation.

Industry's most urgent need is the avoidance of waste, not the elimination of it, for that infers that it is occurring. The report on this subject issued recently by the Federated American Engineering Societies deals, *inter alia*, with the care of the eyes. Some industrial organizations are taking remedial measures. One company employs a specialist. Another arranges for examinations at a reduced rate to the employee. The results are often of significant value to the industry and to the country as a whole. In one instance it was found that out of each 100 employees, 8.4 per cent needed no glasses, 8.3 per cent already had glasses that were satisfactory, and 83.8 per cent needed the services of an optometrist. A comparison of output from the factory before and after the defective eyesight of employees had been corrected showed that the improved efficiency amounted to 28 per cent.

A little more publicity on this subject will prove of great and lasting benefit, for it is obvious that much remains to be done. All employers of labor are responsible; and all employees should be interested, at least, in a matter that affects personal efficiency and comfort, as well as national success.

Use of Automatic Electrical Apparatus

AUTOMATIC water hoisting by electrical equipment, and subsequently automatic ore hoisting at Inspiration and in the mill of the now defunct Alaska Gastineau are well-known examples of the flexibility of electrical apparatus and the high state of development in electrical engineering.

During the last year or more there has been a noticeable increase in the number of automatic installations. An electrical engineer informs us that more than 100 automatic substations have been installed in coal and metal mines during the last year, especially in the last few months. This is significant of the trend of mining companies toward greater economy.

Automatic substation equipment is applicable, apart from the unusual hoisting installations, to pump, compressor, and transportation operation. Pumps and compressors are automatically started and stopped when required. Direct current is supplied when needed by the trolley system, and at other times the unit is shut down. Automatic substation operation has the advantage of absence of stand-by losses, and thus economy in power, a direct saving in labor, and the avoidance of damage to electrical apparatus caused by abuse due to ignorance.

Molybdenum Steel a Success

MOLYBDENUM is quietly acquiring a position of some importance as an alloying material for steel. It is used to a constantly increasing extent to take the place of vanadium and other alloying elements, although best results are secured by the use of certain of these elements in addition to the molybdenum. Some of the most successful molybdenum steels, for example, contain chromium also; or nickel, or vanadium, may be used. Only a small proportion of molybdenum is required, usually from 0.2 to 0.4 per cent, which is 4 to 8 lb. per ton, so that no large demand for molybdenite is likely to arise, and the Colorado deposits at Climax, northeast of Leadville, will be sufficient to supply the market for some time. Nevertheless, prospectors and economic geologists must no longer ignore possible molybdenite deposits as being of little or no value.

The principal virtues of molybdenum as an alloy for steel are embraced in its ability to increase the elastic limit and resistance to fatigue, and to decrease brittleness. Metallurgical problems, such as that of keeping the molybdenum in the steel and making a homogeneous alloy, have been solved.

One of the chief uses promises to be in automobiles. For some time the Wills Sainte Claire has been advertised as "the mo-lyb-den-um car," and it is understood that the Nash, Chevrolet, and Studebaker have adopted the new alloy, or will do so shortly. The Studebaker will soon be made entirely of molybdenum steel with the exception of springs.

THE JOURNAL-PRESS STAFF

FELIX EDGAR WORMSER

THE GREAT WAR marked the beginning of the recognition of the engineer as a factor in governmental affairs, as it brought to the front all of the latent talent in every department of industry and science that the most intensive effort on the part of the Government could effect. After peace came, the *Engineering and Mining Journal* found an opportunity to call into its editorial staff Felix Edgar Wormser, who had distinguished himself through his work with the *Journal's* Editor-in-Chief, in the Bureau of Mines, as a mining engineer engaged in its minerals investigations, and in the settlement of the war minerals claims resulting from the Government's stimulation of the production of essential materials.

Mr. Wormser was born on Oct. 3, 1894, at Santa Barbara, Cal. In 1901, he came to New York City with his parents, and from 1908 to 1912 was a student in Stuyvesant High School. He entered Columbia University in 1912, taking a mining course and winning a Morgan scholarship in 1915. Mr. Wormser was stroke oar on the 'Varsity crew in 1915, and during his course became a member of Delta Upsilon and Theta Tau fraternities. He was graduated in June, 1916, with the degree of Engineer of Mines, and immediately thereafter went to Oregon as a mining engineer for the Snake River Mines Co., at Huntington, Ore., and the Baker Mines Co., at Cornucopia, Ore., doing some work of a geological nature also for the Cornucopia Mines Co., of the same camp, and aiding the manager in his activities. While employed at the Baker mines, Mr. Wormser took an examination as a United States Mineral Surveyor and received an appointment, becoming the youngest mineral surveyor in the state. At the outbreak of the War, he enlisted as a private in an engineering unit situated in Washington, becoming a second lieutenant after being ordered to, and completing his training in, the Engineer Officers' Training School at Camp Humphreys, Va. In March, 1918, he received an appointment to the U. S. Bureau of Mines, under J. E. Spurr, on minerals investigation and war minerals relief work, being responsible for several papers issued on the metal situation.

In April, 1920, Mr. Wormser joined the staff of *Engineering and Mining Journal*, specializing in the work of the paper having to do with metal quotations, the markets, and in the non-metallic minerals, and conducting, also, the departments devoted to consultation and company reports. Readers of *Engineering and Mining Journal* and of the *Journal-Press* are familiar with his Market Studies, which have attained general recognition as authentic and trustworthy analyses of metal and mineral production and marketing conditions. A paper on this subject, "The importance of Foreign Trade in Copper and Other Metals," was published under his signature in the March, 1921, issue of the *Annals* of the American Academy of Political and Social Science, which was devoted to the foreign trade problems of the United States.

FELIX EDGAR WORMSER

Mr. Wormser was married to Elsie Wolff at St. Paul's Chapel, Columbia University, on March 18, 1920, and makes his home in New York City. He is a member of the A. I. M. E. and of the Columbia University Club.

More than six feet two inches tall, and possessing a long "reach," Mr. Wormser is admirably fitted for boxing, which is his favorite indoor sport, although he owns, also, to some experience on the tennis court.

The junior member of the staff, Mr. Wormser has evinced marked adaptability to the requirements of technical journalism, and his office associates believe that he will attain the same warm popularity and esteem with *Journal-Press* readers that he enjoys among the members of the *Journal-Press* force.

In accordance with the policy recently adopted by *Engineering and Mining Journal-Press*, of establishing a closer contact between the field and the editorial office, Mr. Wormser will, during May and June, make a trip through the Black Hills gold-mining region of South Dakota and the Montana mining districts, where he will devote especial attention to those activities centering in Butte, visiting, also, the Cœur d'Alene, Idaho, mining region.

The Strike on the Rand

By T. A. Rickard

THE recent labor troubles on the Rand are interesting not only because they led to a complete cessation of operations in the mining district from which the world derives 45 per cent of its annual supply of new gold but because they involved other features of more than local interest. I venture to review the course of events because the American mining public may wish to know something about the issues that were at stake.

The strike arose in the first instance from an effort to reduce the wages of the white employees in accordance with the higher cost of winning the gold and the declining cost of living. Besides the economic factors there was a political component as represented by an insurrectionary movement on the part of a communist group in the Labor party. This is an old story. In 1907 a strike was instigated by the same element, and also in 1914, just before the War. In South Africa the anarchist unfortunately is only too likely to win support from the small minority of recalcitrant Boers, not yet reconciled to British rule and unwilling to follow the enlightened leadership of such a man as General Smuts. The 'wild men' and the Afrikanders joined hands in the recent affray at Johannesburg, the protest of the unions against any lowering of wages being supported by those who were looking for an excuse to flout established authority.

During the War the British government laid an embargo on the movement of gold within the British dominions; there was no free market for gold, so that the South African producers had to sell their output at the arbitrary price of 84s. 11d. per fine ounce, and therefore lost the currency premium consequent upon the depreciation of the paper pound—not the gold sovereign—as measured in gold or dollars, which remained at a parity. Since July 24, 1919, the South African mining companies have been selling their gold on the London open market under a special contract between the Johannesburg Chamber of Mines, the South African Government, and the Bank of England. For a time the currency premium proved a great help to the mining companies on the Rand; in February 1920, when the pound sterling was worth only $3.26, the currency premium on gold reached 50 per cent and the South African companies sold their precious metal for 128 shillings per ounce. Since then the return toward normal rates of pound-dollar exchange has been rapid, and the price of gold in London has fallen to 94 shillings per ounce. If gold were to sell at par, that is, 84s. 11d. per ounce, only 8 out of the 39 mines that were active in December could be operated at a profit. In a statement prepared by the Chamber of Mines for the information of the Union Parliament it is asserted that seven mines employing 3666 Europeans, and expending £5,316,932 per annum in wages and stores, are already producing their gold at a loss; and when gold drops to the normal price, another 22 mines, employing 10,412 Europeans and expending £14,395,272 per annum, will be in the same predicament. Only 17 mines, employing 10,029 Europeans and expending £14,861,839 in wages and stores, would survive; and even in these mines many millions of tons of low-grade ore would become unprofitable, thus reducing their lives enormously. It is obvious that the assistance given to the gold-mining industry of the Rand by the currency premium is a temporary crutch to a badly crippled industry. The following facts are pertinent: the wages of the white workers increased 57 per cent between 1913 and 1920; since 1913 the cost per ton of ore has increased 29 per cent; since the War the cost of winning the gold has increased $2 per ounce. One is not surprised therefore to learn that the mining companies are making a resolute effort to set their house in order. So long as the depreciation of the paper pound compensated for the increased cost of operations they took no steps to reduce wages; a reduction of 1s. 6d. per shift was made last May, to remain in effect until October, when a further cut was to be made if the currency premium continued to decline. It did. In January of this year therefore the Chamber of Mines brought forward further proposals, including a reduction in the number of white employees. The strike followed.

One cause of trouble was the proposal to make more use of black labor. At the end of 1921 the total number of native workers was 178,000, as against 22,000 white employees. Heretofore the whites have acted chiefly as supervisors over the Kaffirs, in the ratio of 1:8; the Chamber of Mines proposed to diminish the ratio to 1:10½. The mine managers had come to the conclusion that it was necessary to lower the color bar and allow the natives to do some of the work now done only by the whites, because the Kaffir has learned to perform many tasks underground nearly as well as the European, and, of course, he represents a cheaper form of labor. The Kaffir's pay averages only two shillings per shift, plus his keep; whereas the white laborer receives 25 shillings per shift. The Kaffir works for five hours; the white, for eight. The proposal to lengthen the native's shift to the standard eight hours and to extend the range of his employment provoked racial prejudice. The early days of the strike were signalized by brutal attacks on the colored folk.

The strike started on January 10. On January 21 the Johannesburg trams stopped running. On February 5 the strikers assembled in public meeting and passed a resolution calling for the declaration of a republic. It was evident that sinister influences were at work to create a social disaster. Various outrages were committed. The repatriation of the natives was commenced in earnest. Many of them had to travel 1200 miles or more to reach their homes. On February 6 the Premier (General Smuts) and the Minister of Mines (Mr. F. S. Malan) received delegates from the Industrial Federation, representing the labor-unions, but the conference proved abortive. On February 11 General Smuts issued an appeal to the strikers and told them that their loss from eventual unemployment would be much greater if the strike continued than if they had accepted the original proposals for saving the low-grade mines. He said that it was useless to waste time in striving to arrange satisfactory terms of settlement, because the final arrangement of differences would have to be left to Parliament. after an impartial enquiry. The Industrial Federation contended that the profits of the rich mines should be used for the relief of redundant white workers and for the benefit of the poor mines. At a meeting of 4,000 strikers a resolution was passed expressing their intention to stand firm until they won the fight. On February 18 the white miners began to return to work in small numbers and operations were expanded at one or two mines. The price of gold continued to fall. About 4500 white men, including the staffs, were at work. The prospect of a settlement proved illusive. An outbreak of violence ensued. The Dutch became prominent in attacks on the returning workers. The use of the work 'commando' in describing organized groups of strikers is significant. Affrays between the mounted police and these cammandos became frequent. On February 27 a strike at the power station left Johannesburg in darkness. The Government intervened and manned the station. Dynamite explosions became numerous, and many Kaffirs were murdered. The natives showed a tendency to retaliate. On March 6 a general strike was called; to which the Government responded by proclaiming martial law on March 9. The Chamber of Mines made sundry proposals to the Industrial Federation, but the tone of these proposals was considered needlessly provocative. On March 11 a mimic war was blazing all over the goldfield, which extends for 40 miles along the Main Reef series of banket, or gold-bearing conglomerate. The strikers dominated the suburbs of Johannesburg, and fierce fighting indicated that a great crisis threatened the Union of South Africa. The Premier, General Smuts, responded to the call and himself proceeded to the mines with Government troops. On March 12 over 2000 rebels were captured. General Smuts issued a statement asserting that the revolutionary movement was the work of extremists, who were using the strike at the mines to disseminate their syndicalist views. Next day the Government forces, with artillery, began to surround the insurgent centers, the chief stronghold being Fordsburg, which was bombarded by aid of aeroplanes and tanks. Two of the rebel leaders were killed; 3500 insurgents were captured. On March 15 the strike came to a sudden end, by order of the unions. The Mine Workers Union, representing 21,000 men, passed a resolution dissociating itself completely from the "revolutionary movement". General Smuts asked the managers to show generosity in re-engaging the men. An official summary of the outbreak acknowledges the assistance given by the loyal citizens and the help offered to the authorities from every quarter of the Union in suppressing "what undoubtedly was to have been a social revolution by Bolsheviki, international Socialists, and Communists". No account of this revolt would be complete that did not record how admirably the police acted throughout these disturbances.

To those familiar with mining in other countries where colored labor is employed it seems wise on the part of the Rand companies to make an increasing use of the Kaffirs by training them for more effective work and thereby reducing the number of whites, many of whom are not only inefficient but have now proved themselves bad citizens. Experience in other mining regions, such as Korea and Mexico, suggests the wisdom of utilizing native labor and of dispensing as much as possible with imported labor, or even indigenous white labor. Moreover it is advisable to use only the best of the whites—the intelligent and humane—as bosses over the colored workers. The Kaffirs on the Rand are engaged under indenture and during their stay at the mines they are confined within compounds, where they are fed and housed by the companies. The duty of the managers is to treat them fairly and stimulate their interest in their daily task.

The interference of European anarchists, chiefly from Russia, was a sinister feature of this economic struggle; another was the active participation of an unruly element in the Dutch population. In 1913 the white force consisted chiefly of British and Americans; since then the young farmers of the Transvaal have taken to the mines, so that now 80 per cent of the white labor is said to be of Dutch origin. This accounts for the military organization of the insurgents and the general use of rifles. On the other hand, the better class of Dutch burghers proved themselves as loyal as in 1914 and did not hesitate to assist in suppressing syndicalism, even when represented by men of their own race. They responded promptly to the call of General Smuts and supported him vigorously. A recent marked increase in the number of Russian immigrants to South Africa had been noted, and there is good reason to believe that they embittered the struggle. The appearance of Russians and Russian funds wherever a revolt is started nowadays against constituted authority is one of the worst consequences of the soviet revolution. It has been a feature of the civil war in Ireland.

The outrages committed by the insurgent strikers on the Rand alienated public sentiment in the surrounding country and provoked an immediate rally to the side of constituted authority. If a man less capable or less respected than General Smuts had been at the head of the South African government, the result might have been much less fortunate. He has been criticized for his belated use of the military power, but it seems probable that he acted wisely in being slow to proclaim martial law, for this is a step that is repugnant to democratic principle and should be taken grudgingly. It remains to emphasize the peculiar danger of such outbreaks in a region where the whites are so largely outnumbered by the native black population. To start friction between the two races in the Transvaal is like lighting a bonfire in a lumber-yard or smoking a pipe in a powder magazine. Out of a total population of 7,150,000 in the Union of South Africa, only one-fifth is white. According to the 1921 census, the population of Johannesburg is 284,191, of whom 134,513 are colored. Another lesson of this outbreak of anarchy in South Africa is that governments are strong if supported by the consent of the governed and that it makes an enormous difference whether the head of the government be a man of high character or a mere politician; the revolt at Johannesburg was quelled easily and summarily because the side of law and order was represented by a sagacious and humane leader of men, one of the great men of this generation, Jan Christian Smuts.

Marketing Pyrites

In the article, "The Marketing of Pyrites," which appeared in our issue of April 8, 1922, Baltimore was inadvertently omitted as a center of pyrites consumption. Probably 200,000 tons of pyrites are consumed at this point in the chemical industries under normal conditions, according to available information.

The price mentioned for sintered cinder, 12c. per unit of contained iron, was the peak price at the termination of the war. It is now less, but as the price is governed by circumstances, it cannot be given precisely.

DISCUSSION

Kind Thoughts About the Engineer

Pithy Comment Challenging a Correspondent's Opinion as to the Country's Need of Six-Cylinder Super-Technicians

THE EDITOR:

Sir—Mr. Parker, in your issue of March 11, observes that my "Thoughts on Mining Education" seem almost unkind. They were not so intended, and I have been interested to note that President Judson of the University of Chicago, in a recent article, has expressed views on college courses, similar to mine on engineering education, and, curiously enough, in almost the same language. He says:

> "The American college curriculum is the outgrowth of accident. Its origin antedated any American university. It was at the outset supposed to have English sources—whether public school or Cambridge, or both. In fact, it grew as a hybrid—Rugby and Oxford, perhaps—something of both and not much of either, with gradual accretions from what American life seemed to demand. It never was definitely planned as a coherent part of an educational system, but took shape gradually, more or less fortuitously and with a very specific aim.
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> "A very whimsical situation is that in educational organizations. Few things, if any, are more complicated, more entangled one with another, more difficult to reconstruct in any new and simple way. A curious body is a group of educators seeking a solution of one of the many Chinese puzzles in their calling. There will be reams of paper showing how things are, how they came to be as they are, what are their many and obvious infelicities; then what a multitude of difficulties bristle in the way of every approach toward any new and desirable adjustment. Yes, there certainly should be radical changes, but any attempt to bring about such change will at once cause more trouble than it can possibly render service.
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> "The whole educational process has become too long, too involved, too repetitious. There is lack of cohesion, a very definite lack of sequence."

In your issue of Feb. 25 you print some comments by P. B. McDonald. He says he quotes me approximately as saying, "we need more foremen and assistant superintendents and fewer educated engineers of the type of Rossiter Raymond and Pope Yeatman." I am grateful for that word "approximately." If a person shoots at a target and misses it by a foot, he may be said to have approximated hitting it, and Mr. McDonald has in that sense approximated my meaning. He then goes on to indicate that he believes the country could use several thousand Hoovers. Mr. McDonald usually writes very lucidly, but he has become tangled in his thinking at this point, falling into the error which Hiram Maxim has clearly described in his little-known book on the art of writing poetry. Maxim points out that if you say a woman has a velvety voice, you are only trying to ascribe one quality of velvet to the voice. Velvet, however, has many qualities, and the hearer may be in some doubt as to which ones are meant. When Mr. McDonald says the country needs several thousand Hoovers, the quality that he means is probably Mr. Hoover's remarkable mind, which enables him to perceive, analyze, and indicate the remedy for difficult situations. It is generally agreed, however, that the quality of a man's mind—his intelligence—is not affected by his education. Let me make this clearer by a simile.

Take two generators, one 1,000 kw. and the other 1,500 kw. The 1,000-kw. generator may be delivering 1,000 kw., because it is working at full capacity. The 1,500-kw. generator may be delivering only 1,000 kw., because it is working below capacity—is out of order, or for some other reason. The 1,500-kw. generator has a 50 per cent greater capacity than the other, however; a fundamental difference of its original design. Between a Hoover and a John Doe there is a similar fundamental difference in mental capacity. We can determine the capacity of generators irrespective of their output, but usually we can only estimate the capacity of men from their output. Through lack of education, a man of great mental capacity may have a low output, just as the big generator may have a small output. But no amount of education will convert a man of small into one of great mental capacity, any more than by adjustment and polishing you can convert the small generator into a big one.

There can be no doubt, I think, that many men go through educative processes intended for a mental capacity far above what they possess, and a course planned for the exceptional man is ill adapted to the needs of the man who finds his level in subordinate work. The top sergeant would not, on the average, profit by taking the War College course intended for colonels and brigadier generals; indeed, it might seriously interfere with his usefulness as a top sergeant.

Take, now, Mr. McDonald's statement, "I think the country could use several thousand Hoovers, at least . . . ." This reminds me of the story of the Irishman, who, on eating a pie made of apples, but to which a few slices of quince had been added, remarked, "Begorra, if one quince can give such a taste to an apple pie, how would an apple pie made entirely of quinces taste?" The number of generals in Latin-American armies is an old joke, and, to bring the discussion on engineering ground, a works entirely equipped with 1,000-kw. motors, when in most places a 100-or 200-kw. motor would serve the purpose, would not be regarded as an efficient plant.

Probably I am only approximating Mr. McDonald's meaning, and what he has in mind is either the advantage that would accrue if our people had a higher average intelligence level or if there were more people of superior intelligence. To the first, I say a hearty amen, with the addition that I do not know of any method by which the general average can be raised, except eugenics. As to the second, I entertain a reasonable doubt. One Caruso or one Babe Ruth is enough to meet our needs. I believe, and I am quite sure a thousand Hoovers could not render one thousand times as much service to society as one Hoover does.

Washington, D. C. THOMAS T. READ.

How Should Depletion and Depreciation Be Charged?

THE EDITOR:

Sir—Some shareholders in copper-mining companies question charging depletion and depreciation as a cost account, or as an additional amount, as shown in the annual reports. The issue has been raised whether or not the amount paid for income and excess profits taxes should be included in the cost of producing copper, and the items of depletion and depreciation eliminated. It is argued that an amount is actually paid for taxes, but entries of depletion and depreciation are matters which are supposed to relate to accounting or bookkeeping only.

Frequently there appears in a statement of operations of a copper-mining company, in connection with production costs, the following: "Depletion only included," or "depletion and depreciation included," or "excluded," or "before depletion charges." In no reports are income and excess profits taxes so used.

It is suggested that if copper-mining companies would issue a supplementary report, in which was shown the cost per pound for taxes mentioned, that practice would convey to a shareholder the correct cost of production.

In 1917, it is stated, one large copper-mining company did not include as a production cost either depletion or depreciation. The amount of these entries was large, as was shown in the report. The taxes paid the government were about 50 per cent of the amount of the entries for depletion and depreciation. In 1918, the same company used both depletion and depreciation as a cost, and the Government taxes were only 11 per cent of the amount. In 1919, the same company used only depreciation as part of production cost, whereas the amount used for depletion and depreciation was large and the Government taxes were nil.

Presumably there are instances wherein the Government taxes are not adjusted for one or more past years. Nevertheless, when finally determined, should not shareholders, the question is asked, be sent a report of cost of production including the taxes?

To further illustrate the contention, another copper-mining company's statements for 1917, 1918, 1919, and 1920 were as follows: In 1917, no amount shown for depletion and depreciation; if amount paid for income and excess profits was used, the cost per pound would have been nearly 3c. more. In 1918, an amount was given as a production cost for depletion and depreciation, but if the amount of Federal taxes was used the cost would have been about the same. In 1919, both depletion and depreciation were used, but the Federal taxes were about four-hundreths of 1c. per lb. as against nearly 3c. for the former. In 1920, both depletion and depreciation were used, but Federal taxes were about one-hundreth of 1c. per lb. as against nearly 4½c. per lb. for depletion and depreciation.

Briefly stated, the essential question, as asked, is what justification is there for applying depletion and depreciation as a production cost instead of the income and excess profits taxes? M. W. YOUNGS.

Houghton, Mich.

Efficiency in Drilling and Blasting

THE EDITOR:

Sir—In an article in the *Engineering and Mining Journal* of March 18, 1922, B. F. Tillson discusses "Promoting Efficiency in Drilling and Blasting" and invites discussion, so I trust that he will not take it amiss if I disagree with some of his statements.

The first point is in regard to the effect of pressure on the rate of burning of fuse. Mr. Tillson says:

> "In general, it may be stated that the greater the pressure exerted upon a fuse, the slower the flame will travel in it. It therefore is evident that the portion of the fuse tamped in a drill hole will burn at a slower rate than that in free air. A more impervious covering, as a paper tape or a double or triple tape, will better confine the gases of combustion, increase their pressure and produce a slower burning rate. Fuse will therefore burn faster at high altitudes than at sea level."

From all of the evidence that I have been able to gather on this subject, I would say that just the opposite is true—namely, that the rate of burning of fuse is increased by subjecting the fuse to increased pressure. An exhaustive study of the subject was made by the Bureau of Mines and is published in Technical Paper 6, "The Rate of Burning of Fuse." The results, I think, are conclusive in establishing the fact that increase of pressure increases the rate of burning.

In regard to electrical detonators, Mr. Tillson says: "Electric exploders should never be connected in parallel, as their variation in resistance will cause the shunting of the blasting current chiefly through those of lowest resistance and the other holes will probably misfire."

Let us consider the facts. At the University of California we made a study[1] of some of the elements of electric detonators. We found from measurements of a great many bridges that the resistances of the cold bridges varied between 0.745 ohms and 1.29 ohms. The current necessary to fire a detonator was never greater than one ampere. If fifteen or twenty of these bridges are connected in parallel across a 110- or 250-v. line, it is quite evident that it will be impossible to have the shunting of current through the low-resistance bridges to such an extent that the other bridges will not receive enough current to fire the exploders.

Further experiments showed that different exploders, with the same current, required different times of application of the current to make them explode. If exploders are in series the same current passes through all, and some may fire and break the circuit before others are brought to the proper temperature for exploding. Therefore I feel confident in stating that, where a high-voltage circuit is available, the best results will be obtained by connecting the exploders in parallel. The source of power must be such that each exploder will get at least one ampere. If, however, a "battery" is used, and a large number of holes are fired, the exploders must be in series, because the current capacity of the "battery" is not large enough to supply one ampere to each exploder if they are in parallel.

When blasting with delay-action exploders, what is termed "no-delay" exploders may be used in the cut. These are detonators in which the explosion is retarded long enough to let the delay fuses get started.

Berkeley, Cal. WALTER S. WEEKS.

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[1] "A Study of Electric Detonators," by Carl T. Long and Hubert L. Pascoe. *Mining and Scientific Press*, June 19, 1920.

Plant of Coniagas Mines, Ltd., Cobalt, Ont., which has the lowest mining and milling cost in the camp

Cobalt—Its Past and Future*

A Study of the Geology of the District in the Light of a Recent Survey—Principles Worked Out by Miller Proved Correct—Important Structures Revealed by Operations of Past Decade—Years of Silver Mining Probably Remain

BY CYRIL W. KNIGHT

DURING ITS LIFETIME of eighteen years, Cobalt has produced in silver a sum of money equal to about one-eleventh of the national debt of Canada, or $23 for every man, woman, and child in the dominion.[1] The value in dollars of its silver output almost, but not quite, rivals the value in dollars of the silver output of the Comstock lode in Nevada; but in actual quantity of silver produced Cobalt has far outstripped the Comstock production (see Table 1). The dividends paid by the mines at Cobalt amount to over $84,000,000.[2] Records these, surely, to be proud of!

The total shipments of silver from Cobalt, including outlying areas, to the end of 1921 amounted to 322,858,563 oz., which sold for $198,099,336. The Comstock lode is credited with an output of $228,400,000 in silver, but it had also a great output of gold—namely, $153,000,000.[3]

Cobalt had none of the handicaps which fettered mining operations at Virginia City, such as the severe floods, which required years to drain, and the great increase in temperature with depth, this rising 3 deg. F. for every additional 100 ft. sunk. The ground at the Comstock was bad, necessitating an immense consumption of timber; whereas the quantity of timber required at Cobalt is, in comparison, of little consequence.

When it is remembered that most of the silver from Cobalt has been obtained from a surface zone about 300 ft. deep, and that none of it, with the exception of an insignificant and non-commercial quantity mined at the Beaver from a depth of 1,600 ft., was obtained from a greater depth than about 800 ft., these figures of Cobalt's production are impressive. Cobalt has truly proved to be a shallow camp. The Comstock lode, on the other hand, reached a vertical depth of 3,000 ft., although none of the great bonanzas were found below a depth of 2,000 ft.[4]

The comparison of the silver yield of Cobalt and Comstock is hardly, perhaps, a fair one, on account of the great yield of gold which the Comstock lode has had. In addition to the enormous yield of silver from Cobalt, the camp has produced a quantity of metallic cobalt and its compounds valued at about $9,000,000, and also a quantity of crude and white arsenic valued at about $3,000,000.

COBALT RESURVEYED AT REQUEST OF OPERATORS

The steady decline in the silver production of Cobalt during the last decade induced the mine managers of the camp about two years ago to ask the Ontario government for a geological resurvey of the camp. I was accordingly instructed by the Provincial Geologist of Ontario, Willet G. Miller, to undertake the work. The resurvey was carried out during 1920 and 1921, and required a year, this time being spent wholly underground, with the exception of a few days' work on the surface.

The extent of the underground workings at Cobalt is probably greater than is generally known. Including drifts, crosscuts, winzes, raises, and shafts, there are about 140 miles of workings. Most of these workings were accessible during the time that the resurvey was being carried on, so that it was possible to obtain a fairly complete record of the underground geology.

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*Published by permission of the Ontario Department of Mines.

[1] Ontario Department of Mines, Bull. No. 43, W. R. Rogers, statistician.

[2] Does not include dividends by private companies which do not publish their reports; including dividends of private companies, the proportion of dividends to total output would be about 46 per cent.

[3] *Mineral Deposits*, Second Edition, Lindgren, p. 518

[4] *Mineral Deposits*, Second Edition, Lindgren, p. 519.

As to the surface geology and the general structural relations of the rock formations, it need scarcely be mentioned here that these were worked out in the early days of Cobalt by Willet G. Miller. He has come to be known as the father of the Cobalt camp, and his report on the area has received world-wide recognition. It has passed through four editions, published during the years 1905, 1906, 1908, and 1913. Although many articles have appeared on these celebrated deposits, Miller's is the only report which in any sense constitutes a memoir. Copies are still available for distribution, as are also the geological maps which accompany it.

COMPREHENSIVE REPORT IN PREPARATION

It is now nearly a decade since Miller's last report[5] was published. Much mining has been done in the meantime. Moreover, as no attempt has been made by the Ontario Department of Mines to examine and map systematically all of the many levels and other workings of the various mines, it was considered advisable that this should be done during the resurvey. This has been accomplished, and the Ontario Department of Mines has now geological plans of most of the levels of the various mines. The plans show the veins, the kind of rocks, the faults, the mine workings in relation to the boundary lines of the properties, and so on. It is the intention of the department to publish these plans, together with a report. Probably the plans cannot be redrawn and the report printed until the end of the present year, or early in 1923. It has therefore been considered timely to issue now the brief summary which is given in this article.

In making the resurvey, the broad general principles of structure which were worked out by Miller in the early days of the camp were found to be correct; but extensive mining operations, carried on since Miller's last report was published, have revealed certain structures of great economic importance. These structures and their relationships to oreshoots could not be recognized and understood until mining operations had advanced beyond the stage reached at the time Miller's last report was issued.

MAIN FEATURES OF GEOLOGY OF COBALT DESCRIBED

Before describing the structures referred to in the preceding paragraph, it may be well to mention briefly the main features of the geology of Cobalt and outlying areas.

The rocks are of pre-Cambrian age. The oldest series, known as the Keewatin series, consists mainly of basaltic lava flows, interbedded with which are beds of "iron formation" consisting of slate, chert, and graywacke, the whole series of basalts and "iron formation" having been tilted up into vertical position. On this ancient basement rest rocks of the Cobalt series. This series is of immense economic importance for the reason that most of the silver has been mined from veins in it. It has been gently folded. It consists of conglomerate, graywacke, slate-like graywacke, and quartzite, having a maximum thickness of 600 or 700 ft. The Keewatin and Cobalt series have been cut by an enormous sill of diabase about 1,000 ft. thick in places. The sill is known as the Nipissing diabase and is of Keweenawan age. The solutions which formed the orebodies are believed to have emanated from this intrusion.

Though the formations referred to above constitute essentially the main geological features, it may be added that there are scores of lamprophyre dikes, 5 or 10 ft. or more in width, intruding the Keewatin series, but not intruding the Cobalt series. The area has been glaciated.

VEINS USUALLY A FEW INCHES WIDE

The veins, it may be recalled, are generally not more than 3 or 4 in. in width, and they are vertical or dip at steep angles. On account of the mineralization of the wall rock, the stopes at some of the mines are wide, reaching a width of 86 ft. in one instance. The mineral of most importance is native silver, with which occur arsenides of cobalt and nickel in a gangue of calcite or dolomite.

80 PER CENT OF SILVER FROM COBALT SERIES

In connection with the veins a prediction made by Miller in the early days of the camp may be mentioned here. In the notes on the geological map which accompanied Miller's first report[6] on Cobalt, published in 1905, Miller advised prospectors to pay most attention to the rocks of the Cobalt series, because he believed that most of the silver veins would be discovered in these rocks. The truth of his prediction has been proved to the hilt, as about eight-tenths of the total yield has come from these rocks.[7] Indeed, it has been the ghastly tragedy of Cobalt that most of the silver disappears from the veins when they pass downward from the Cobalt series into the Keewatin rocks. This tragedy is doubly poignant when it is remembered that in many instances the veins themselves, consisting chiefly of calcite, do persist deep into the Keewatin, in one instance, that of vein No. 64 on the Nipissing, to a vertical depth of about 800 ft. below the Cobalt series.

It has fallen to the lot of few geologists to size up and predict so profound a truth at so early a stage in the development of a mining camp.

SILVER ORESHOOTS FOLLOW COBALT-KEEWATIN CONTACT

Keeping in mind the general geological conditions outlined above, certain new structures of economic importance may now be described. These structures have been worked out by, and have gradually become apparent to, the mine operators during the last five or ten years.

One of the most important structures regarding the orebodies is the general occurrence of the silver oreshoots at and near contacts. The mine operators have found, for instance, that the silver occurs largely at and near the base of the Cobalt series, along the contact with the underlying Keewatin rocks. It has been shown that the silver oreshoots seldom rise more than 150 or 200 ft. above this contact, although the veins themselves, consisting mainly of calcite, do rise in many instances higher than this. Though the silver oreshoots may rise 200 ft. above the Keewatin contact, they rarely, except as hereinafter mentioned, penetrate more than 25 ft. into the Keewatin.

One of the clearest examples of how the silver oreshoots follow the contact between the Keewatin and

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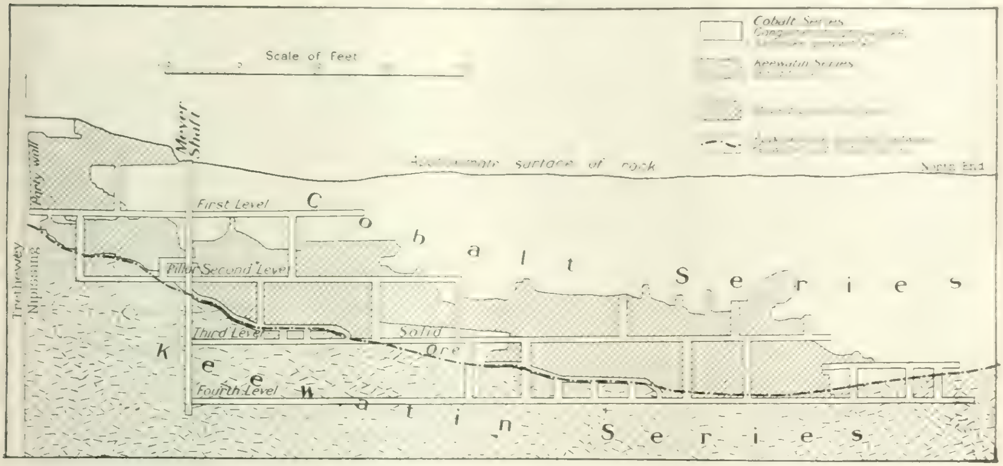
[5] Report of Bureau of Mines, Vol. 19, Part 2, 1913, "The Cobalt-Nickel Arsenides and Silver Deposits of Temiskaming (Cobalt and Adjacent Areas)," by Willet G. Miller, Provincial Geologist of Ontario.

[6] Report of the Bureau of Mines, 1905, Part 2, "The Cobalt-Nickel Arsenides and Silver Deposits of Temiskaming," by Willet G. Miller, Provincial Geologist of Ontario.

[7] *Transactions* Canadian Mining Institute, Vol. 15, p. 239. "The Probable Total Production of Silver from the Cobalt District," by G. R. Mickle.

Cobalt series is found in the Meyer vein of the Nipissing Mining Co. The oreshoot of the Meyer vein rises only an average height of about 110 ft. above the Keewatin, as shown in the vertical section on this page. This vein is one of the most important in the Cobalt camp, but on the surface it is a barren calcite vein about ¾ in. wide, except where the rich oreshoot is exposed at the surface toward the west end, owing to erosion. The vertical section here shows that the vein has been stoped for a length of 1,100 ft. Practically none of this vein was productive of silver in the Keewatin series, nearly all of the silver having been mined from that part of the vein which occurs in the overlying Cobalt series. I am indebted to R. B. Watson, general manager of the Nipissing Mining Co., for the information illustrated by the vertical section given. It may be added that Mr. Watson first pointed out to me that the silver oreshoot of the Meyer vein closely followed the Keewatin contact.



Vertical section through Meyer vein, Nipissing mine, Cobalt, showing how oreshoot follows contact between Keewatin and Cobalt series

There are other important examples of the remarkable occurrences of silver oreshoots at and near the base of the Cobalt series along this Keewatin contact. Another instance may be mentioned—that at the north end of the City of Cobalt property, now owned by the Mining Corporation of Canada. The vein system here consists of several veins, and it has been found that the silver oreshoots rise from only 100 to 175 ft. above the Keewatin contact. Moreover, these veins are scarcely noticeable at the surface, which is in places 300 to 400 ft. above the Keewatin, or, in other words, the Cobalt series has a thickness of 300 to 400 ft. in this part of the camp.

VEINS IN KEEWATIN SERIES ALSO IMPORTANT PRODUCERS

Although by far the largest part of the silver has been obtained from veins in the Cobalt series, near the Keewatin contact, it may be pointed out that important quantities of the metal have been mined from veins occurring in the Keewatin series. But the silver in these Keewatin veins appears to have been deposited under the influence of another contact.[5]

This is the contact which the great Nipissing diabase sill makes with the Keewatin series where the sill cuts the Keewatin, as illustrated on page 764. Oreshoots have been mined along the upper contact of the sill and along the lower contact. Two important producers from the upper contact have been the Temiskaming and Beaver mines, contiguous properties with veins passing from one property to the other. The combined output of the two mines was about 18,000,000 oz. of silver, of which the Beaver accounted for about one-third. Most of the silver—about 85 per cent—came from within 125 ft. of the contact, both the Keewatin series and the Nipissing diabase being productive, but the Keewatin producing most of the ore. Though the veins in the Beaver and Temiskaming rise as high as 600 ft. above the Nipissing diabase sill, and descend into the sill at least 200 or 300 ft., let it be emphasized again that the high-grade silver ore occurs largely within a distance of about 125 ft. of the contact.

BEAVER AND TEMISKAMING ORE NEAR IRREGULARITY IN DIABASE SILL

In passing, one may note that the oreshoots at the Beaver and Temiskaming occur near what looks like a sharp fold in the Nipissing diabase sill, shown on page 764. There is no evidence, however, to prove that the sill has been folded in this manner. Probably the molten sill took that shape during its intrusion; but the occurrence of the silver near this sharp irregularity of the sill may be noted.

The orebodies at the Temiskaming and Beaver mines illustrate, curiously enough, that old and much-abused saying of certain prospectors that "the ore will get better as you go down." The explanation for the increasing richness of the ore in the Beaver and Temiskaming is now seen to be simple enough, in the light of actual mining operations; that is to say, most of the high-grade ore was found to occur along the contact of the diabase sill with the Keewatin.

At the O'Brien mine the silver oreshoots occur not at the upper but at the lower contact of the sill; and it has been found that most of the ore is confined to within 100 ft. of the contact. At the O'Brien, however, the diabase produced about three-quarters of the silver, whereas at the Temiskaming and Beaver the Keewatin was the more productive.

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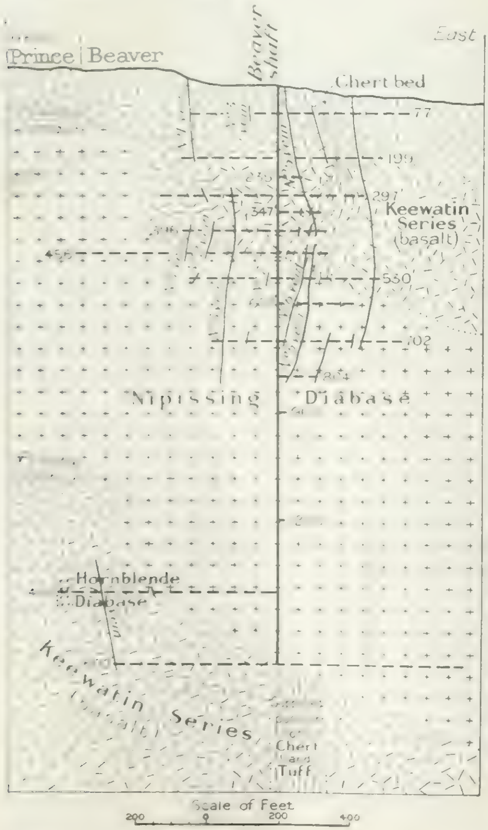
[5] Report of the Ontario Bureau of Mines, Vol. 19, Part 2, 1913: p. 125. "The Cobalt-Nickel Arsenides and Silver Deposits of Temiskaming," by Willet G. Miller.

LAW OF CONTACTS MAY BE APPLIED TO PROSPECTING

It is hardly necessary to point out the practical importance of understanding the influence of contacts on the deposition of silver oreshoots. It is apparent that veins on the surface may be unproductive, but that deeper down, near contacts, they may be highly mineralized. Indeed, this law of contacts has been used in a practical way in South Lorrain, sixteen miles south of Cobalt, and has resulted in the discovery of promising orebodies. South Lorrain will be referred to on another page.

The law of contacts was fully appreciated by G. C. Bateman, manager of the La Rose mine, in his excellent exploration plan to develop the Violet mine. Mr. Bateman sank a shaft 330 ft. in the diabase sill in the expectation of obtaining ore along the lower contact between the diabase sill and the Keewatin series. There were no veins on the surface. The shaft was sunk on his faith in structure and in the hope that veins on the property to the west would extend into the Violet.



Vertical section through Beaver Mine, Cobalt, showing relation of Nipissing diabase sill to veins

His exploration work was successful, and about a quarter of a million ounces of silver has been obtained to date along this contact.

Though contacts play such an important part in the deposition of silver at Cobalt, there is another factor which must be taken into account. No economic quantities of silver have been found at a greater depth than about 800 ft. below the surface. It would appear that the present surface may have some bearing on the depths to which profitable bodies of silver may be found. The significance of the relationship of the surface to depth of economic orebodies at Cobalt is not as yet understood.

CHARACTER OF FRACTURES IN WHICH VEINS OCCUR VARIES

A word may be said concerning the character of the fractures in which the veins occur. Many of the veins occupy joint planes in which no movement is perceptible. Other veins occur in joint planes along which a little movement has taken place. Then, again, certain markedly productive veins have been found in important faults and constitute true fissure veins. These faults show displacements of a few inches up to hundreds of feet. The Cobalt Lake fault, the greatest in the camp, is a thrust fault with a displacement of more than 500 ft. Two important oreshoots, which produced hundreds of thousands of ounces of silver, occurred in the Cobalt Lake fault, and there were several other smaller oreshoots in this fault. It is evident that the ore was deposited in these faults after the faults were formed. Following the deposition of ore in the faults, some later movement took place. The extent of this later movement is unknown. It may be added that oreshoots in the larger faults at Cobalt are smaller, more irregular, and less common than are the oreshoots in joint planes.

Mining operations in recent years have gradually demonstrated that certain faults appear to limit, to some extent at any rate, the area in which productive veins occur. These faults are older than the orebodies. The outstanding example of such a fault occurs at the northern end of the Cobalt camp. This fault, which is a normal one with a displacement of from 4 to about 25 ft., strikes east 22 deg. south and dips to the southwest 70 to 90 deg. It is a remarkable fact that north of the fault in the Cobalt area proper practically no high-grade ore has been found and only about 200,000 oz. of milling ore has been discovered. The fault itself contained important quantities of high-grade silver ore, both in the Hudson Bay and Nipissing mines; in the latter the vein was 26 in. wide in places.

FAULTS ACT AS BARRIERS TO SILVER SOLUTIONS

Why should this fault define the northern boundary beyond which comparatively little silver ore has been found in Cobalt? I suggest—merely suggest—that the fault acted as a dam, or impermeable barrier, through which, on account of the clay gouge in the fault, the solutions carrying the silver were not able to penetrate to any important extent. Bear in mind that calcite veins carrying cobalt and nickel arsenides do occur north of the fault, but the veins are for the most part barren of silver. Silver was the last material to be deposited in the veins; for some reason the barrier—the fault—was only impermeable in respect to the silver solutions.

There is another example of how a fault acted as an impermeable barrier to silver solutions. This was found at the Beaver mine, at the south end of the camp, where a fault, striking northwestward and dipping steeply to the northeast, appears to have dammed back the silver solutions. To the north of the fault no commercial grade of silver ore has been found on the Beaver property. High-grade silver ore was found in the fault, and, although some of the veins extend through and to the north of the fault, no silver ore was found in these extensions.

SOLUTIONS DAMMED BACK ONLY LOCALLY IN SOME OCCURRENCES

Other examples in the Cobalt camp could be cited showing how faults have acted as impermeable barriers. In some instances the faults have dammed back the solutions only locally. That is to say, a vein may have been productive of silver ore up to a fault, but beyond the fault may have been barren for 50 or 100 ft., after which silver ore may have again developed.

In this connection it might be well to refer again to the fault at the north end of Cobalt. As has already been mentioned, little silver has been so far discovered to the north of this fault. But it may be that important orebodies do exist to the north, owing to the probability that the fault may have dammed back the silver solutions only locally. It is known, for instance, that two miles northeast of the fault, on the Green-Meehan, more than 300,000 oz. of silver has been obtained, and that twelve miles north of the Green-Meehan, in Casey township, about 3,000,000 oz. has been recovered. Certain areas a mile or two north of the fault, including the Genesee and Kirkegaard interests, may well be worthy of exploitation. It is not safe to put too much stress on the efficacy of impermeable barriers.

In the early days at Cobalt it is said that a "mud seam" cut off the ore in a vein at the Provincial mine. This mine was, at that time, being worked by the Ontario government under the supervision of Willet G. Miller. In other ore deposits throughout the world, at Freiberg, Germany, for instance, it is not uncommon to find impermeable barriers.[9]

MORE ATTENTION NOW PAID TO GEOLOGICAL STRUCTURE

The operators at Cobalt realize more than formerly the importance of understanding the geological structure, and, as a consequence, more attention is paid to this aspect of mining than was done in the early days of the camp when abundance of high-grade ore was constantly being developed. It is good practice now to diamond drill to ascertain such structural features as the thickness of the Cobalt series (conglomerate, graywacke, and others), the contact between the Keewatin and Cobalt series, the contact between the Nipissing diabase and Keewatin, and so on. Such diamond drilling precedes actual mining, and the result is that there is now less guesswork in directing crosscutting, drifting, and other development work than formerly. Two instances may be cited in which diamond drilling is at present being carried on prior to actual mining operations. At the Ruby property, under option to the Coniagas mine, there is a mantle of drift, consisting of clay, gravel, and similar material, covering practically the entire claim, which consists of forty acres. This property will be explored by diamond drilling to ascertain if there is a sufficient thickness of the Cobalt series to justify the expenditure of further funds.

McKinley-Darragh Mine, Cobalt, showing stope in Cobalt Lake fault on 350 level.

Again, in South Lorrain, at the Frontier mine, a diamond drill is exploring the contact between the Nipissing diabase and the Keewatin to permit further development work to be planned intelligently.

DIAMOND DRILLING LIKELY TO MISS NEW VEINS

Though diamond drilling is looked on with favor as an aid to working out the structure of the rocks, the mine operators have not, as a general rule, been keen on the use of diamond drilling to explore for new veins. The veins are, for the most part, so small—not more than 3 or 4 in. in width—that the drill is likely to intersect the deposits at an unproductive point. It is a fact that much disappointment has followed the use of the drill for this purpose. Nevertheless, something may be said in its favor. Possibly a more careful sampling of the core might lead to better results. But the unsatisfactory feature of diamond drilling at Cobalt is that negative results do not conclusively prove that the ground thus explored is barren.

An historic instance may be given of the manner in which diamond drilling failed to discover a vein system which eventually produced 12,000,000 oz. of silver. This vein system occurred at the north end of the City of Cobalt property. The ground was diamond drilled, and a drill hole touched one of the veins at an unproductive spot. Some years later another company began exploration work and found this vein system in a crosscut. The vein, showing the diamond-drill hole in it, was finally discovered in a stope. This was rather a knockout blow for the efficiency of the diamond drill as a means of discovering veins at Cobalt.

On the other hand, at the Crown-Reserve mine, high-grade silver ore was discovered by means of the diamond drill before mining operations began, and rich ore was obtained in the drill core.

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[9] *Mineral Deposits*, Lindgren, Second Edition, pp. 122, 191-194.

A curious fact has been observed regarding the strike of some of the veins in the west part of the camp. It has been found, for instance, that certain veins follow the strike and dip of the Keewatin "iron formation." That is to say, the beds of this old Keewatin formation formed lines of weakness, along which fractures—faults and joints—opened up. These fractures in the iron formation extended upward into the overlying rocks of the Cobalt series. It is thus seen that many fractures in rocks of the Cobalt series were guided, as to their direction of dip and strike, by the character of the older and underlying Keewatin series.

The westward strike of many of the veins, west of Cobalt Lake, is evidently due to the fact that several more or less vertical beds of "iron formation" underlie the Cobalt series in this part of the camp. These beds of Keewatin "iron formation" have a general east and west strike. Certain veins at the Foster mine also have been shown to follow the strike and dip of narrow beds of "iron formation."

NIPISSING DIABASE SILL PROBABLY INTRUDED FROM SOUTHEAST

Although the direction from which the Nipissing diabase sill was intruded does not appear to be an important question, it may be put on record that the sill was in all probability intruded from the southeast toward the northwest. The evidence for this statement was obtained at the Beaver mine. Here, at the top of the Nipissing diabase sill, a great block of granite, about 150 ft. long, was found included—caught up—in the sill. To the southeast a few hundred yards a batholith of granite, similar to the inclusion, occurs, and it is evident that, as the diabase sill forced its way northwestward through the granite mass, it caught up a block of this granite during its progress.

The thickness of the sill has now been definitely ascertained. It has been penetrated at three points and found to be about 1,000 ft. thick. At the fourth point the sill was penetrated to a depth of 700 ft. without reaching the bottom.

For reasons unknown to me there has always been more or less discussion regarding the occurrence of another sill of diabase below the Nipissing diabase sill. It remained for the Crown-Reserve Mining Co. finally to explore for such a possible sill. The company in the year 1920 put down a diamond-drill hole, at an angle of 70 deg., to a depth of 1,800 ft. below the 500 level. No sign of a second sill of diabase was discovered. The chief reason, however, for putting this hole down was to explore the rocks below the silver-producing zone. This zone had a depth of 100 to 200 ft. No ore was found in the core of the diamond drill.

THREE OUTLYING SILVER PRODUCING AREAS

Surrounding the Cobalt area proper there are three localities in which silver has been produced from veins similar to those in the main camp. These three areas are known as: (1) the township of South Lorrain, sixteen miles south of Cobalt; (2) the township of Casey, thirteen miles north of Cobalt, and (3) Gowganda, fifty miles northwest of Cobalt. But the output from these three localities forms only a small, and comparatively speaking, an unimportant part of the total production. The three outlying camps have produced in all, to the end of 1921, a total of 12,374,530 oz. of silver, which is less than 4 per cent of the gross production. Casey township has produced 2,941,512 oz. of silver; Gowganda, 6,135,012 oz.; and South Lorrain, 3,298,006 oz. No output has come from Casey township for two years, but active mining operations are being carried on in Gowganda and South Lorrain. A publication on Gowganda by A. G. Burrows is being issued by the Ontario government.[10]

SOUTH LORRAIN NOW DRAWING ATTENTION

Brief reference may be made to South Lorrain, where I spent a week last December in examining the mine workings of the Keeley and Frontier mines. In the early days of Cobalt the South Lorrain area received somewhat of a black eye because of certain unfortunate developments at the Keeley mine. It is to the credit of J. Mackintosh Bell that South Lorrain is now attracting considerable attention, owing to promising developments at the Keeley mine. This property was taken over by English interests before the war through the efforts of Bell, and the property has been nursed along and finally brought to a producing stage. In 1921 the Keeley shipped 281,659 oz. of silver, and it is now treating in its mill sixty tons of ore daily. In the fall of 1921 the management reported that more than 800,000 oz. of silver had been blocked out.

On the adjacent property to the north, the Frontier, promising developments are also taking place, due largely to the efforts of H. F. Strong and J. G. Harkness. The Frontier is under option to the Mining Corporation of Canada. At both of these properties, the Keeley and Frontier, it was found that much of the ore occurred at or near the contact of the Nipissing diabase and the Keewatin series. The realization of the importance of this contact is the key to the situation in South Lorrain. Further prospecting of the contact will doubtless be done.

PRODUCTS OF PRE-GLACIAL WEATHERING VISIBLE AT KEELEY MINE

One remarkable feature regarding the Keeley mine is worth consideration. Pre-glacial weathering has been so deep that the glaciers have failed to remove all of its deeper-seated products. This weathering was first discovered and pointed out by J. Mackintosh Bell in a recent paper.[11] At the Keeley mine in a fissure vein, known as the Wood's vein, the weathering has extended to a depth of 420 ft., the deepest workings attained last December. The vein and country rock on each side of the fissure are more or less oxidized, decomposed, and weathered to clay and other secondary materials, brown, yellow, or red in color. It is not likely that the oxidized and weathered zone extends many feet on each side of the fissure. Certain lamprophyre dikes have weathered more readily than the Keewatin basalt. The weathered zone appears to extend down from the surface in the form of a tooth.

As development work proceeds at the Keeley mine it will be interesting to find out if bonanza silver ore of secondary origin occurs at or near the bottom of the oxidized and weathered zone of the Wood's vein. It is reasonable to expect that the silver would have been leached out from the upper part of the vein during pre-glacial weathering and oxidation, and deposited lower down in the vein. The veins at Cobalt, with the exception of some of the fault veins, are not oxidized or decomposed. A few of the veins in faults are, however, oxidized to a minor extent here and there.

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[10] Ontario Department of Mines, Vol. 30, 1921, Part 2.

[11] Bulletin of Institution of Mining and Metallurgy, February, 1922, "The Occurrence of Silver Ores in South Lorrain, Ont., Canada," by J. Mackintosh Bell.

Other occurrences of pre-glacial clays are known in northern Ontario, such as the clays of Lower Cretaceous age which have been recognized by Joseph Keele on the Mattagami River 200 miles north of Cobalt.[12] The surface geology of South Lorrain was mapped by A. G. Burrows in 1908.[13]

CONIAGAS MINING AND MILLING COSTS LOWEST

It is not necessary to refer to the high costs caused by the war. The satisfactory price of silver during the abnormal time partly compensated for costly operations. The average price of silver per oz. in New York in 1917, 1918, 1919, and 1920 was 81c., 97c., $1.11 and $1.01 respectively. When, however, in the last eighteen months, the price of silver fell to about pre-war levels, it was disastrous for some of the companies. In March, 1921, the average price of silver per ounce in New York was 56c.[14]

The Coniagas is mining and concentrating ore at a lower cost than any other company in the camp—namely, 33½c. per oz. of silver. This low cost is due partly to the compact nature of the undertaking, partly to the immense width of the stopes, in one instance 86 ft., and partly to the excellent management of mine and mill.

LONG LIFE PREDICTED FOR SILVER MINING

So much for Cobalt's past. What of its future? Let it be said at once that mining will doubtless be carried on for generations, either in or around Cobalt, or in the outlying areas of Gowganda, South Lorrain, Casey, Montreal River, and elsewhere.

The increase or decrease of mining operations is, it need scarcely be pointed out, somewhat dependent on the price of silver. Certain mines, recently closed down, are known to have important quantities of low-grade ore, either broken in the stopes or blocked out. Should the price of silver ever rise to a dollar an ounce, these companies could begin profitable mining once more.

COBALT'S BEST DAYS PROBABLY OVER—NIPISSING IN CLASS BY ITSELF

In Cobalt itself it is not at all likely that operations will ever again reach their past magnitude. Many of the highly productive properties have, indeed, been cut by such a veritable labyrinth of drifts, crosscuts, winzes and raises that there is little likelihood of discovering new vein systems of great importance, although smaller orebodies may be found. The properties west of Cobalt Lake, for example, belong to this class of highly prospected mines. On the other hand, the Nipissing Mining Co. is in a class by itself. It has 846 acres in the heart of Cobalt and has already paid $24,000,000 in dividends. Part of this large acreage is still unexplored, and though the discovery of important vein systems is problematical, no one can foretell what further prospecting may bring to light. As late as last summer a new vein of high-grade ore was discovered on this property.

OTHER PROMISING AREAS AWAIT DEVELOPMENT

There are some properties which merit further development, such as La Rose Extension, Colonial, Ruby, Genesee, and others. The drift-covered areas, too, north of the Violet and Chambers-Ferland are attractive from a speculative point of view. The south end of Cobalt itself, known as Southeast Coleman, merits discriminating attention, where the upper contact between the diabase and Keewatin will no doubt be further explored as the years go by on account of the success obtained at the Beaver and Temiskaming mines.

In the outlying areas, South Lorrain and Gowganda offer opportunities for prospecting, and the recent promising developments at the Keeley and Frontier mines, in south Lorrain, will encourage the expenditure of more money in this area.

There will, of course, be more or less risk and hazard in developing the properties and areas referred to in the two preceding paragraphs. Only companies or syndicates of strong financial standing should attempt this speculative work. Disappointment will doubtless follow some of the ventures, but the prizes are so great that there will always be enterprising people who will take a chance, and "play the game" like true sportsmen if they lose.

SILVER PRODUCTION FROM IMPORTANT LOCALITIES COMPARED

A comparison may now be made of the silver yield of the Cobalt area with the silver yield of other important silver-producing localities. The accompanying table shows that Cobalt stands fourth in the list, but it should be noted that Cobalt has been producing for only eighteen years and is the youngest field among those mentioned.

TABLE 1. COBALT'S SILVER PRODUCTION COMPARED WITH THAT OF OTHER DISTRICTS (a)

Locality	Silver Production (Metric Tons)	Years
Potosi, Bolivia	30,000	Since 1545
Guanajuato, Mexico	15,000	Since 1558
Zacatecas, Mexico	14,000	1548-1832
Cobalt, Canada	10,042	1904-1921
Freiberg, Germany	5,243	1163-1896
Comstock, Nevada	4,820	1859-1889
Pachuca, Mexico	3,500	1522-1901

(a) "The Deposits of the Useful Minerals and Rocks," by Beyschlag, Vogt and Krusch, 1916, translated by S. J. Truscott, pages 202, 529, 675.

TABLE 2. TOTAL SHIPMENTS FROM COBALT AND OUTLYING AREAS, 1904 TO 1921 (*b*)

Year	Average Price, Cents per Ounce (New York)	Ounces	Value
1904	57.2	206,875	$[illegible]
1905	60.4	2,451,356	1,360,503
1906	66.8	5,401,766	3,667,551
1907	67.5	10,023,311	6,155,391
1908	52.9	19,437,785	9,133,378
1909	51.5	25,897,825	12,461,576
1910	53.5	30,645,181	15,478,047
1911	53.3	31,507,791	15,953,847
1912	60.8	30,243,859	[illegible]
1913	57.8	[illegible]	16,553,981
1914	54.8	25,162,841	[illegible]
1915	49.69	24,746,534	[illegible]
1916	65.661	[illegible]	[illegible]
1917	81.417	[illegible]	[illegible]
1918	96.772	17,661,694	17,341,790
1919	111.122	[illegible]	[illegible]
1920	100.900	[illegible]	[illegible]
1921	62.654	8,279,320	5,413,520
Totals to end of 1921		322,858,563	$198,099,336

(b) Ontario Department of Mines, Bulletin No. 43, W. R. [illegible] 1922.

ACKNOWLEDGMENTS

During the examination of the mines I had the opportunity to discuss with mine managers and mine captains the geology of the various properties. Most of the views outlined herein are those held in well-informed circles at Cobalt. It is not possible, of course, to mention the names of all the mining men from whom information was obtained. I was, naturally, more associated with those engineers who were particularly interested in geological structure, and would like, therefore, to refer especially to G. C. Bateman, manager of the La Rose mine, Warren Emens, of the Mining Corporation of Canada, John Reid and Angus Campbell, of the O'Brien mine, and Major J. H. Rattray.

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[12] Ontario Department of Mines, Vol. 29, 1920, Part 2.
[13] Ontario Bureau of Mines, Vol. 18, Part 2, and Vol. 19, Part 2.
[14] *Engineering and Mining Journal*, April 9, 1921, p. 645

During the resurvey I had the valuable assistance of James Hill, J. M. Robb, T. R. Buchanan, and others.

No attempt will be made here to discuss the literature on Cobalt. The report of Willet G. Miller has already been mentioned; his report will always remain the classic on the area. But a number of interesting papers have been published from time to time, chief among which is the account of A. R. Whitman's and W. L. Whitehead's examination in 1916 of the Cobalt mine workings, which was privately done for and at the expense of the mining companies at Cobalt.[15] Their work, together with the papers of E. S. Bastin, J. Mackintosh Bell, S. F. Emmons, G. R. Mickle, Chase Palmer, John Reid, and many others, will be discussed in the final report on Cobalt. Accompanying the final report will be a chapter dealing with the history and methods of treating the ores of Cobalt by F. D. Reid and James Denny, than whom there are no more skilful research men in Canada. Owing to the research work of Reid in the concentration of the Cobalt ores, and of Denny in the metallurgy of the ores, these men have become the leaders in their field.

Volumetric and Gravimetric Determination of Zinc in Ores

The quantitative separation of zinc from all the common metals, its gravimetric determination as oxide and volumetric determination by the ferrocyanide and sulphide methods have been discussed at length in a series of articles by S. Urbasch in the *Chemiker Zeitung.* We quote from an abstract published in the *Journal of the Society of Chemical Industries:*

The following modified ferrocyanide method is recommended for routine work on ores and smelter products, and if followed in detail gives results comparing favorably with those obtained by other methods. An amount equaling 1.5 g. of the finely powdered sample is dissolved in 20 c.c. of fuming hydrochloric acid; 3 c.c. of strong nitric and 6 c.c. of 1:1 sulphuric acid are added, and the solution is evaporated to expel most of the hydrochloric acid.

The assay is then treated with hydrofluoric acid, drop by drop, until all gelatinous silica has dissolved (the glass of the beaker must be free from zinc) and the heating continued till fumes of sulphuric acid are evolved. The residue is dissolved in 60 c.c. of water, the solution saturated at 60 to 70 deg. C. with hydrogen sulphide, filtered, and the filtrate boiled to expel excess of the gas. The boiling solution is oxidized with 3 to 5 c.c. of 3 per cent hydrogen peroxide, allowed to cool, treated with 0.5 to 2.0 c.c. of bromine and diluted to 180 c.c. Then 20 g. of ammonium chloride is added, followed by 100 c.c. of ammonia (sp. gr. 0.91) and the solution is diluted to 300 c.c. in a graduated flask. At this point 100 c.c. (=0.5 g. of ore) is filtered through a dry paper into a beaker, which is allowed to stand on a warm sand bath overnight to expel the bulk of the free ammonia. The solution is exactly neutralized with hydrochloric acid; three drops of 1:1 acid are added in excess, the liquid is diluted to 150 c.c., heated to boiling, and titrated with potassium ferrocyanide (21.6 g. per liter) until the blue color of the solution fades to white (3 c.c. of ferric chloride solution containing 0.1 g. of iron per liter is previously added as indicator).

A standard zinc-chloride solution containing 5 g. of zinc per liter is then carefully run into the assay until the blue color just reappears, and this amount of zinc is deducted from that found in the first titration. The ferrocyanide is standardized against pure zinc that has been through the same series of operations as the assay.

A large excess of ferrocyanide must be avoided in the first titration, or high results will be obtained. With small quantities of zinc (less than 5 mg.), the volume of the solution before titration should not exceed 30 c.c. and it should contain not more than 0.5 g. of ammonium chloride; only 0.2 c.c. of the iron indicator is added and 1 c.c. excess of ferrocyanide after the change from blue to white. The latter solution in this case is 1/5 the strength given above.

The separation of zinc from cadmium by means of hydrogen sulphide in 10 per cent hydrochloric acid is not complete, in the presence of much zinc, in one operation, as the cadmium sulphide adsorbs zinc. Complete separation of the cadmium may be obtained by boiling the solution (100 c.c.) containing 5 c.c. of strong hydrochloric acid for 30 to 45 minutes with a strip of aluminum, adding 30 c.c. of strong hydrogen sulphide water and filtering off the cadmium precipitate, washing it with hydrogen sulphide solution.

Zinc may readily be precipitated as sulphide from a solution containing 1 c.c. of $\frac{N}{1}$ acid and less than 0.15 g. of metal per 100 c.c. by saturating the solution with hydrogen sulphide at 50 deg. C.; from solutions containing slightly more acid than this, complete precipitation is effected by heating under pressure. In either operation separation from the other metals of the ammonium sulphide group is complete except when much cobalt is present, in which circumstance the first precipitate is green and contains cobalt.

The Schaffner volumetric zinc assay is discussed at some length, and it is shown that to obtain concordant results, the concentration of ammonium salts and ammonia must be as low as possible and, in any event, the same in the assay as in the standard.

Germany Will Import Iron Ore from Newfoundland

Sundry German companies, which made a trial of Newfoundland iron ore many years ago, have just concluded contracts for the delivery of 800,000 tons of Newfoundland Wabana ore, according to *Commerce Reports.* This ore is as suitable for the production of basic bessemer pig iron as French minette or the French ore in Normandy. It is estimated that it will be possible to procure about 1,000,000 tons per annum of this ore from Newfoundland or Labrador. The price of the ore, contracts for which are said to have been entered into with three Wabana companies, is given at the low figure of 18s. 6d. c.i.f. Rotterdam. Supplies from French Lorraine and from former German Lorraine were for a long time limited by the French government after the Armistice, and though they are now more abundant, little is being imported into Germany.

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[15] *Economic Geology,* Vol. 15, No. 2, March, 1920.

Magnetic Log Washers in Iron-Ore Concentration

The Development of a Satisfactory Device for Concentrating Low-Grade Magnetic Iron Ores—Washers of Rake Type Receive Overflow from Classifiers, and Discharge Is Into Machines of the Spiral Type at the Babbitt Plant

By H. H. Wade*

THE MAGNETIC LOG WASHER has been developed at the Minnesota School of Mines Experiment Station as a means of concentrating finely crushed magnetite ores. In 1915, samples of hard magnetite-bearing rock from the eastern Mesabi Range were brought to the station for examination and tests. This eastern Mesabi rock, or taconite, is hard, of a greenish gray color, with black bands of magnetite, and contains about 25 per cent magnetic iron. After crushing the rock to pass 150 mesh, it is possible, by the use of magnets, to collect the iron oxide as a concentrate that is sufficiently pure for blast-furnace use. Some trouble was experienced in using the available magnetic separators for concentrating the finely crushed ore, and in an endeavor to obtain a more suitable machine the magnetic log washer was developed.

Large tonnages of low-grade hematite ore of a variety called "wash ore" are concentrated in Minnesota by use of specially designed and perfected log washers similar to those that have been used in the Southern states for many years. By adding magnets to the bottom of the trough of an ordinary log washer, a machine which has been used for concentrating the hematite ores can be used also to concentrate the finely crushed magnetite ores. The first machine of this type made at the Mines Experiment Station was a rather crude device, but its operation showed sufficient promise to warrant further investigation.

Later a small machine was built, such as the one shown in Fig. 1. This consists of a rectangular box 24 in. long and 4 in. wide, along the bottom of which are magnetic poles. Inside the box and extending the full length are two parallel shafts or "logs" which are provided with blades placed at such an angle that they agitate the material and carry the concentrate forward. An overflow dam at the lower end of the machine maintains a pool of water into which the finely ground ore is fed at a point about eight inches from the lower end. The effect of the magnetic field in the bottom of the box is to cause all of the particles of magnetite, no matter how fine they may be, to become magnetized and stick to one another, thus forming larger particles resembling small snowflakes. The magnetic attraction also causes the particles to settle rapidly to the bottom of the box, where they collect in a bristling mass somewhat resembling fur. The blades of the rotating logs cut into this mass of material, violently stirring it and at the same time moving it upward along the inclined bottom of the box. The magnetite, after being conveyed from the pool of water, passes under a clean wash-water spray, and is finally discharged at the upper end of the machine as a clean concentrate. The rotating logs produce sufficient agitation to keep the non-magnetic material in suspension until it is carried over the tailing dam by the flow of water. When a properly prepared feed is treated in this machine, the concentrate contains practically no free particles of non-magnetic material and the tailing practically no free particles of magnetic material. When treating —150-mesh eastern Mesabi rock assaying 25 per cent magnetic iron, a concentrate is produced assaying 65 per cent iron, and the tailing carries less than 1 per cent of magnetic iron. In other words, the extraction is usually better than 95 per cent.

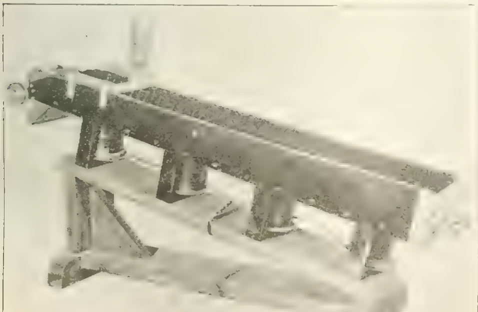
Fig. 1. Experimental 24-in. magnetic log washer

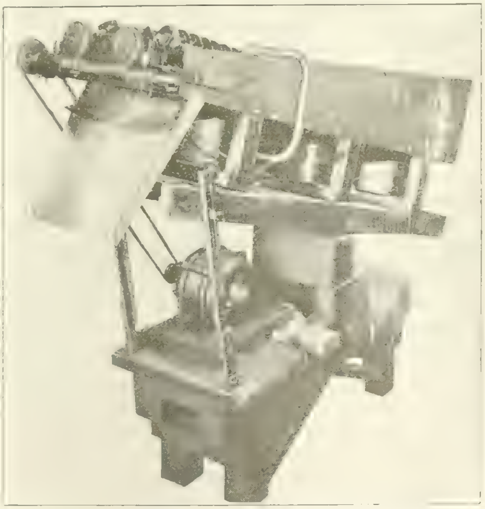
Fig. 2. Magnetic log washer, 60-in. type

After considerable experimental work with the small machine, in which mechanical as well as metallurgical data were secured, a machine was built for experiments on a larger scale. This machine, shown in Figs. 2 and 3, is 5 ft. long and 12 in. wide. Originally, it was equipped with blades similar to those used in a standard log washer, but to simplify construction and increase capacity continuous spirals were substituted for the blades. These spirals, which are of ribbon form and are wound to produce a worm of rather large pitch, perform the same functions as blades and are mechanically far superior to the blades used in the original design. Many tests were made on this machine, some of which were in combination with a ball mill and classifiers and approximated continuous working conditions. Capacity figures were obtained, and gradually facts were assembled which made it possible accurately to design a still larger machine.

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*Metallurgist, Mines Experiment Station, University of Minnesota, Minneapolis, Minn.

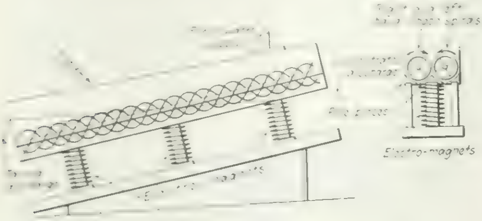

Fig. 3. Diagram of magnetic log washer

The opportunity came to design a semi-commercial magnetic log washer when the Mesabi Syndicate erected its experimental mill at Duluth during the summer of 1916. Two magnetic log washers were built for this mill, each of which was 14 ft. long and 24 in. wide. Originally these machines were equipped with logs having a number of blades, but eventually the blades were replaced by ribbon spiral conveyors. These two machines were operated continuously in twenty-four-hour service during the summer and fall of 1916, and from then until the plant was dismantled in 1918 they were operated intermittently. About six thousand tons of concentrate was produced by means of these two machines.

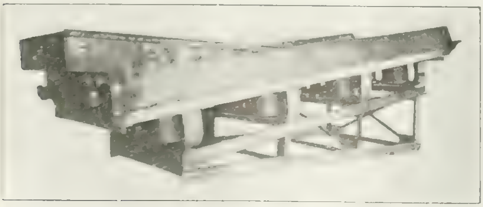

Fig. 4. Magnetic log washer (18-ft.) made for Mesabi Iron Co.

From the information gained at this mill, designs were made for the commercial machines (Fig. 4) which are now being installed at the plant of the Mesabi Iron Co. (formerly the Mesabi Syndicate) at Babbitt, Minn. These machines are 18 ft. long and 6 ft. wide, and each is equipped with four logs of the ribbon spiral conveyor type. Each of the machines will receive a feed of —150 mesh ore direct from bowl classifiers and will have a capacity of about one hundred tons of concentrate per day. About one kilowatt of electrical energy will be required for exciting the magnetic poles and about one horsepower will be sufficient for the mechanical operation of the machine.

The feed to these machines will assay about 35 per cent magnetic iron. This product will be the overflow from a Dorr bowl-type classifier and will contain about 92 per cent water. To secure the fine classification, this amount of water is necessary, but it has been found that better operating conditions are secured if part of the water is removed before attempting the concentration of the ore. For this reason the classifier overflow will first be delivered to magnetic log washers operated with Dorr rake instead of spiral motion. These rakes move slowly and produce little agitation. The magnetite in the feed is drawn immediately to the bottom of the trough, and the action of the rakes moves it forward and upward until it is delivered over the front end of the machine at about 60 per cent solids. The excess water and a large amount of fine tailing washes over the rear end of the machine, and therefore a thickened, partly concentrated ore is produced. As a matter of fact, practically all of the free silica is carried away with the excess water, and the gangue that accompanies the concentrate is really a middling and carries particles of magnetite attached to particles of silica. The cleaning action may be increased in this machine by altering the shape and cycle of operation of the rakes by introducing baffles in the rear end of the machine or by the use of wash water introduced as a surface spray from above, or as a bottom water from below.

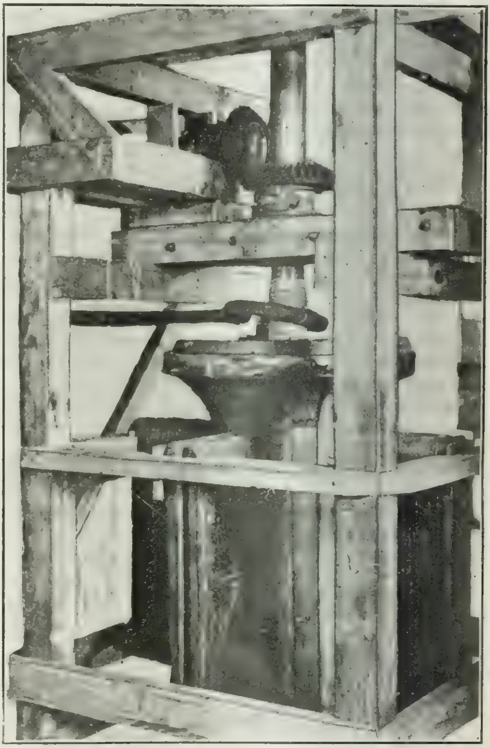

Fig. 5. Vertical design of magnetic log washer

This partly concentrated product from the rake-type machine is discharged directly into the spiral-type magnetic log washer, which produces a finished concentrate which will assay 65 per cent iron. The tailing from this second machine will assay less than 1 per cent magnetic iron and may either be discharged from the plant or be returned to the ball mill or classifier for further grinding. Any iron not in the magnetic state, such as hematite or iron silicate, will be lost in the tailing.

The magnetic log washer is really a slime-treating machine, and any material coarser than 48-mesh, whether magnetic or non-magnetic, that is fed to this machine will be discharged as concentrate. Therefore, no ore should be fed that contains material coarser than 48-mesh. Best results are accomplished on material crushed to 100-mesh or finer. The action of the magnetic field is so positive that the ore cannot be crushed too fine to be handled satisfactorily in this machine. If ore coarser than 48-mesh is to be treated, it should be separated into a sand and a slime, and only the slime should be passed through the magnetic log washer.

During the experimental period, several modifications of the design of the magnetic log washer were tried out. These were simply the natural developments resulting from observing the action of the machine. In one of these the log washer was modified into the form of a vertical machine. (Figs. 5 and 6.) The tank, instead of being box shaped, open at the top and one end, was made cylindrical, open at the top and with a spigot at the bottom. The magnets were placed around the outside of the vertical cylinder, and by their action produced a magnetic field inside the cylinder. This machine was equipped with only one log, which was suspended in the cylindrical tank and driven by a spur gear from above. The shaft was made hollow for about one-half of its length, so that the original feed could be added to a rotating cone at the top of the shaft, and could be delivered through the hollow shaft to the magnetized part of the cylinder at about its center. This machine was operated either by revolving the log in such a direction as to cause the concentrate to be conveyed up the side of the cylinder and discharged over the upper edge against a downward wash of clean water, or by revolving the log in the opposite direction so as to cause the concentrate to move down the side of the cylinder against an uprising wash of clean water and be discharged through a spigot at the bottom of the machine. In one method of operation the tailing was discharged through the spigot at the bottom and in the other it overflowed the top of the cylinder.

In the first test, made on a small machine a few inches high, it seemed that satisfactory results might be expected. Therefore a large machine having a 12-in. diameter log about 6 ft. long was constructed and tested. Though it was possible to make a separation of the magnetic from the non-magnetic material by means of this machine, results could not be secured which were as satisfactory as those produced on the inclined machine, and after experimenting with a number of modifications of the design, this type of construction was discontinued. From an operating point of view, the type had many disadvantages.

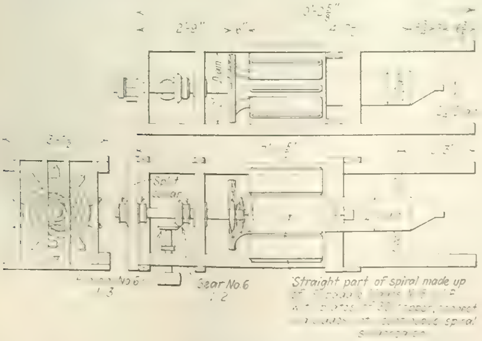

Fig. 6. Sketch of vertical magnetic log washer

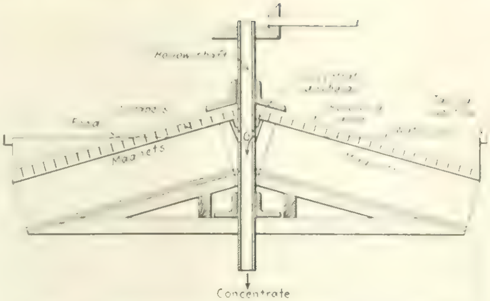

Fig. 7. Inclined design of magnetic log washer

Another design (Fig. 7) was proposed in which the inclined open tank was made annular in shape, similar to a Dorr thickener tank, with magnets placed along the bottom. The bottom of the tank was made conical, with the apex of the cone in the center extending a short distance above the water level. Plows were used similar to the plows on a thickener, and the overflow, as in the operation of the thickener, extended around the entire periphery. The concentrate was scraped up the incline and discharged through an opening near the center of the machine. Wash water was added to the concentrate above the water line. Though this machine would not produce a clean concentrate, it would make an effective magnetic dewaterer. This type of machine will not be included in the plant at Babbitt, however, as it does not fit into the mill design, and the rake-type magnetic log washer is a more satisfactory substitute.

It should be understood that the types described were not the only ones tried, the fact being that these are the survivals of a long series of experiments with all sorts of rotating, shaking and agitating devices—too long a list to describe in this article.

Mineral Resources of the Ivory Coast

The geology of the Ivory Coast, on the Western coast of Africa, has been little studied, and gold is the only mineral that has been worked to any extent.[1] The gold-bearing region is apparently extensive and is probably related to that of the Gold Coast. Prospecting is difficult, owing to the need for sinking exploratory shafts, but the veins, situated in lateritic strata, are often rich, and contents of 500 g. (16.1 oz.) gold per metric ton are not uncommon. The mineral contains bismuth telluride, which causes losses in the amalgamation process and makes treatment with chlorine or cyanide almost impossible. Superficial deposits of limonite occur in the laterites, but have never been exploited.

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[1] *Rev. Prod. Chim.*, Jan. 15, 1922; abstracted in *Journ. Soc. Chem. Ind.*

The Marketing of Silver Bullion

North American Continent the Greatest Source of Metal—Asia Consumes Largest Amounts of Bullion and Coin—London and New York Market Practices Discussed

By Parker D. Handy
President, Handy & Harman

FROM the earliest recorded history of mankind, silver has been used as a money metal, and the people of China and India, representing the oldest civilizations of the world, are today the largest buyers of the white metal for coinage and commercial uses. More than four hundred millions of people in China use silver as a standard of value, and in India, although that country is on a gold exchange basis, her huge population find silver as attractive as the yellow metal, and even when the Indian government is not buying silver to be coined into rupees, large amounts are daily bought and sold in the bazaars. During 1921, when no purchases were made for the Indian mint, more than 40,000,000 oz. was shipped to India.

In China a coin is valued not so much because the government stamp makes it legal tender, but because this stamp guarantees a definite content of precious metal. China's monetary system consists of small coins of nominal value, dollars both foreign and Chinese, and many kinds of taels of varying weight and fineness, all of which are used as mediums of exchange. The Chinese government is endeavoring to stabilize the silver circulation, and has established one of the largest mints in the world at Shanghai, with a capacity of coining half a million dollars a day.

SILVER IMPORTANT AS A MONEY METAL

Trade balances are covered by purchases of silver bullion, and fluctuations in exchanges cause large speculative operations, China banks' buying and selling silver depending on exchange rates and economic conditions. During 1921 China's demand was the backbone of the silver market, as over 52,000,000 oz. was shipped to her ports.

To mention one recent instance of the importance of silver as a money metal, Lord Reading, Viceroy of India, made public acknowledgment last year of the great service done to the cause of the Allies in the World War, by the action of the United States Congress in passing the Pittman Act, thus furnishing over 200,000,000 oz. of fine silver for export to India, and thereby enabling the Allies to maintain their credit and to purchase and pay for supplies essential to win the war. Silver bullion was absolutely necessary, as India had reached the saturation point on the issue of rupee paper. England also required, during the war, large coinage issues for use in Egypt and Mesopotamia.

The value of silver as a money metal has also been illustrated since the war by the reverse side of the picture in Central Europe, where the silver coins in circulation have been largely melted and sold for export to provide for fiscal emergency and where units of value have depreciated owing to the large issue of paper money and economic disturbance. In normal times, however, there is a demand from other countries for silver for coinage purposes.

From the earliest days of artistic development, silver has been the favorite metal of the artisan in metallic craft, and today we have a constant demand to satisfy the silversmith, whether he is manufacturing the bangles and bracelets to adorn a Hindu wife, or the beautiful silverware displayed in the show windows on Fifth Avenue or Regent Street.

The principal uses for silver are therefore:

First, for coinage purposes, and as a medium for exchange in settlement of trade balances.

Second, for manufacturing demand from the jewelers, silversmiths, the dental trade, the electrical industries, and producers of nitrate of silver for photographic purposes.

The production of silver is by three stages—(a) mining, (b) smelting, and (c) refining. All refiners endeavor to produce "commercial silver" in bars weighing about 1,000 troy ounces and assaying .999 fine. In this "raw material" form silver is sold and shipped for export. The manufacturing trades in this country require silver to be pure and free from traces of other metals, and consequently the raw material from the refinery is usually fabricated for their special needs by extra refining, alloying, and rolling to suit trade requirements.

As the largest demand for silver is for export, the chief marketing points correspond geographically to the financial and shipping centers, and are London, New York, San Francisco, Bombay, Calcutta, Shanghai, and Hongkong. When India is the best market, silver naturally goes via New York and London to Calcutta and Bombay; but when China is the buyer, silver is shipped via San Francisco to Shanghai and Hongkong. There are, at times, special orders for coinage purposes from other countries, but the bulk of our exported silver is for the Far East.

The annual production of silver varies considerably, depending on economic conditions, development of new mineral deposits, such as the Cobalt district, or exhaustion of old mines. The peak in the world production occurred in 1911, with an output of over 226,000,000 fine ounces; but the last few years show a drop to about 175,000,000 oz. annually.

The production figures for this continent show:

		Ounces		Ounces
United States peak	1915	75,000,000	1921	50,000,000
Mexico peak	1911	79,000,000	1921	64,000,000
Canada peak	1911	33,000,000	1921	10,000,000

Silver is largely a by-product in the mining of copper and lead, and consequently the recent reduction in copper mining has affected the silver output. The consumption of silver for coinage, trade balances, and manufacturing purposes yearly amounts to the total output. For the last two years the silver market has also absorbed about 50,000,000 fine ounces, the proceeds of coin melted up by the countries of Central Europe.

China is usually a heavy buyer toward the close of the year, in time for shipment for the Chinese New

Year settlement, which occurs in January or February. Indian demand may increase at the time of the settlement periods, which occur monthly, but the only seasonal demand is during the summer and early fall, depending on the prospect of a good monsoon, which means good crops.

For export and coinage purposes, silver .999 fine in bars weighing 1,000 to 1,100 oz. is considered good delivery, although bars assaying .996 to .998 fine are sometimes accepted without additional refining charges; but settlement is always on the basis of a troy ounce .999 fine.

Manufacturing demand in this country is usually heavier in the spring and fall.

For manufacturing purposes .999 fine silver only is good delivery, and the metal must be free from all chemical impurities, such as selenium, tellurium, arsenic, cobalt, and other metals.

Silver bars bearing the stamp of the U. S. Government or of any recognized refinery are considered good delivery, and settlement is made upon the basis of stamped weight and fineness, subject to claims for any difference in weight or fineness verified by report of reliable assayers. Quantities handled vary from a few hundred ounces to fill requirements of some small manufacturer, to hundreds of thousands of ounces, covering exchange operations or coinage orders.

Fractional fineness less than .001 is not recognized, and in weighing, $\frac{5}{100}$ of an ounce is the closest fraction allowed, although in London settlements $\frac{1}{4}$ of an ounce is the nearest fraction paid for.

Silver for export in bar form is usually shipped naked, the shipping marks being stamped or painted on the bars. Silver for manufacturing demand in small lots or in fabricated shape is always packed for shipment. Shipments for export or domestic use are always insured against loss at best rates obtainable, upon actual cost valuation.

Storage charge in safe-deposit vaults is at the rate of 1c. per day per bar, with a minimum charge of 5c. per bar.

Silver is valued in cents per troy ounce .999 fine, and terms are net cash against delivery of silver; but the domestic manufacturer expects credit, depending on conditions.

LONDON AN IMPORTANT SILVER CENTER

In London there is a spot and future market, and daily quotations are made for prompt and sixty-day deliveries, the latter quotation generally ruling at a discount under spot. The London price is quoted in pence per ounce .925 fine. Purchase and sale of silver bullion in London is conducted by four bullion houses which command the respect and confidence of the Eastern banking institutions and other leading silver operators. These four firms are Messrs. Mocatta & Goldsmid, Samuel Montagu & Co., Pixley & Abell, and Sharps & Wilkins. All of them have been engaged in the silver trade for several generations. The daily quotation that these brokerage houses settle upon at 2 p.m. is arrived at by comparing the orders to purchase with those to sell, and as a result of the exchange of ideas the official, or what is called the "fixed," price is determined. It is the general usage, when the price is established, for the buyers to accept all silver offered at the conference at that price. This, however, does not imply that silver offered for sale afterward can be disposed of at the fixed price. It might command a higher or lower price. Bullion is sold free of charge, but the purchaser pays one-eighth per cent commission.

Silver in New York is usually sold for prompt delivery, although at times forward business is also transacted. The daily New York official quotation is for spot silver New York delivery per troy ounce .999 fine, and is based on the best market obtainable for silver in round amounts, whether for export or domestic use. Economic law applies to silver prices, and export demand is really the determining factor in fixing the price for silver. The official New York price is usually established each day about noon after receipt of cables quoting the London and Far Eastern markets and determination of exchange rates. This quotation necessarily cannot cover all transactions each day, depending on varying conditions as to amount offering, fluctuating exchange rates, and tendency of the market.

It is often impossible to sell in London at the official quotation after the price has been fixed and orders have been filled, or even at the official price at time of fixing, unless silver is spot in London. The New York quotation, therefore, has to be an average fair price, representing the daily market conditions.

The average annual price in cents per troy ounce for the past twelve years has been:

	Cents		Cents
1910	53.49	1916	[illegible]
1911	53.30	1917	81.42
1912	60.83	1918	96.77
1913	59.79	1919	111.11
1914	54.81	1920	100.90
1915	49 68	1921	62 65

Large imports are made to this country from Mexico, Canada, and South America to be sold and refined, as New York and San Francisco are the best points for export.

The effects of the war and subsequent deflation are reflected in the fluctuations in price the past few years. The reaction in price would undoubtedly have been much more severe had it not been for the purchase of all domestic production by the U. S. Government under the Pittman Act the past two years at one dollar per ounce 1.000 fine.

Attempts have been made in the past to dominate prices by cornering the supply, but invariably with disastrous results to the principals, as it is a dangerous game to try to control the exchanges of the world, in which silver plays so important a part.

Zinc-Dust Fires

At the Pittsburgh, Pa., Experiment Station of the Bureau of Mines, tests were recently made with water, sodium-carbonate solution, carbon tetrachloride, silicon tetrachloride, and a frothy mixture as extinguishers for zinc-dust fires. The frothy mixture extinguished the fire most quietly and effectively, so it was tested on a larger fire in 300 lb. of zinc dust. Three 2½ gal. foam extinguishers smothered the fire, but danger of rekindling had passed only after elapse of several hours, due to retention of heat in the metal by the foam blanket.

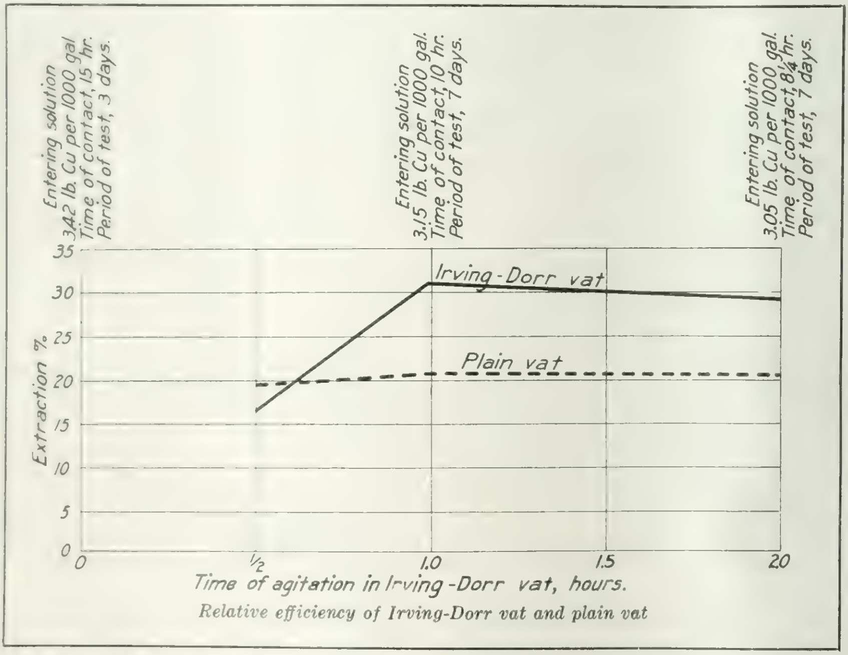
Thermal data show that water, carbon tetrachoride, and carbon dioxide react with zinc with liberation of considerable heat, carbon tetrachloride producing most. However, no violent reaction occurred when red-hot molten zinc was poured into carbon tetrachloride.

Although some fire-extinguishing materials may be injurious or may be decomposed in fires to produce toxic gases or vapors, no especially poisonous gases or fumes are evolved from burning zinc itself.

Heap Leaching of Low-Grade Copper Ores—II

Properly Constructed Vats Preferable to Launders for Precipitation Purposes—Irving-Dorr Vat, Equipped With Stirring Apparatus, Superior to Ordinary Type

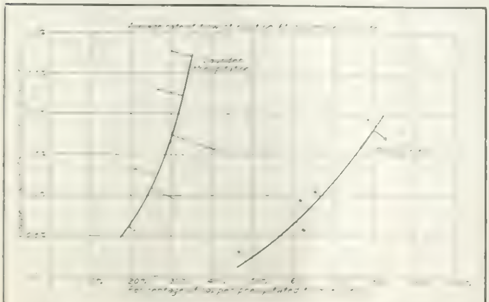
By Joseph Irving



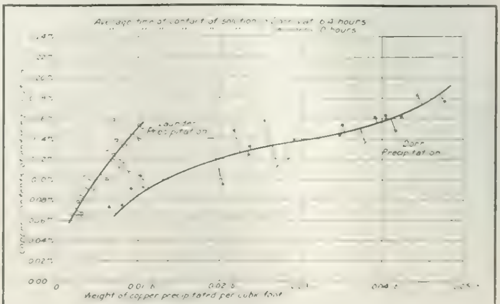
Relative efficiency of Irving-Dorr vat and plain vat

PRECIPITATION ON IRON is the only method that has been found generally acceptable for the recovery of copper from solutions resulting from heap leaching. It has long been a moot question whether a vat or a launder will make the best precipitating medium. In Spain and Australia, where both are used, the launder seems to be preferred; at Tharsis, for example, at one time about 9,000 m. (29,000 ft.) of launders were used. The main reason for the use of launders is that, because of the fast flow obtainable compared with that in an ordinary vat, contact is better, and a higher grade of precipitate is produced from weak liquors. One great drawback to a launder installation is the large area required, even when launders having a 4 x 4-ft. section are used.

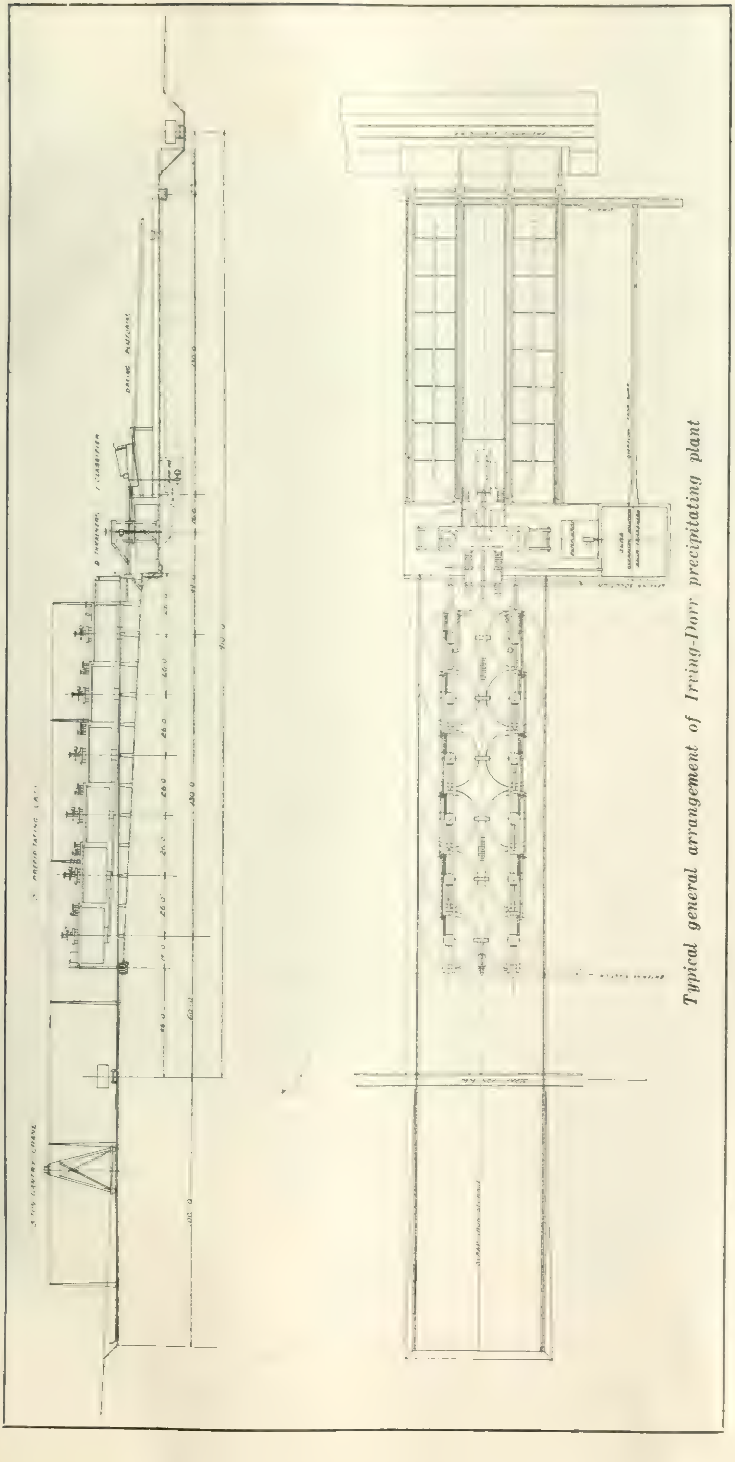
However, the result of many years' experience has shown that for general utility and efficiency, a properly constructed vat is the best medium for the satisfactory



Relative efficiency of vat and launder on high-grade solution



Relative efficiency of vat and launder on low-grade solution



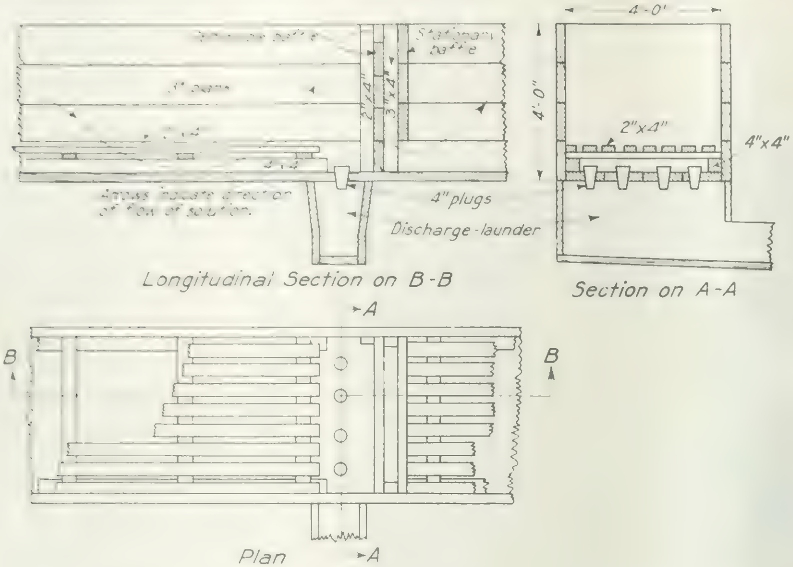
Typical general arrangement of Irving-Dorr precipitating plant

recovery of copper from solution; practice has demonstarted that one with a working capacity of 2,680 cu.ft. has given as good results as do two launders with a combined working capacity of 14,000 cu.ft. Examples are given herewith.

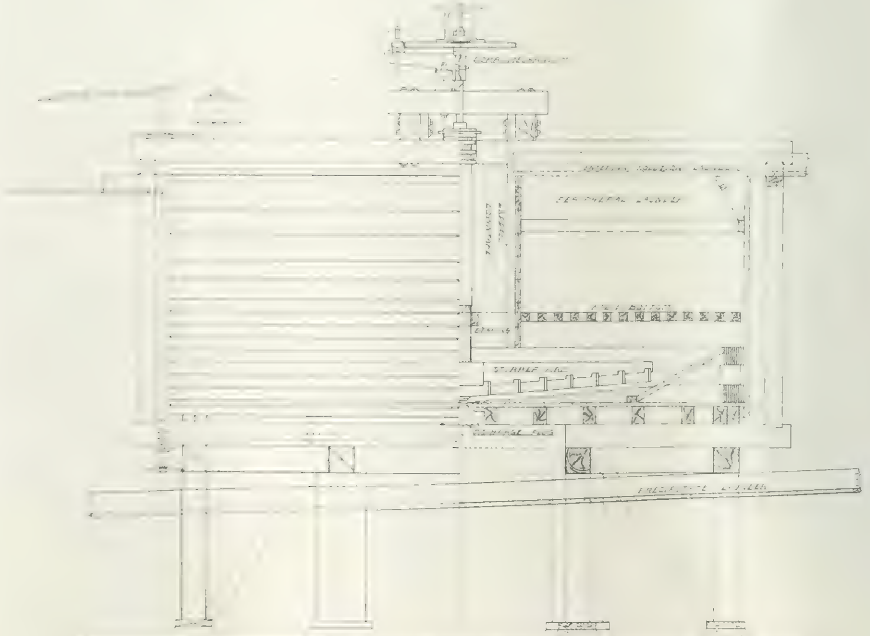
The advantages of a simple vat system may be summed as follows:

As a result of the efficiency of the vat system, the area required to precipitate a given quantity of copper is much smaller than that for a launder system. As vats can be erected on a flat site or on a sloping hillside, and can be arranged with either the minimum drop between them or a drop that suits the site, the amount of excavation necessary is always a minimum. As the underpinning for a vat system consists entirely of large timbers, the cost of framing and erection is small. The vats come from the manufacturers cut, shaped, and marked, so the erection cost is further lightened. The vats are all of standard size; the time required to cut them out and ship them is therefore short. Previously, the vats were designed with the inlet and the outlet opposite to each other and set in the rim of the vat; when filled, the solution merely ran in and out for the most part. Contact with the iron was limited, which was one of the reasons why vats were looked upon with doubt for some time. When the entering solution is carried to the bottom of the vat by a downtake, and has to rise through the iron before escaping by the outlet, the contact of solution with precipitant is more satisfactory.

As the vats are round, any contraction or expansion caused by the solution is easily adjusted. There are only a few intake and discharge plugs; these are all on the outside, and accessible for repairs; the danger of losses, due to leaky system, is minimized; the nuisance of concealed or underwater plugs is



Type of precipitating launder used in vat vs. launder tests



General arrangement of Irving-Dorr precipitation vat avoided. One great advantage of vats over launders is that large pieces of iron can be placed in them. Furnace jackets, converter shells, and, in fact, all the scrap from a smelter is available for use.

The Irving-Dorr vat is vastly superior to the ordinary vat, even when the latter is equipped with a downtake; a more complete contact of the solution with the iron is insured, in consequence of the intermittent agitation of the solution that is possible. This new modification is similar to an ordinary vat, with the addition of a Dorr stirring apparatus, of which the paddles and blades are placed under the false bottom of the vat and connected by a wooden shaft with the stirring mechanism built over the top. The stirring apparatus need be worked for only a few hours each day. The agitation produced serves to dislodge some of the copper deposited on the iron, thus exposing fresh surfaces to the incoming solution. At the same time the cement copper is brought forward toward the central discharge hole that is placed in the floor of the vat.

Experimental vats at cementation plant

I have carried out extensive experiments at Bisbee to determine which was the most efficient and at the same time most economical medium to use for the recovery of the copper from the solutions. Launders were tried in competition with plain vats with flush inlets and outlets; plain vats vs. vats provided with a downtake inlet; and finally vats with only a downtake inlet vs. the Irving-Dorr vat, with its downtake inlet and stirring apparatus. Each succeeding step showed a steadily increasing advantage over the launders, and further increased advantage over the preceding one. The accompanying tables of results obtained in these investigations show clearly the superiority of the vats over the launders, and the further increased advantage to be gained by using the Irving-Dorr precipitating vat. The new cementation plant at Bisbee will contain twelve of these.

Vats or launders should be provided with false bottoms to carry the iron, leaving a space of at least 6 in. between the false and the true bottom. This arrangement facilitates the recovery of the cement copper, as only a minimum amount of iron will have to be handled; the cement copper is washed into the lower compartment and out through the discharge holes. The open space between the false bottom and the floor of a vat should be about 12 in. at the center, which permits a slope in the floor from the periphery toward the point of discharge.

Some of the line drawings that accompany this article have been reproduced from an article by my son, Joseph Irving, Jr., on the "Development of Copper Precipitating Apparatus" that appeared in the *Mining and Scientific Press* of Oct. 15, 1921. I take this opportunity to acknowledge the assistance of H. F. Yoder, whose careful sampling and measuring during the period over which the investigations were in progress helped greatly to secure accurate data on the precipitating efficiency of launders and vats.

COMPARATIVE EFFICIENCIES OF VARIOUS VATS

	Four Vats In Series	Large Vat	Irving-Dorr Vat
Capacity, cu.ft. . .	10,720	3,904	3,904
Solution treated, gal	529,462	214,080	354,700
Inflow, lb. copper per 1,000 gal.	4.27	2.64	4.27
Effluent, lb. copper per 1,000 gal.	2.04	1.96	2.37
Extraction, per cent . .	50.52	25.75	44.50

COMPARATIVE EFFICIENCIES OF PLAIN VATS AND LAUNDERS

Fourteen-Day Period

	Vat		
	Flush Inlet	Downtake	Launders
Precipitating capacity, cu.ft.	2,680	2,680	14,000
Solution treated, gal .	1,050,000	1,050,000	3,698,000
Inflow, copper per 1,000 gal. . .	18.46	18.46	15.46
Effluent, copper per 1,000 gal.	11.86	9.2	9.65
Extraction, per cent .	35.75	50.10	36.83

COMPARATIVE EFFICIENCIES OF PLAIN VATS AND LAUNDERS

Fourteen-Day Period

	Vat	Launders
Precipitating capacity, cu.ft. . .	5,360	14,000
Solution treated, gal.	195,000	3,525,500
Inflow, lb. copper per 1,000 gal	9.7	7.49
Effluent, lb. copper per 1,000 gal	5.83	5.5
Extraction, per cent	39.9	26.72

Five-Day Period

	Vat	Launders
Solution treated, gal. . .	300,000	448,000
Precipitating capacity, cu.ft.	5,360	7,000
Inflow, lb. copper per 1,000 gal.	8.67	8.02
Effluent, lb. copper per 1,000 gal	5.02	6.67
Extraction, per cent	42	16.83
Solution treated, gal	300,000	448,000

COMPARATIVE EFFICIENCIES OF PLAIN VATS AND IRVING-DORR VATS

	Irving-Dorr	Plain
Precipitating capacity, cu.ft.	3,904	3,904
Solution treated, gal	[illegible]	1,057,700
Copper recovered, lb. per 1,000 gal. . .	0.858	0.636
Copper recovered, lb.	1,194	680

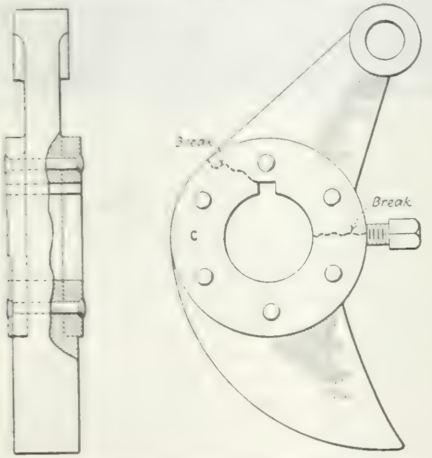
COSTS OF POWER AND LABOR. PLAIN VAT VS. IRVING-DORR VAT

Test 1. **Irving-Dorr Vat**		
Power: 7 days at 1 hr. per day, 9 days at [illegible] hr. per day, 5 days at 2 hr. per day, equals 27.5 hr., [illegible] 77 kw., at 3.5 cents equals		$2.695
Labor		3.00
	Total. . . .	$5.695
Copper recovered, lb.	1,194	
Cost per lb.	$0.0047	
Plain Vat		
Labor		$6.00
Copper recovered, lb.	680	
Cost per lb.	$0.0088	
Test 2. **Irving-Dorr Vat**		
Power: 50 days at 1 hr. per day [illegible] per hr. equals 140 kw., at 3.5 cents [illegible]		$4.90
Labor.		6.00
	Total. . . .	$10.90
Copper recovered, lb.	4,095	
Cost per lb.	$0.0027	
Plain Vat		
Labor.		$12.00
Copper recovered, lb.	2,521	
Cost per lb.	$0.0048	

USEFUL OPERATING IDEAS

Repairing a Compressor-Valve Cam

One way of repairing a compressor-valve cam in an emergency is described by Earl Paggett in *Power* of April 25, 1922. A cam on the valve gear broke through the valve-stem hole. There being no spare cams in stock, it was necessary to get the broken one repaired and back on the compressor as soon as possible.



Method of making temporary repair to valve cam

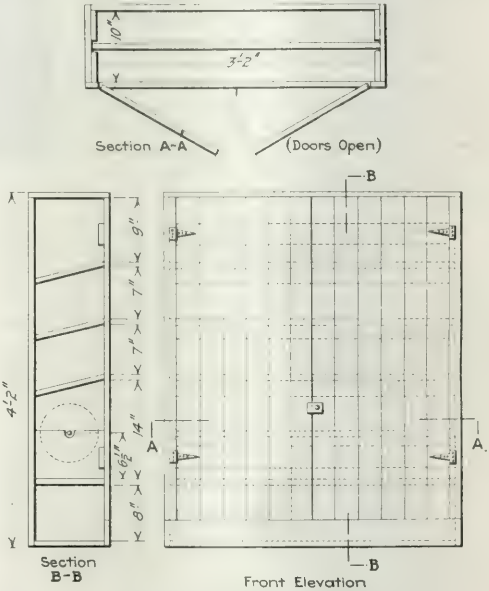
The pieces of the cam were chucked in a lathe, trued up by the valve-stem hole, and recessed on each side, as shown in the illustration. Two large washers were then bored out to a driving fit on the valve stem and held in line, while drilling and riveting, by an arbor the size of the valve stem. After the riveting was done, the keyway was cut in the washers to coincide with the keyway in the cam.

The job has been running several weeks and looks as if it would be good indefinitely.

Wood Cabinet for Drafting Supplies

A case for use on jobs where it is frequently difficult to obtain a suitable container for drafting supplies, such as detail paper and tracing cloth, is described by Arthur M. Shaw in *Engineering News-Record* of April 27, 1922. Its design is shown in the accompanying cut. It can be made in a few hours by a carpenter, and ordinary dressed lumber can be used. It should be made wide enough for the largest-size sheets of paper employed.

It is not necessary to remove any of the rolls to take off the required amount. The loose end is pulled out the required length, and the finger is run over the paper on the square edge of the shelf, leaving a mark for cutting. A ten-cent paring knife is suspended by a string on the inside of one of the doors and is used for cutting the paper. The 50-yd. roll of detail paper is mounted on a roller.



Cabinet for drafting supplies

Loading Ore in Skips

There are two methods of skip loading. In the first, the bin chutes extend to the edge of the shaft timbers, and a short spout which is operated by a lever spans the clearance space between the skip and the timbers. The bin gates are operated by racks and pinions, or, preferably, by compressed-air cylinders. Gates and gate openings are of comparatively large section, and chutes should be high-sided to prevent overflowing and spillage. Rapid charging is necessary where large tonnages are to be handled.

In the second method, a small steel bin is placed directly below each bin gate. The auxiliary bin is equal in capacity to a skip load, and is provided with a quick-acting gate which enables the contents to be discharged in a few seconds. The auxiliary bin is filled while the skip is being hoisted. In both methods the front of the skip bins is set back from the shaft timbers about 5 ft. This gives a sufficient working space for the loaders. Access to this working space is obtained by a small ladderway leading to the station or connected with the manway compartment of the shaft.

THE PETROLEUM INDUSTRY

Senator La Follette Attacks Lease of Teapot Naval Oil Reserve

Policy of Thirteen Years' Standing To Conserve Naval Oil Resources Has Been Abandoned — Indefensible, Says Senator

SENATOR LA FOLLETTE, of Wisconsin, on April 28, attacked the action of the Navy and Interior departments in leasing the Teapot Dome oil field, north of Caspar, Wyo., to the Mammoth Oil Co., controlled by Harry F. Sinclair and associates. A full investigation is to be made. The Senator said in part:

"The throwing open the naval reserves by leasing the lands to oil corporations by this administration came as a distinct surprise to the country. The policy of thirteen years of conserving underground oil in naval oil reserves has been abandoned. The three great naval oil reserves have recently become private oil reserves.

Without access to the records in this case it is somewhat difficult to get at all the facts, but there is sufficient material available to make it plain that the naval reserves are in immediate danger of being sacrificed to private exploitation at the hands of favored interests.

On the twenty-eighth day of February there was organized under the laws of Delaware the Mammoth Oil Co., with a capital stock of $1,000,000. The incorporators were T. L. Croteau, of Wilmington, Del., who subscribed for eight shares; M. A. Bruce, of Wilmington, Del., who has one share; C. H. Blaske, of the same place, who also subscribed for one share.

The next record, which appears in the files of the Secretary of State of Delaware, is an amendment to the articles of incorporation of the Mammoth Oil Co., which by this time had blossomed out with a vice-president and secretary, who filed the amended articles of incorporation with the Secretary of State. They are, respectively, G. C. Wahlberg and H. W. Kenwell. The former appears in the directory of directors of New York City as a director of the Sinclair Central American Oil Corporation. This amendment increased the capital of the Mammoth Oil Co. from $1,000,000 to $2,005,000. There were certain other amendments of the articles of incorporation not material to note at this time. In passing it may be interesting to observe that this capital stock is divided into two classes—A and B—2,000,000 shares being class A and 5,000 shares constituting class B. The right to elect directors in this corporation is vested exclusively in the holders of class B stock. This virtually gives these 5,000 shares absolute control of the company.

A conservative estimate of the value of the Teapot Dome is one-half billion dollars. Any Senator with paper and pencil can figure out the value of these 5,000 shares of stock.

At the very time when correspondents of the press were being assured by officials of the Interior Department that no lease of the rich naval reserve No. 3 had been made, a certain gentleman, prominent in oil, racing, and administration circles, published an interview in the New York *World* in which he asserted that the lease had been signed. This gentleman was none other than Harry Sinclair, of the Sinclair Oil Co.

This lease between the Secretary of the Interior, the Secretary of the Navy, and the Mammoth Oil Co. was signed on April 7, 1922. The fact that this lease had actually been made was not officially admitted until April 21, when its existence was acknowledged in the letter of the Acting Secretary of the Interior and the Secretary of the Navy, in response to Senate resolution of April 15, 1922, introduced by the able and diligent junior Senator from Wyoming (Mr. Kendrick).

During the time between April 7 and 21, when this mystery surrounded the public's business, speculation in Sinclair oil jumped on the New York Exchange in three days' trading over $30,000,000.

The only possible defence which the Interior Department can make for leasing the No. 3 reserve is that it is being drained by drilling in the adjoining, privately owned Salt Creek field. No other valid reason can be advanced, and some reason of paramount importance for the action taken will have to be proven before the public will accept this reversal of an approved Government policy which has been in force for nearly thirteen years.

The Interior Department has stated that an "expert of this department" has found that the Teapot Dome was menaced by drainage. This claim, made by one lone expert of the Interior Department, is contrary to nearly all opinions of geological experts who have heretofore examined and are intimately acquainted with this field.

I have wired Dr. G. B. Morgan, State Geologist of Wyoming. His telegram is direct and to the point. It is as follows:

> Cheyenne, Wyo., April 23, 1922.
>
> Senator Robert M. La Follette,
> Washington, D. C.
>
> No producing wells in neighborhood of Teapot except Salt Creek wells. My opinion is that Teapot and Salt Creek are separate structures and practically no possibility of draining Teapot through Salt Creek wells.
>
> G. B. MORGAN, State Geologist.

This is the statement of a scientist in the employ of the State of Wyoming, and I think his testimony should be accepted as disinterested. A telegram from the Hon. W. A. Blackmore, Mayor of Casper, Wyo., which is very close to this reserve, gives very interesting facts. I trust that Senators will listen carefully to this telegram. I read:

> Casper, Wyo., April 24, 1922.
>
> Hon. Robert M. La Follette,
> United States Senate.
>
> The Teapot structure cannot be drained by outside wells. The Salt Creek and Teapot Domes are entirely separate. The syncline between contains water—two wells drilled on Salt Creek side proved this. Shannon sand in Teapot carries oil—same sand in Salt Creek carries water. Hence impossibility for outside wells to drain Teapot. These views upheld by geologists who are familiar with actual conditions. Government owns entire Teapot Dome, and I believe it unwise to tap same at this time with 900,000,000 gallons gasoline reserve.
>
> W. A. BLACKMORE, Mayor.

In addition to all the foregoing I had my secretary call Dr. David White, chief geologist of the Geological Survey. In answer to a direct question as to whether or not his office had stated that the Teapot Dome could be drained by contiguous drilling, Doctor White replied:

> There is no information in my office upon which I could make any such statement. The only statements which we have are those of interested oil parties. We have considered sending a man to the field to investigate this situation, but have not done so as yet because of our limited appropriations.

Throughout this entire period[1] the record will show that the Navy Department was in correspondence with the President and the Interior Department urging the necessity of reserves for fuel oil. Finally two petroleum reserves were created by Executive order—No. 1 on Sept. 2, 1912, and No. 2 on Dec. 13, 1912. These were withdrawn by Presi-

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[1] Several years prior to 1912.

[illegible] [illegible] later on President Wilson established, by Executive order of April 30, 1915, naval reserve No. 3, in Wyoming, also known as the "Teapot Dome."

In practically every annual report of the Secretary of the Navy there are references to the importance of holding these naval reserves intact for future naval use. For instance in his report of Dec. 1, [illegible] the Secretary of the Navy devotes six pages to the necessity of oil conservation for the Navy.

Likewise on Dec. 9, 1916, the Naval Consulting Board, through Thomas A. Edison, its chairman, declared in an official statement that the national defence would be imperiled if any legislation was enacted which would divert from the Navy any portion of its petroleum fuel reserve. Hearings before the House and Senate committees on Public Lands and on Naval Affairs for the past several years show testimony by naval experts support the conclusions of the Edison report.

There are many official reports and statements by experts on the necessity of doing everything possible to keep in the ground intact a supply of fuel oil for the Navy.

In a letter to the chairman of the Naval Affairs Committee, dated Feb. 17, 1916, Secretary Daniels said:

> These reserves were [illegible] upon when the policy of building oil-burning ships was adopted, and now that we have a large and increasing number of ships that depend solely upon oil for fuel, it is of the utmost importance that the rights and needs of the Navy be not overlooked in the effort to relieve oil claimants on the lands. . . . The Navy Department does not desire to produce oil from the naval petroleum reserves at the present time and does not want the oil converted into money at any time, but does want the oil preserved under ground, where it may be stored without cost and free from loss or evaporation until the decreased production and the increased market price renders its production [illegible] [illegible].

Gulf Production Co. Proves New Dome in Texas

SPECIAL CORRESPONDENCE

A new salt-dome oil field in Fort Bend County, Tex., about seven miles south of Richmond, the county seat, is an assured fact. In February, drilling was started by the Gulf Production Co. on the Wheat Ranch, near Big Creek. Oil was struck in cap rock at about 650 ft. and in rock salt at 750 ft. The discovery of this new field is generally credited to W. C. Moore and Lee Hager.

The selection of the drilling site was influenced by a gas seep and a sulphur-water spring in the bank of Big Creek near by. So far there is little to indicate which way the dome will extend. Leasing is not as active as would be usual under normal conditions, but here the big oil companies, especially the Gulf Production Co., had most of the surrounding area "sewed up" before the well was drilled. There are, however, a few small tracts left which are held at moderate prices.

West Columbia, the largest producing coastal salt-dome oil field, is just emerging from an overflow of the Brazos River. Operations are increasing, especially in the northwest extension, where eight or ten rigs are drilling. In this section, the Humble Oil & Refining Co. is preparing to set screen in its No. 1 Badge well at 3,470 ft. This well, the most northwesterly in the field, blew out violently about two weeks ago, wrecking the derrick.

No. 2 Melgard well, drilled by the same company, has an oil showing at 3,470 ft. On the east side of the field the Texas Co., in its No. 72 Hogg, is setting 8½-in. casing at 3,652 ft. This is probably a record depth for casing of that size in the Gulf Coastal fields. The well is an offset situated on the central east line of the Japhet tract.

Loss of Gasoline by Evaporation in the Oil Fields Should Be Reduced

A detailed field investigation conducted by J. H. Wiggins, petroleum engineer for the U. S. Bureau of Mines, has shown that in a single stage of the handling of crude oil the volume of gasoline that evaporates is equal to one-thirtieth of the country's yearly gasoline production. This loss occurs during the few days that the oil is stored on the leases before being taken by the pipe line, and in one year, in the Mid-Continent field alone, it amounted to 122,100,000 gal. Large as it is, this is only a part of the loss on the lease. Investigation has shown further that the gasoline in crude oil evaporates from one-half to six-tenths as rapidly as the same gasoline after being distilled and stored, all evaporative conditions being the same. Many wastes in the oil fields are called "necessary." By this is meant that the cost of preventing the waste is greater than the gain through saving. Evaporation losses have fallen heretofore in this category, but now they must be considered unnecessary. It is no longer economical to permit losses through evaporation.

In accordance with its purpose of seeking to conserve mineral resources, the Bureau has investigated the loss of gasoline by evaporation in the storage and handling of petroleum. Inasmuch as most producers had not decided that their losses justified corrective measures, and as no evidence was available on the comparative losses in various stages of handling the oil, the investigation was limited to determining by experiment and observation the nature and magnitude of evaporation losses, where the greatest losses are, and the factors controlling evaporation. The results of the investigation, as presented in Bulletin 200, indicate that losses from evaporation are so large that they should at once receive serious consideration by the industry, which should endeavor to reduce them to a minimum.

Santa Elena Fields, in Ecuador, Produce 4,000 Bbl. of Oil Monthly

The principal petroleum developments in Ecuador are those at the Santa Elena fields, on the west coast, according to *Commerce Reports*. There are five drilled wells and many open wells. The Anglo-Ecuadorian Oil Fields, Ltd., has new machinery with which it plans to drive five more wells in 1922 to prove up the fields. The quantity of crude oil produced is about 4,000 bbl. per month. The product of the open wells is of much lower grade than that of the drilled wells, the latter being of exceptionally high grade. No accurate figures are available, but it is known that all of the crude product is consumed locally, there being two small refining plants in the district, where kerosene and gasoline are produced.

A recent discovery of oil shale and petroleum was also made in a district north of Guayaquil and more than 100 miles from the Santa Elena fields.

Production in Mexia Field Decreasing

Oil production from the Mexia field is falling rapidly. During the week ended March 11 the daily production was 153,000 bbl.; March 18, 163,700 bbl.; April 1, 117,000 bbl.; April 8, 112,000 bbl.; April 21, 94,000 bbl. Up to April 15, 17,300,000 bbl. was the total production from the field.

BY THE WAY

Geology Applied to Novels

In an interval of illness, when the mind and body wanders backward in the direction of childhood, we have been reading popular novels—detective stuff, South Sea stuff—anything, so long as there isn't a real thought in it. It is astonishing what a wide selection of this there is. And yet, no doubt some of these popular novelists take themselves pretty seriously, as we take ourselves; and possibly their millions of readers are more swayed by them than our thousands are by us.

One thing particularly interested us, though—what these novelleros owe to geology. Without geology they would be lost. Note the following quotation (p. 214):

"All my life I've dreamed of this," he said divertingly, with a gesture which included the yacht. "These islands that come out of nowhere, like transparent *amethyst*, that deepen to *sapphire*, and then become thickly green. And always the white coral sand rimming them—*emeralds* set in *pearls!*"

And elsewhere (p. 233): "In one hand the bright torch of danger and in the other the golden apples of love, with her eyes full of *sapphires* and her mouth full of *pearls*. 'With her eyes full of sapphires, and her mouth full of pearls.' All day long the phrase interpolated her thoughts." And well it might.

Again (p. 270): "The iron slipped from his face . . . the recollection rolled up to her lips as verbal lava . . . the father granite, the daughter fire . . . when he faced Spurlock the granite was cracked and rived."

Sapphires and emeralds were good geological-literary stuff in the time of Solomon, but how sick we are of emerald isles in sapphire seas, with an occasional jade wave, no one will ever know. What we need is to have no one given a novelist's license without a short course in geology, so that at least he can ring in quartz, feldspar, calcite, and diorite as novelties.

As, frexample:

"His face was monzonite, silicified and quartz-veined; but suddenly grief rived and faulted it, and from his eyes there leaped drops of calcite. And her own countenance, which had so long been stony and even marble, and even, under the poisoning effects of suspicion had actually chilled into aquamarine, suddenly became the most beautiful kunzite, as it was suffused again with love. The glacial period that had so long ruled in her heart had been briefly superseded by the hot sea of flaming basalt; but now the basalt cooled, except for unexpected little fumaroles here and there, and the sun shone thereon. She was, after all, a nugget among women—a thirty-ounce nugget. But the man—he of the chrome-steel sinews and the stellite endurance—what of he? Never before in all his molybdenous career had he thus been fairly vanquished. The paystreak of pure high-grade chalcocite which was in his character, concealed by the slight overburden of accumulated habit, had been laid bare in a moment by the steam-shovel of her woman's wit. He had come to the end of his sinking rope and must crosscut or quit; but the woman had accomplished in a flash what was beyond his own power. He blinked at her uncertainly, as a candle flickers against a newly opened vug; then the nickel-steel dropped from his face, for he saw that she was of purest gold—nay, more than gold, of platinum, while the utilitarian women he had so long admired were aluminum—solid, but dreadfully inexpensive. Their lips met, and each had a distinct impression of a seismic disturbance somewhere in the latitude of Charleston, or that somebody had fired a round of shot on the seventh level."

No charge—no copyright. Heighho, these quibblers!

Too Much of a Drawback

"Been readin' a lot 'baout these 'ere new dances, m'son," said Cap'n Dick. "Dam-me, do seem as 'ow tha 'ol country 'ave gone plumb daft. An', min' you, not h'only tha young chaps—t'were nothin' but they did dancin' h'in my time, m'son—but a lot o' these 'ere h'old beggars 'ave to 'ave a go with un. Still some o' they mus' 'ave some sort o' h'exercise. But 'ard, I fancy, h'on some o' these young maids 'oo be light h'on their feet an' don't like no draggin'. Puts me h'in mind o' tha young college chap 'oo come 'ere three year h'ago an' super put to work in tha timber shed with Martin Treloar, cuttin' timbers for square sets. Af'fer they'd 'ad a go for 'baout a 'our, Martin sez, ''Ere, boy, I don't min' thee ridin' h'on tha saw, but thee'll 'ave to stop scrapin' thy feet h'on tha bloody groun.''"

What Washington Overlooked

George Washington should have been a geologist instead of a surveyor. All about him at Valley Forge lay boundless mineral wealth, if we may believe the Year Book of the Chester County Council of Boy Scouts, yet it escaped his notice—and this at a time when the financial shoe must often have pinched exceedingly. The Year Book says:

> "A marvellous discovery—on an eleven-acre farm just half a mile beyond Valley Forge, where Washington with his ragged, barefoot soldiers trod valiantly back and forth so many years ago, a modern Golconda has recently been discovered, with wealth enough to have clothed and fed and armed the entire Continental Army and brought the war to a speedy and successful conclusion.
>
> "For on this comparatively small space of ground have been discovered 90 per cent of all the various kinds of metals ever found in this country, together with precious and semi-precious stones that rival in infinite variety the most splendid tales of the Arabian Nights. These included veins of platinum, tin, and quicksilver.
>
> "Among the precious stones (which Mr. Barr has) dug up are three white sapphires, exceedingly rare gems, besides opals, topazes, blue sapphires, jasper, sardonyx, lapis lazuli and many other varieties.
>
> "The gold vein (on Mr. Barr's property), which is of the vertical variety, is over 10 ft. thick, and has been assayed as high as $172 a ton. The owner, however, has never dug deeper than 15 ft. and has no knowledge of how far down into the earth it extends. In spite of the unlimited possibilities which his property holds forth, he has no intention of working the land for some time to come, at least.
>
> "'The metals and gems will stay here,' he asserts, 'and meanwhile I feel that I am doing the world more good by letting people have the mineral water which flows from my land. Perhaps, later, when I get more money, I will mine some of the metal and see just what it is worth.'"

Unfortunately, a member of the State Geological Survey failed to corroborate these claims, and the fame of Valley Forge still rests upon patriotic grounds.

Selected at Random

As a sobriquet that is neat but not gaudy, the name of the Midnight & Tidal Wave Mining Co., of Arizona, takes the blue ribbon. What *is* in a name after all?

SOCIETIES, ADDRESSES, AND REPORTS

Northwest Associations Seek Higher Tariff on Magnesite

The feature of the weekly noon luncheon of the Spokane Chamber of Commerce, on April 25, attended by over four hundred representative business men, was the attention paid to the matter of protective tariffs on lead, zinc, and magnesite, all of which ordinarily are produced in considerable quantities in and around Spokane. Frank M. Smith, smelter director of Bunker Hill & Sullivan Mining & Concentrating Co., presided over the gathering. Addresses were made by Howard F. Wierum, of the American Minerals Product Co., Valley, Wash., and by Donald A. Callahan, president of the Wallace Chamber of Commerce, president of Galena Mining Co., a subsidiary of the Callahan Zinc-Lead Mining Co.

Two resolutions, with reference to the lead and zinc tariff and the magnesite tariff, were presented and indorsed, with a request to the trustees of the Spokane Chamber of Commerce that they be adopted. The resolutions which were presented at the meeting were as follows:

LEAD AND ZINC TARIFF

Whereas, the lead-silver-zinc mines of the Cœur d'Alenes and other districts in Idaho and Washington have created and still account for much of the prosperity of this city and the whole Northwest; and,

Whereas, the Cœur d'Alene district alone produces in normal times approximately one-third of all the nation's lead, a heavy zinc output, and about 10,000,000 oz. of silver, and many other districts of Idaho and Washington contribute important quantities of the same metals; and,

Whereas, over 12,000 people in Shoshone County, Idaho, alone, are directly supported by the operation of its mines, and other communities of Idaho and Washington also depend largely upon the same industry; and,

Whereas, the continued prosperity of this industry depends upon provision of an adequate tariff upon lead and zinc in manufactured forms or in ores; and,

Whereas, the import tariff rates provided in the Fordney bill will enable the domestic industries to compete with the cheap-labor products of Europe and Mexico, to the everlasting benefit of United States capital and labor; now, therefore, be it

Resolved by the general membership of the Spokane Chamber of Commerce, Northwest Mining Association, and Washington Mining Association, in joint meeting assembled, this, the twenty-fifth day of April, 1922, that the Senate of the United States be and hereby is respectfully petitioned to adopt and maintain the tariff schedules provided for in the Fordney bill upon lead and zinc, and that appreciation of the attitude maintained by Senators Poindexter and Jones and all Congressmen of the State of Washington toward such tariff legislation be and hereby is expressed; And be it further

Resolved that copies of this resolution be sent to the Congressional delegations from all Northwest states, to Chairman Fordney of the Ways and Means Committee of the House of Representatives; to Senator McCumber, chairman of the Senate Finance Committee, and the press of the Northwest states.

MAGNESITE TARIFF

The resolution relating to magnesite tariff was as follows:

Whereas, the production of magnesite within our own borders is an accomplished fact, adding one more distinct, new and essential resource to the commercial independence of the United States; and,

Whereas, the chief supply of American magnesite industry is located in the State of Washington; and,

Whereas, the industry, if perpetual in America, would continue to furnish profitable and steady employment to some 1,500 men, thus supporting 6,000 men, women, and children, pay American railroads $3,000,000 per year in freight charges, contributing generously to the business of coal mining, iron mining, explosives manufacture, hardware, chemicals and steel products, besides keeping alive the important industry of magnesium chloride, manufactured chiefly in the states of Utah and Michigan; and,

Whereas, this American magnesite industry positively cannot live in competition with foreign magnesite produced by labor which is paid from 25 to 35c. per day of ten hours, served by carriers transporting the product over 3,500 miles to our shores for approximately $5.50 per ton of 2,000 lb., unless a tariff of at least $15 per ton be levied by the United States Government upon such foreign magnesite; and,

Whereas, the American magnesite producers actually contributed vitally to the life of the steel industry during the war at the behest of the steel manufacturers themselves and to their enormous profit, but without profit to the magnesite industry itself; and,

Whereas, directly or indirectly, this same steel industry is now the chief and most selfish opponent of the American magnesite industry in its fight for life; and,

Whereas, the recommendation of the Senate Committee on Finance of a tariff of $8 upon dead-burned magnesite is positively inadequate and would result in the ruin of the industry in Stevens County; now therefore, be it

Resolved by the Spokane Chamber of Commerce, Northwest Mining Association and Washington Metal Mining Association, in general joint meeting assembled, this the twenty-fifth day of April, 1922, that no lesser rate of tariff than $15 per ton on dead-burned or calcined magnesite and $10 per ton on crude magnesite can possibly realize to the United States the tangible benefits offered by development of this industry; and, be it further

Resolved, that the Senate of the United States be and hereby is respectfully and earnestly urged as a patriotic duty to stand firmly for the recommendation of the Ways and Means Committee of the House of Representatives providing a tariff of $15 per ton on all calcined magnesite; and be it further

Resolved, that grateful appreciation of the attitude maintained by Senators Poindexter and Jones and all Congressmen of the State of Washington, particularly Congressman J. Stanley Webster and Lindley H. Hadley, toward such tariff legislation, be and hereby is expressed.

Problems of Western Mining To Be Considered in Conference

At the invitation of Bulkeley Wells and the Colorado Metal Mining Association, a conference of Western mining men is being arranged by the American Mining Congress, to meet in Denver on June 20 and 21. The purpose of the meeting is to discuss vital problems confronting the Western mining industry and to formulate constructive policies relating especially to national "blue-sky" legislation, protection of the gold standard, future of silver mining, unfair Federal and state taxation, and closer co-operation of state mining organizations with each other and with the American Mining Congress.

Zinc Producers Co-operate With Fabricators

Special interest was taken by the zinc-ore producers in the convention of the Sheet Metal Contractors' Association, held in Joplin on April 28 and 29. Arrangements had been made to have E. H. Wolff, of Peru, Ill., president of the American Zinc Institute, and S. S. Tuthill, its secretary, address the convention at Joplin, but because the visiting metal workers wished to make a trip through the mining district it was decided to hold a noon meeting at Picher on April 28, at which both men were heard. The metal contractors were shown over the district and through the Netta mine of the Eagle-Picher Lead Co., and also through the plant of this company at Joplin.

The general purpose of the zinc operators was to impress the sheet-metal contractors with the value of zinc for roofing and gutter material.

MEN YOU SHOULD KNOW ABOUT

H. C. Schmidt is making a three weeks' visit to San Francisco.

John Tallant is on his way home to San Francisco from La Paz, Bolivia.

Eugene H. Dawson is examining mining properties in southern Illinois.

Roy H. Elliott has been in Gold Hill, Nev., inspecting operations of the United Comstock.

Frank L. Sizer has returned to San Francisco from inspecting a mine in Mono County, Cal.

Harry L. Brown, chief field engineer of the American Metal Co., has returned from a trip to Cuba.

Charles E. Rogers, of London, is expected to arrive in New York, May 8, on the steamship "Orbita."

E. Percy Smith, mining engineer, announces occupancy of his new office at 15 William St., New York City.

Harold McLeod Cobb, general manager of the Soto Mines Co., has arrived in New York from El Paso, Tex.

Reginaldo Opeda has recently been examining prospects at Jimulco. He has returned to Guanacevi, Durango, Mexico.

H. C. Dudley has returned to Pasadena, Cal., from a visit of inspection to the Ahumada lead mine, in Sonora, Mexico.

E. E. Whitely, superintendent of the Calumet & Arizona Mining Co., has been called to Minnesota by the death of his father.

Sir Henri W. A. Deterding, of the Royal Dutch-Shell Oil Co., is in California on a tour of inspection of the company's properties.

Raymond Guyer, of Spokane, left on April 21 for a trip of inspection to the property of the Cori Gold Mining Co. at Acaponeta, Nayarit, Mexico.

Hewitt O. Fearn, mining engineer of Hyder, Alaska, and Oyster Bay, N. Y., left New York on April 30 for Maracaibo, Venezuela, on oil exploration.

Theodore Dickel has finished his engagement with the Cia Minera de Eureka at Tejamen, Durango, and will examine properties elsewhere in the state.

C. M. Loeb, president of the American Metal Co., reached Seattle on April 25, after a trip of seven months around the world. He arrived in New York on May 1.

M. W. Hayward, chief engineer of the Cia Minera de Peñoles, has been in Guanacevi, Durango, Mexico, for the last two weeks inspecting the company's properties.

H. A. Linke, of Salt Lake City, and **Peter Roder**, of New York, have joined the Federal engineering force at the Independence-North Star properties near Hailey, Idaho.

George L. Dickinson has been transferred from Santa Barbara, Chihuahua, Mexico, to Asarco, Durango, as chief assayer of the branch there of the American Smelters Securities Co.

Robert N. Bell, former state mine inspector of Idaho, who has been operating the Red Bird property, came East recently in the hope of securing beneficial medical attention for his eyes.

Philip L. Foster, Robert M. Raymond, and **Alfred F. Main**, consulting mining engineers, announce that their offices were removed on April 25 to 350 Madison Ave., New York City.

C. M. Weld, of Weld & Liddell, has returned to New York from a professional trip to Alabama and Tennessee, and will leave on April 30 for West Virginia, where he will investigate some coal properties.

J. B. Moore has resigned as manager of the Jimulco Mining Co. and the Texas-Mexico Mining Co., at Jimulco, and Velardeña, Durango, Mexico. He is succeeded by **I. S. James**. Mr. Moore has gone to Santa Cruz, Durango, to take charge of the Santa Cruz Mining Co., succeeding **S. W. Loving**.

G. H. Dowell, manager of the Copper Queen Branch of the Phelps Dodge Corporation, has gone on a six months' vacation to California and Honolulu. **D. D. Irwin**, formerly in charge the corporation's operations at Nacozari, Sonora, Mexico, is in charge temporarily of the Copper Queen Branch.

The partnership of **Huntoon & Van Arsdale** has been discontinued. L. D. **Huntoon** will continue practice as consulting mining engineer at 115 Broadway, New York City, and **G. D. Van Arsdale** will continue practice as consulting chemist and metallurgist at 1011 South Figueroa St., Los Angeles.

Dr. F. V. Meriweather, surgeon for the U. S. Bureau of Mines, and **R. V. Ageton**, car engineer for the Bureau, have returned to Houghton, Mich., from a trip to Elcor, Minn., where they presented a hero medal to Dan Beondich on behalf of the Bureau in recognition of his work in saving lives at a mine fire at Elcor.

H. Foster Bain, director of the U. S. Bureau of Mines, left Washington on April 30 for a trip of inspection in Alaska during which he will witness tests of coal from the Chickaloon and Bering River fields to determine their fitness for naval use. En route he will visit the experiment stations of the Bureau at Urbana, Denver, San Francisco, and Seattle. He will leave Seattle on May 17 and visit Governor Bone at Juneau, going on to Seward and Sutton, where the coal tests will be held, and traversing the region covered by the Alaskan railroad.

Mining and metallurgical engineers visiting New York City last week included: **E. James Lowry**, of South Bend, Ind.; **Eugene Lilly**, of St. Paul, Minn.; **Donald C. Barton**, of Houston, Tex.; **Henry Johnson**, of Kingman, Ariz., **Frank Hess**, of Washington, D. C.; **R. O. Griffis**, of Middletown, Ohio; **R. A. Schmucker**, of Red Hook, N. Y.; **G. R. Elliott**, of Goderich, Ont.; and **Lloyd L. Evans**, of Cleveland, Ohio.

SOCIETY MEETINGS ANNOUNCED

The American Zinc Institute will hold its annual meeting at St. Louis, Mo., on May 8 and 9.

The **Fourth International Mining Convention** will be held at Nelson, B. C., on July 3-7. Chairman of the various local committees have been named and the necessary preliminary work is being undertaken.

The Utah Metal Mine Institute will hold the second meeting since its organization, in Park City, July 14 and 15. The Park City meeting will be the first of the two meetings planned for 1922, and the time will be devoted largely to the inspection of the mining properties in the camp. The second meeting of the year will take place in Salt Lake City at a date not fixed, and will include papers and discussions. Members of the executive committee are: **A. S. Winther** and **E. A. Hamilton**, of Bingham; **H. M. Hartman**, of Ophir; **Forest Mathez** and **O. N. Friendly**, of Park City; **T. P. Billings** and **A. J. May**, of Tintic; and **C. A. Allen, Ernest Gaford, N. A. Robertson** and **A. G. MacKenzie**, of Salt Lake City.

OBITUARY

Jesse G. Morgan died at Webb City, Mo., on April 27.

Harold J. MacKenzie, of Woodstock, Ontario, died of pneumonia on April 25, in his thirty-first year. He was graduated from Toronto University, with honors, as a mining engineer in 1914, and was engaged with the Clark-Dodge Corporation of New York in charge of the Montana Consolidated Copper Co. When the war broke out he enlisted in the Canadian Engineering Corps, rose to the rank of Major, and won the Military Cross.

W. H. Armstrong died recently in Vancouver, B. C. A high tribute was paid to his work by members of the Vancouver Branch of the Canadian Institute of Mining & Metallurgy. It was pointed out that he had much to do with the founding of the great fireclay refractories, and brick industry of Clayburn; the development of coal mining at Merritt, the development of the Ikeda Mine, at Queen Charlotte Island, and exploration for coal and other minerals in the Similkameen district, Queen Charlotte Islands and other portions of the province.

THE MINING NEWS

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Leading Events

MINERALS Separation and the Jackling interests have at last affected a settlement of all flotation litigation between them. The Miami Copper Co. is also included in the compromise. All parties are reported satisfied.

Mine law revision, as provided in the so-called Arentz bill, received its first consideration by the House Committee on Mines and Mining on April 27.

The American Smelting & Refining Co. has joined hands with the Bulkeley Wells and Eastern interests to ease the Colorado Smelting situation.

An interesting discovery of iron ore, possibly one of much importance, has been made on the Cuyuna Range in Minnesota.

Power rates for mines and mills in Colorado are not to be increased by the Colorado Power Co., as a result of a decision by the Public Utilities Commission.

Improvement in the price of lead is reflected in the Cœur d'Alenes. The Tamarack & Custer will resume soon and the Hercules may follow.

A hearing on Minnesota's tonnage tax is in progress in St. Paul.

Interesting Ore Discovery Made on Cuyuna Range

Steel & Tube Co. Makes Remarkable Find in One Drill Hole

What may prove to be one of the most important discoveries of iron-ore reserves in recent years on the Cuyuna Range in Minnesota has just been made by the Rogers-Brown Ore Co. drilling on Lot 5, Sec. 29,47-28, east of the Kennedy mine. The tonnage developed by this drilling has been variously reported up to 5,000,000, but investigation reveals the fact that the operators have made no such estimate, nor could any reasonable estimate be made, as drilling in ore has not been extended beyond one section and in this only one hole so far has a remarkable ore showing.

Hole No. 716, recently completed, showed a continuous depth of 395 ft. of commercial ore, from its encountering ledge at 105 ft. to a depth of 500 ft., where it was stopped in ore. The first 300 ft. of this ore averaged slightly more than 58 per cent in iron. Whether this represents a narrow, nearly vertical, band of concentration (which is not an uncommon occurrence on the Cuyuna) or the edge of a wide deposit will not be known until the drilling has been considerably extended. The property had been drilled several years ago, at which time nothing beyond iron formation was found. T. F. Rundle, chief engineer of the Rogers-Brown Ore Co., directed the recent exploration.

The Rogers-Brown Ore Co. is a subsidiary of the Steel & Tube Co. of America. Owners of fee interests in the property are William Harrison and George H. Crosby, of Duluth, with the Onondago Iron Co., Lake Investment Co., and Northern Minnesota Ore Co. holding minor interests.

Jackling and Minerals Separation Settle Flotation Litigation

Miami Copper Co. Also Included in Agreement—Legal Proceedings To Be Wound Up—Details Not Made Public

NEGOTIATIONS between the Jackling mining companies and the Miami Copper Co., on one hand, and Minerals Separation, on the other, terminated on April 28 in a settlement that is satisfactory to all parties. Certain details as to how the legal proceedings shall be terminated remain to be decided. It is not known whether the terms of settlement will be published. Both parties, it is said, displayed a willingness to effect a compromise.

The litigation involved in this compromise has been in progress for eleven years, if one includes as a part of it the suit against James M. Heide (who introduced flotation at the Butte & Superior), which suit was brought in October, 1911, and was concluded by the U. S. Supreme Court decisions of Dec. 11, 1916. Contention arose as to whether this decision against James M. Heide could be applied against Minerals Separation, Ltd., since it developed that Mr. Heide was not an officer of the Butte & Superior company. While contending that it did not so apply, Minerals Separation did not contest the point, having already brought another suit against the Butte & Superior company itself, in October, 1913. The Butte & Superior case was decided by the U. S. Supreme Court in June, 1919. The Circuit Court of Appeals, in San Francisco, had held that to sustain the appellees' patent would be to give to the owners thereof a monopoly of that which others had discovered. The Supreme Court reversed the Court of Appeals to the extent that it found that the inventors of the patent, 835,120, had taken the final step which had turned failure into success, and upon this ground the patent was declared to be valid.

In the Supreme Court's opinion in the Butte & Superior case the Circuit Court of Appeals was in part reversed and in part sustained—sustained as to the right of the Butte & Superior to operate with an oil or oily substance in excess of 1 per cent on the ore, regardless as to whether or not it could be termed "a frothing oil."

The suit against the Miami Copper Co. had been brought originally in the summer of 1914, shortly after the time at which the Circuit Court of Appeals, in San Francisco, had found the Minerals Separation patent, 835,120, to be invalid. The original Miami suit was withdrawn, without prejudice, and in its place another suit was filed to include the third patent, as well as the second, neither of which had been in the Heide case (nor were they in the Butte & Superior case). The Miami case also included the experimental Callow cell operation. (See *Engineering and Mining Journal*, Dec. 1, 1917.)

The Miami Copper Co. case was decided in the Circuit Court of Appeals in

Philadelphia, on May 24, 1917, in a decision by Judge Woolley, (Judge McPherson concurring), which found that the operation of these preliminary steps in the experimental plant had embodied the agitation of the Minerals Separation process, and that the defendant could not escape infringement by employing a fourth step, even though that fourth step might not in itself infringe. However, whether the Callow cell did or did not infringe was not adjudicated.

Therefore in both the Butte & Superior and in the Miami cases, the proceedings were each in the hands of a master, to determine the damages.

In the Butte & Superior case a considerable tonnage, covering an extended period, had been adjudged to have been treated during infringement, so that here "the standard of comparison" was an important question. Minerals Separation sought to have the District Court instruct the master that the standard of comparison must be some process which would have been open to defendant's use at the *time of the discovery* of the infringed process, 1905. This the District Court refused to do, by deciding that the defendant was at liberty to set up as a standard of comparison any process available at the time of the *infringement*, 1914-15, which might have meant, possibly, the flotation results, with oil in excess of 1 per cent, which, except for the cost of all, were comparable with the metallurgical results which had been obtained by the infringing use of the process.

The hearing before the master, in the Miami case, had been in progress for about four years, and yet the plaintiff's *prima facie* case was not much more than completed.

In the Supreme Court decision in the Heide case, the validity of Minerals Separation patent 835,120 was determined.

In the Supreme Court decision in the Butte & Superior case the scope of the claims as to quantity and character of "oil" was determined.

In the Miami case the question as to what constituted the agitation of process was the principal point at issue. Just what is the scope of the claims of the patent as to degree and character of agitation has not yet been determined by the Supreme Court, nor did the Circuit Court of Appeals in Philadelphia, in its opinion in the Miami case, of May 24, 1917, determine whether or not the so-called pneumatic cell, such as the Callow cell, if acting alone, comes within the scope of the patent. (See *Engineering and Mining Journal* of Dec. 1, 1917.)

In addition to the three main cases there were the various supplemental bills, upon which court decisions have been rendered.

In the Butte & Superior case, as to the standard of comparison available, and in the Miami case, there were also several appeals, two of which went up to the Court of Appeals, the most important being possibly the decision by the Circuit Court of Appeals in Philadelphia sustaining the District Court's action in its refusal to find the Miami Copper Co. in contempt of court for the continued use of its flotation process.

Then there are, of course, the cases pending against the several other Jackling properties, so that, with the necessarily tedious progress of the hearing before the masters, it appeared that the litigation would be practically interminable had the legal proceedings been carried to their conclusion.

Hollinger Will Refuse to Sign Power Contract

It is officially stated that the Hollinger Consolidated Gold Mines, Ltd., of Porcupine, Ont., will refuse to sign a contract with the Northern Canada Power Co. unless it is forced into that position legally. As soon as the power outlook clears, Hollinger will go ahead with its mill addition, bringing its daily tonnage to 7,500. The company expects to produce $12,000,000 of gold this year, which signifies that the heads will be held between $8.50 and $9.

Minnesota Tonnage Tax Hearing at St. Paul

Attorneys for the thirty iron-mining companies seeking a permanent injunction against the collection of the Minnesota occupational, or so-called tonnage, tax, completed their arguments in the Federal Court hearing at St. Paul April 24, and the state began presentation of its side of the case.

The plaintiffs contended that the ore is an article in interstate commerce as soon as it is taken from the ground, and that the tax is therefore invalid, as it places a burden on interstate commerce. E. S. Oakley, Assistant Attorney General, and P. L. Ryan, special attorney for the state, made the claim that the tax is not a levy on the business of transporting or selling iron ore; that it is not a property tax, nor an income tax, but solely a tax on the business of mining which is carried on within the state, and they contend, may properly be taxed by the state as a business.

The hearing is being conducted by Federal Judge Tillman D. Johnson, of Salt Lake City, Utah.

Magma Copper Co. Lets Contract for New Railroad

By Telegraph to "Engineering and Mining Journal-Press."

Phoenix, Ariz., May 1—A contract for three-quarters of a million dollars has been awarded by the Magma Copper Co. to Twohy Brothers Construction Co. for the construction of a thirty-four-mile broad-gage railroad to Magma from the Arizona & Eastern Railroad. The time limit is eight months. Operation of the present narrow-gage will be continued meanwhile. The Twohy company has large contracts for concrete work at Clarkdale.

A. S. & R. Enters Agreement To Ease Colorado Smelting Situation

Joins With Bulkeley Wells and Eastern Interests—Durango and A. V. Smelters To Handle Ore

The American Smelting & Refining Co. will hereafter divert all ore in Colorado to its Leadville and Durango plants, which are to be remodeled and improved. At Durango the smelting company and the Metals Exploration Co., of which Bulkeley Wells is president, will expend $250,000 in the installation of the Coolbaugh process for the treatment of complex ores. This it is believed will bring a largely increased tonnage to the plant.

At Leadville the A. V. smelter is to be remodeled to meet present conditions of ore supply. The smelting company and the Metals Exploration Co. have joined with eastern interests represented by Lewis Fanders to resume operations at the Rawley mine and a 300-ton mill, to be enlarged later to 500 tons, will be built at once to handle the output. The concentrates will be shipped to Leadville and will furnish a much needed supply of lead ore for the furnaces.

A new and simpler schedule is being prepared by the smelting company for both the Leadville and Durango plants and the Colorado Metal Mining Association has taken up with the railroads a proposition for freight rate adjustments which, if adopted, will lead to a large increase of shipments to the smelters. Mining men are greatly pleased with the outlook, and a decided increase in mining activity is expected.

For several months Bulkeley Wells, chairman of the Colorado Metal Mining Board, has been negotiating with the American Smelting & Refining Co. with a purpose of securing a readjustment of smelting conditions and rates in Colorado. Decreased production of smelting ores had resulted in the closing down of various smelting plants throughout Colorado, leaving only the Leadville and Durango plants in operation, both of which are owned by the American Smelting & Refining Co. These plants were operated under serious disadvantages, on account of a lack of necessary ores to make a proper charge for the furnaces. As a consequence, there was a heavy increase in smelting charges and, taken together with the longer freight haul, it resulted in the closing down of many mines which under more favorable conditions would have furnished a desirable smelting product. The situation was further complicated by the fact that the plants in operation were antiquated and poorly adapted to present conditions of ore supply.

Kongsberg Mines Cut New Silver Ore

By Cable from Reuters to "Engineering and Mining Journal-Press"

Christiania, April 28—An important discovery of silver is reported to have been made at mines belonging to the Kongsberg Silver Co.

Swiss To Reorganize Russian Platinum Industry

By Cable from Reuters to "Engineering and Mining Journal-Press"

Geneva, April 27—At the invitation of the Soviet government, Louis Duparc, government director of the Geneva School of Chemistry, is going to Moscow at once to reorganize the crude platinum industry.

Wages Reduced at Port Pirie

By Cable from Reuters to "Engineering and Mining Journal-Press"

Melbourne, April 26—The Federal Arbitration Court has decided to reduce the basic wage at the Port Pirie smelter from 14s. 8d. to 12s. 8d. per day. The court held that foreign competition prevented the payment of a higher rate.

Cole Heads Seneca Copper

The new board of directors of the Seneca Copper Corporation has elected Thomas F. Cole president. Mr. Cole succeeds J. Parke Channing, recently resigned.

Power Rates in Colorado Not To Be Raised

State Commission Denies Application—Proposal Fought by Metal Mine Operators' Association

The Colorado Public Utilities Commission has handed down a decision refusing permission to the Colorado Power Co. to increase rates for power for mines and mills from 20 to 40 per cent. The power company serves the principal mining camps of Boulder, Gilpin, Clear Creek, Summit, and Lake counties, and surplus power is sold to the Denver Gas & Electric Co.

The application was resisted by the mine operators and their association on the grounds that it did not provide for an advance in the rate for power furnished Denver, and that the rates charged the mines should not be increased without a corresponding advance in the Denver rate. It was also contended that the company's generating capacity was much in excess of the requirements of the districts served and that the mining industry should not be taxed to provide interest on an unwise investment of the power company.

H. H. Armstead Sells Interest in Idaho Property

By Telegraph to "Engineering and Mining Journal-Press"

Spokane, May 1—H. H. Armstead has sold his interest in his company, Armstead Mines, Inc., to A. H. Burroughs, Jr., engineer and managing director of the company. The company's property is at Talache, Bonner County, Idaho, and includes a concentrator just completed. New York interests are said to be associated with Mr. Burroughs.

Workmen Strike at Perth Amboy Lead Plant

A strike that has been in progress for some time at the works of the Barber Asphalt Paving Co., at Perth Amboy, N. J., spread to the lead plant of the American Smelting & Refining Co. on May 3. Part of the 600 or 700 men employed at the latter plant quit work, asking a wage increase of about 50 per cent. Mexican ores only have been handled at this plant recently, little other smelting being done. The situation is not considered serious.

News from Washington

By PAUL WOOTON
Special Correspondent

House Passes Denison "Blue-Sky" Bill

Senate Committee Expected to Speed Its Passage—Volstead Amendment Limits Suits to $3,000 or More

Rejecting pleas of both Eastern and Western Congressmen against restricting stock transactions by mining corporations in behalf of the mineral development of the country, the House of Representatives on April 28 passed without a record vote the Denison bill restricting the sale of stock securities. Under the bill securities cannot be sold through solicitation through the mails of another state than that in which incorporated unless permission is obtained from the states in which it is desired to do business. Western members sought to exempt securities recognized by three or more states, but were unsuccessful. During the debate various members, including Chairman Steenerson of the Postoffice Committee, and Chairman Volstead of the Judiciary Committee, which had considered similar legislation, said that they did not approve all of the provisions of the proposed law.

The bill now goes to the Senate, where it is said the Committee on Interstate Commerce will expedite consideration of the measure.

An amendment was adopted, offered by Representative Volstead, limiting suits under the bill to recover at least $3,000 or more, which is the minimum for a suit to be filed in Federal courts.

First Hearing Held on Mining Law Revision

All Want Law Changed to Conform to Future Conditions, Opinion Differing as to Procedure, Says Ingalls—Bain Cites Opposition to Leasing Act

CONVINCED that it would be a mistake to hurry through any legislation looking to the revision of the mining laws, the Committee on Mines and Mining of the House of Representatives and proponents of such legislation are going about the task with deliberation. Their position was made clear at the hearing on the subject, which was held on April 27. On that date the committee heard W. R. Ingalls, the head of the committee of engineers who drafted the bill now under consideration. Mr. Ingalls went exhaustively into the situation surrounding the legislation.

H. Foster Bain, Director of the Bureau of Mines, testified briefly and will submit for the record a written statement supplementing what he told the committee verbally. As it was impossible for Horace V. Winchell to be in Washington at this time, the committee decided to adjourn the hearing until he could appear, which is expected to be some day the latter part of the month. Mr. Bain told the committee that he could say "without fear of contradition that Horace Winchell is the foremost American authority on mining litigation. He has had more experience as an expert witness in the difficulties which have flowed out of our old mining law than has probably any other one in the United States."

Referring to the Ingalls committee, Mr. Bain told the committee that the men composing it (W. R. Ingalls, Walter Douglass, J. Parke Channing, James R. Finlay, John Hays Hammond, L. D. Ricketts, and Horace V. Winchell) have had wide experience, and are familiar with mining law, not only in this country but in other countries. As a result, they bring to the work a knowledge of what has proved feasible in other lands as well as a familiarity with the system which has been followed in this country. Continuing, Mr. Bain said:

"Then with regard to the extent of the demand for the revision of law; since this report appeared there has been an enormous amount of material which has come to the office of the Bureau, most of which I have transmitted direct to the chairman, in criticism of particular features in this report, and in reading that I think it would be fair to take account of the fact that those criticism are directed at particular features, and that there is relatively little opposition to revision *in toto*. There are a number of the men who have written in, as you will find when you examine the material, who have come to the conclusion it is best not to make any change. As I have met that opinion in travels in the West and in letters, I think it is founded on that innate conservatism of human nature. We have found a way whereby we get things done; we have got certain rights established; we have got certain precedents, certain practices and procedure, and it is feared that if we attempt to disturb those at all, changes will be so far-reaching that you will make trouble in unanticipated places. That is, of course, a real difficulty, and yet it is a difficulty which you have met before.

"When a law is framed to apply to a certain set of facts, a certain condition of nature, and as years go on and development extends into a new territory, you get a new type of deposits which the old law was not framed with a view to meeting. It then becomes necessary either to have additional law or by interpretation to stretch the old law to cover new facts and conditions. This process of stretching has gone on now since 1872, and in a great many cases the law has been stretched to a point which, in my judgment at least, and that of many others, is unsafe. The time has come when the burden should rest upon Congress to give to the courts and to the department new law to apply to new facts and conditions, because we are now developing types of ore deposits which were entirely unknown at the time the present law was framed, and in the future we shall have to devote a great deal more attention to such deposits.

"I think some of the members of this committee as it is now constituted served on the committee through the years when the matter of revision of the public law with regard to oil lands was under consideration. You will recall that something over ten years ago the demands for revision of that law arose. At that time the only way that oil lands could be taken up was under the terms of a law which had been written with a view to taking up gold placers, an entirely different type of deposit, and by a process of construction a method had been found to apply that to the taking up of oil lands.

"It was an extremely unsatisfactory process of taking up the land; it was one which led to a great deal of confusion, a great deal of trouble, and yet when an attempt was made to change that law the people who were in the industry were so impressed with the undesirability of any change that they fought it stiffly for about ten years. Nevertheless, as the result of patient work on both sides in the effort to get the minds together, a new law was framed. The oil leasing act went into effect Feb. 20, 1920, and while the time is still short to judge the effect, I may say from my experience in the actual operation of the law that it has worked very satisfactory, and I doubt if any considerable number of the men who are working under the new law would care to go back to the doubts and uncertainties and the opportunities for striking and blackmailing which existed under the old law.

"The present law on lode claims is in many particulars as unsatisfactory as the old placer law was in its application to oil leases, and it will be your opportunity here to examine witnesses who have had experience in its actual operation."

Extracts from Mr. Ingalls' remarks before the committee are as follows:

"I am not aware of what I would like to characterize as any change in sentiment. I am aware of more or less criticism of details of this bill that have been made since its publication, its publication having been specifically for the purpose of developing such criticisms.

"The ideas that have been expressed in criticism of the bill since its publication, have been in general in no wise different from the expressions of opinion which developed in the prolonged discussions preceding the work of the committee. There is not to be expected unanimous opinion among all people engaged in the mining industry, because this is a very great country, and the people who are engaged in the mining industry in one part of it are very likely to have a different opinion as to what the law ought to be in detail.

"There has been a rather extensive objection to one detail of the bill, namely, the provision that prescribes location in conformity with the public land survey. Now the committee is of the opinion that that is best, although I have never laid any questions formally before the committee, since its report was made. Since the rendering of its report to the Bureau of Mines, the committee had no formal meetings: nevertheless, I feel quite safe in saying that as the result of conversation, while the committee is of the opinion that that method of locating claims is the best method, nevertheless the committee would consider that to be an immaterial provision, and if the people in the mining industry in general do not want it, and I get the idea from the discussion that that is a fact.

"I am satisfied, and I think every member of the committee is satisfied, that the mining industry wants an abolition of the law of the apex, that it wants an abolition of discovery as a prerequisite to location, that it wants to preserve as much of the existing laws as is possible, and beyond that I think that everybody in the mining industry wants to have a revised law that will conform to conditions of mining, as they will be in the future, and as we can foresee them. Those are the fundamental principles, and upon them I think there is general agreement. Now as to details of procedure, as to just how claims shall be laid out, as to methods of recording and other details, there may be differences of opinion. The committee has tried to co-ordinate its differences of opinion in conformity with its own best judgment."

In the course of Mr. Ingalls' testimony, Representative Arentz, of Nevada, said:

"I wish to say that the criticisms received resolve themselves into five sections of this bill. Nothing else has been mentioned in the letters outside of these five sections, and they have to deal, first, with the repeal of the apex; second, with the location without discovery; third, cash payment in lieu of assessment work; fourth, the requirement for locations to be in conformity with the public-land surveys; fifth, the mill-site provision. And it seems to me since we have not received any criticisms or objections to any other features of the bill except these five, that the hearing should be confined to the five and should consider the rest of the bill satisfactory. There are several other things mentioned in the bill."

Chairman Rhodes stated that, if the committee were compelled to make up its mind on the bill in its present form, it is his opinion the committee would report it unfavorably.

Gold and Silver Institute Organized

Formal announcement was made on May 1 of the establishment of the American Gold and Silver Institute. The moving spirit in the organization is H. N. Lawrie, formerly the economist of the American Mining Congress, who was in charge of its precious-metals division. Mr. Lawrie's title is managing director. No other officers of the institute have been announced as yet. A number of prominent persons interested in the production of gold and silver, including Tasker L. Oddie and Key Pittman, the two Senators from Nevada, are enthusiastic backers of the new organization. The purpose of the institute is to engage in statistical research and economic surveys which are to be used as a basis for national legislation and for administrative regulations promulgated in connection with laws having a bearing on transportation and taxation. In addition, the institute expects to be active in efforts to influence international action affecting gold and silver.

Tariff Discussion Is On

Discussion of the tariff bill has occupied most of the time of the Senate since April 20. The leaders of each party have outlined the general course their arguments will take. With few exceptions, specific rates have not yet entered into the debates.

New Mexico National Park Bill Introduced in Senate

In a bill introduced in the Senate the creation of a new National Park in New Mexico covering the Mescalero Apache Indian reservation, the Elephant Butte reservoir and the White Sands and Mal Pais lava beds is proposed by Senator Bursum of that state. The bill stipulates that the mining laws, including the leasing act, shall not be abrogated by creation of the park as to the lands embraced therein and that coal deposits on the Indian reservation may be leased or worked for the benefit of the Indians.

Over Million Engaged in Mining

When the 1920 census was taken, there were 1,090,223 persons engaged in the extraction of minerals. The figure given in the 1910 census was 965,169. The 1920 total is subdivided as follows: Foremen, overseers and inspectors, 36,931; managers, 14469; officials, 2,522; operators, 17,334; coal mine operatives, 733,936; copper mine operatives, 36,054; gold and silver, 32,700; iron, 38,704; lead and zinc, 20,798; other specified operatives, 11,320; not specified operatives, 9,271: quarry operatives, 45,162; oil and gas well operatives, 85,550; salt well and works operatives, 5,472.

News by Mining Districts

London Letter

Nundydroog's Gold Yield Decreases—Mount Elliott's Negotiations Progressing—East Pool Sinking New Shaft

By W. A. Doman

London, April 21—At the end of 1920 the Nundydroog Company was reconstructed as the Nundydroog Mines, the reorganization being effected to obtain additional capital for suitable machinery and plant, to permit milling at greater depths with economy and efficiency. Treatment was not so productive in 1921 as in 1920, as from [illegible] tons of quartz, with tailings and slimes, the total recovery was only [illegible] oz. of fine gold, as against 71,531 oz. from 102,431 tons in 1920. The combined extraction was 11 dwt. 11 grains, as compared with 13 dwt. 13 grains, the decrease being attributable to the lower grade of ore treated. This naturally follows on the comparatively low grade of ore opened up in recent years, and the superintendent remarks that unless some rich discoveries are made at once, it will be necessary to reduce the grade still further.

Development showed an increase of 461 ft. at 9,800 ft.; the footage would have been more but for a shortage in the supply of electrical power early in the year. Though the gold content is less, judging at least by the remark of the superintendent quoted above—the new tonnage brought in was 115,082, or more than that milled. The reserves of ore at Dec. 31 were estimated to be 175,200 tons, in contrast with 165,800 tons at the end of 1920. The reserves are really the weak spot in the company's report, for they represent only about 1.6 year's supply for the mill. At the 4,000 level the main lode has shown improvement and some good ground has been opened up, though of a patchy character. On the same level an eastern lode was discovered north of Kennedy's shaft. Generally speaking, it is narrow, from 13 in. to 18 in., but values are satisfactory. What is considered as probably a new orebody has been cut on the 4,000 level, as there is nothing at the 3,000 level corresponding with it. The Henry shaft has been sunk during the year 498 ft. to a total depth of 3,022 ft.

A short time ago I mentioned a rumor that a scheme for raising additional capital for Mount Elliott had fallen through, owing to difficulties that had arisen in Paris. It is now officially announced that the rumor is incorrect, and that the negotiations are making satisfactory progress.

Although only a small amount of development was done in the East Pool and Agar mine during 1921, results were of a highly satisfactory nature. In May the East Pool shaft collapsed, and has been abandoned. A new shaft is now being sunk, and is so situated that all of the rich lodes discovered in the property during recent years will become accessible to it. It will serve the rich Rogers lode which has been opened up for a continuous length of about 1,700 ft., which still shows high-grade ore in the most easterly and westerly workings, and which traverses the full length of the property, about 4,000 ft. There are three other lodes which it will serve, as well as the eastern continuation of the Great Lode, met in the driving of the Tolgus tunnel, where it averaged 158 lb. of black tin and wolfram per ton. It is expected that this new shaft will enable the property to be economically worked, and to give a profit even at the present low price of tin.

BURMA

Burma Corporation Mills 18,000 Tons in March

Namtu—In March, 18,003 tons of ore was milled, producing 12,281 tons of leady concentrate; 11,996 tons of lead-bearing material was smelted in the blast furnaces, producing 3,621 tons of hard lead. Refinery products were 3,250 tons of refined lead and 332,000 oz. of refined silver.

Gold Output in Rhodesia and West Australia

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, May 1—The gold production in Rhodesia during March totaled 54,643 oz.

The gold output in Western Australia during March amounted to 43,022 oz.

CANADA

British Columbia

Work Under Way in Selkirk Mountains Near Albert Canyon

Revelstoke—Last summer a group of Spokane and Cheney capitalists bonded the Tangier and Waverley groups, which are in the Selkirk Range, twenty-six miles north of Albert Canyon, on the main Canadian Pacific Railway line. The old workings have been cleaned out, retimbered, and made safe, and it was found that about 4,000 ft. of development, mostly in tunnels and levels, had been done. The Tangier fissure is 18 in. to 5 ft. wide, and has been traced for more than 2,000 ft. on the surface. Careful sampling last year gave an average of $36 per ton in gold, silver, and lead. The Waverley fissure is 18 in. to 4 ft. wide, and samples $44 in gold, silver, and lead. Neither vein contains zinc.

Revelstoke—The Multiplex Mining, Milling & Power Co. Ltd., recently elected officers as follows: President, O. T. Bibb; secretary, J. Stevenson. A small crew will be kept at the mine.

Trail—Ore received at the Consolidated smelter from April 15 to 21 inclusive totaled 9,008 tons, of which 43 tons came from the Silversmith mine at Sandon and the rest from the company's mines.

Ontario

McKinley-Darragh To Resume May 15—Why Bailey Mine Shut Down—Dome Mines May Make Another Capital Repayment

Cobalt — The McKinley Darragh, which has been closed since Dec. 31, 1920, is making the necessary repairs to the mill preparatory to resuming operations on May 15. It is understood that a monthly production of about 4,000 tons of 15-oz. ore will be handled the first few months. The company has about 320,000 oz. of bullion in storage in New York, held from previous operations.

The drift on the 260 level of the Castle has progressed approximately 45 ft. along the vein recently struck. Values and width continue to hold good.

The following statement has been given out by A. J. Young, president of the Bailey Silver Mines, Ltd., in connection with the closing down of the mine: "It is purely a matter of financing, and we have been depending upon the profits from the operation of the custom mill to pay for the development of the mine. We expect to start up again within two months."

A crosscut is being run north on the 350 level of the Genessee property, which now has a length of about two hundred feet. Exploration work is being energetically carried forward.

The Nipissing has dropped its option on the Rochester property at Porcupine, being convinced that the property could not be economically developed. Diamond drilling is being done on the properties recently taken under option about six miles east of Elbow Lake, Man., and it is expected that the company will be able to tell definitely the value of the gold and copper deposits in a few months. It is thought that the earnings of the Nipissing for 1922 will be as large as those of 1921.

In March, 140 tons of ore was shipped from the Cobalt camp, over the T. & N. O. Ry., of which tonnage the Coniagas shipped 44 tons and the O'Brien 96. The average price received for silver during March was 64.44c.

Kirkland Lake—Lake Shore continued in March to uphold its reputation as the richest gold producer in northern Ontario. During the month it milled 2,210 tons of ore and recovered therefrom $54,870.20. The mill ran 94.75 per cent of possible running time, and the average heads were $24.83 a ton.

Wright-Hargraves mill is understood to be making about $1,200 a day net profits on a daily tonnage of 200 tons.

Porcupine.—It is stated on good authority that Dome Mines will make another repayment of capital of $1 on Oct. 20.

It is thought that McIntyre's net profits for the fiscal year will be approximately $1.50 per share.

Santa Cruz Mine in Santiago Papasquiaro District, Durango

Open Cut Iron Mining at Cerro de Mercado Deposit, Durango

DURANGO

State Government Building Railroad from Rosario to El Oro and Indé —Anita Mill at Guancevi Down

By Alberto Terrones B.

Guanaceví—E. F. Knotts has shut down his Anita mill on account of ore shortage, as work has been stopped in all mines. He has closed a deal with Dionisio Barraza for an option on the San Fernando and Quebradilla mines where rich ores have been recently struck in the andesite-conglomerate contact south of San Pedro. Arrangements have been made for operation of the mines.

Santiago Papasquiaro—The Santa Cruz Mining Co. is still working the Santa Cruz mines. A fifty-ton concentration-flotation mill has been recently installed. It is equipped with hydro-electric and steam power plants, a Ruth flotation machine, and a No. 54 Marcy mill, the only sectional mill in this part of the country. L. V. Elder has severed his connection with the Santa Cruz company.

An English syndicate has taken over the properties for which George Stinson had been negotiating at San Andres de la Sierra.

Durango—Work continues on the Cerro de Mercado, the ore being shipped to Monterrey.

James F. Reilly, representing the Mexico Mining and Development Co., has been in Durango investigating asbestos. This company intends to acquire properties in the state.

The Cía Minera de Eureka, owning properties at Tejamen, has finished installing its mill.

T. E. Moore and J. B. Crawford have been active in organizing an exploration company that will operate in Pueblo Nuevo and San Dimas.

For the convenience of travelers, through Pullman service was started from the City of Durango to Mexico City via Cañitas, beginning April 17.

El Oro — The state government has started negotiations for the construction of the railroad from Rosario to El Oro and Indé camps. General J. A. Castro, the Governor, has just left for Mexico City for that purpose.

The federal government has canceled the concession of the Indé Gold Mining Co. to use 20,000 liters per second from the Nazas River (Sextin) near El Oro, for hydro-electric power.

ARIZONA

Further Hearings on Jerome-Superior Trouble To Be Held in Los Angeles

Phoenix—Early in May the Arizona Corporation Commission will hold a hearing in Los Angeles on the affairs of the Jerome-Superior Copper Co., which has been in bitter litigation for several months. Most of the directors and stockholders live in Los Angeles. Indictments found by the Los Angeles grand jury against the company's officers, M. P. Fraser, president, George D. Case, secretary, and George Mitchell, manager, have been quashed by a trial judge for errors in the wording.

Kingman—The new Signal mill, in southern Mohave County, is expected to be in operation soon. It has a capacity of 250 tons.

Bisbee—At the Cole shaft No. 3, of the Calumet & Arizona company a leached area has been opened up on the 500 and 600 levels. Development has not progressed sufficiently far to determine its importance, but from indications ore should be found soon.

At the Boras, the shaft has been completed to the 1,100 level, and stations have been cut on the 900 and 1,100 levels. A drift is being driven on each of these levels toward the Tuscarora orebody which lies about 3,000 ft. to the north.

The Night Hawk Leasing Co. is shipping sulphide ore to the Copper Queen smelter. Development work is being carried on from a winze below the 750 level. Some new sulphide ore is being opened up in this winze.

CALIFORNIA

Gold Placer and Drift Mining Active—Shasta Zinc & Copper Ready to Start Zinc Oxide Plant

San Francisco Correspondence

San Francisco—Marked activity in placer and drift mining districts of California is to be noted. In the Downieville area companies are preparing to operate. H. Levine and associates are seeking to patent nine claims in the Gibsonville Ridge mineral area in the northern part of Sierra County, and prior claimants are contesting the applications. Rich gravel is reported to have been struck at North Bloomfield in Nevada County. A prospect shaft was sunk near the old Malikoff workings and a pay-streak struck at a depth of 103 ft. Preparations are being made to "drift mine" the deposit.

In Northern California the Shasta Zinc & Copper Co. is preparing to start its zinc oxide plant. The Chicago mine, near Igo, southwest of Redding, is preparing to make ore shipments to the smelters.

At Sutter Creek, the Central Eureka mine has completed the transfer from its old steam hoist to the new electric hoist recently completed. The Penolay Ranch mine, near Jackson, is now being reopened. The Angels Camp Deep Mining Co., near Angels Camp, recently won a lawsuit abrogating a stock sale contract which was made with Frederick Bennett for the purchase of 350,000 shares of the company's treasury stock.

Randsburg is active, and Nevada capital is said to be interested in the camp. The limits of mining activity are expected to be extended beyond the present area.

NEVADA

Leadville Mines Report High-Grade Find—Hudson Leasers Ship to Belmont Mill

From Our Special Correspondent

Leadville—The Leadville Mines Co. reports finding on the 400 level, which is 100 ft. below the stoped area on the 300 level and 600 ft. below the surface, 4 to 5 ft. of high-grade silver-lead ore. There is still considerable snow in the immediate vicinity, and no ore shipments can be made yet.

Tonopah—Bullion shipments for the first fifteen days of April were: Tonopah Belmont, $114,500; West End, $81,200; Tonopah Extension, $63,000; Tonopah Mining, $50,000.

The large pumps to be installed on the 1,540 level of the McCane shaft workings of the Tonopah Extension have arrived and will be installed as soon as station and foundations are ready. The Jim Butler has leased what is known as the Gold Hill portion of its property. Narrow veins containing good values were worked to shallow depths in the early days of the camp, but no large orebodies discovered. Leasers expect to sink and prospect below the 80 level.

Royston — Leasers at the Hudson mine have shipped fifty tons of ore to the Belmont mill. The ore was mined from above the 300 level, and values are said to exceed $100 per ton.

Goldfield—The ore discovery on the Sunbeam lease in Goldfield Florence ground is said to be looking particularly good in the raise being driven from the 150 level about 40 ft. from the company shaft. So far, the ore has been proved to exist for 20 ft. along the strike, with every indication that it may extend to the surface.

The Goldfield Deep Mines Co. has announced that in future a diamond-drill hole will be carried ahead in shaft sinking. This will aid in locating water channels and allow preparations for handling the water to be made in advance. The shaft has reached a depth of 1,300 ft., which is below the water level in other Goldfield shafts, without eencountering water.

WASHINGTON

California Interests to Undertake Dredging at Swauk Valley

Yakima—The Swauk Valley placers are to be developed by California capital. Dredging operations are to be conducted under the supervision of G. H. Edmonds and George J. Carr, consulting engineers of the Hammond Dredging Co.

A protracted contest between William R. Lewis and the Japanese-American Silica Co., the former seeking homestead title to 400 acres in the Rosa section, and the Silica company, maintaining that the land was more valuable for silica production than farming, has been decided in favor of Lewis, according to advices received by the Yakima land office.

UTAH

South Hecla Opens New Ore Near Sells Boundary—Eagle & Blue Bell and Victoria to Increase Output

From Our Special Correspondent

Alta—The South Hecla has opened new ore near the division line between this property and the Sells ground recently acquired. This ore is a mile west of the new ore opened during the winter in the Rustler vein.

Eureka—The Eagle & Blue Bell and the adjoining Victoria (both owned by the Bingham Mines) are planning a considerable increase in their output. The ore in these properties is silver-lead, and there are excellent reserves. Recently, the orebody which is being worked on the 1,800 level was found to continue to the 2,000. The output of the two mines is at present at the rate of 150 tons daily.

The Chief Consolidated, which in 1921 was the largest silver producer in the United States, is maintaining its output, which is produced entirely by lessees. There are now about 100 leases let, with 300 men working. The second large ore zone, opened more than two years ago, is producing a large tonnage from the 1,500 and 1,900 levels. Drifting is being done in search of this zone on levels higher up. In this property ore has been followed to below the 2,000 level.

The Grand Central mine, recently acquired by the Chief interests, is being opened, also under the leasing system. Electrical equipment to operate the hoist is being installed, and as soon as this work is completed production, at present limited by the hoisting capacity, will be increased. Silver ore of an excellent grade is being produced. Several lessees are shipping gold ore also.

United Comstock Miners' Strike Continues

There is no change in strike conditions at the property of the United Comstock Mines Co. at Gold Hill, Nev. The men struck on April 18 for eight hours collar to collar and a flat wage scale of $5. Over 80 per cent of the underground men are still out. State officials are taking an active interest and making a study of conditions and circumstances. So far there has been no violence and no noticeable radical action or leadership.

The whole argument appears to hinge on whether or not the men will have their lunch half hour on their own or company time. The former is customary throughout the state, and always has been at any property where one or two shifts only are working. When three shifts are employed the men eat lunch on company time. The demand for a flat wage scale of $5 per shift for all underground men, it is said, was probably an added afterthought, without proper consideration, as it is customary for a skilled man to receive better pay than a mucker or trammer.

IDAHO

Coeur d'Alene District

Tamarack & Custer To Resume—Hercules May Follow Suit

Wallace — Uncertainty regarding the future of the Day mines, namely the Tamarack & Custer and the Hercules, has been in a measure removed by increasing activity at the Tamarack and the assurance that it will resume production by the middle of May. A few men are being added almost daily. Normally, the company employs about 250 men. The situation at the Hercules is less clear, but there are indications that it will also be active before long in spite of possible complications in connection with the estate of the late Eugene R. Day. The Hercules when active employs about 500 men.

The advance in the price of lead is having a buoyant effect upon the mining industry in the Coeur d'Alene district. Though the Bunker Hill, Hecla, and Federal (Morning mine) continued production throughout the long period of depression in the market, the high costs of mining and excessive freight rates reduced the profits to an uncomfortably narrow margin.

The development of a large body of low-grade lead-silver ore by the Independence Lead Mines Co., operating about a mile from Mullan, has attracted much attention, and the outlook is favorable for its becoming a productive mine when development is carried deeper. The property is between the Morning and Hunter mines, which have long been important producers, and there is little doubt that the Independence has the same veins. The property was at one time under bond to the late F. August Heinze, who spent a large sum in driving a deep tunnel, without satisfactory results. Recent ore disclosures indicate that this tunnel ran north of what is known as the You Like vein and not far enough to intersect the Morning vein, both of which pass through the Independence group.

The Western Union Mining Co., operating about two miles from Wallace, is putting in an electrically-driven I-R compressor preparatory to carrying out an extended plan of development. Since November, 1920, ore shipments by leasers amount to $100,000 in round figures, as shown by smelter returns.

OREGON

Homestead-Iron Dyke Preparing to Resume

Homestead—Work is to be started at the Iron Dyke mine, which has been inactive over a year and a half.

A 50-ton mill recently installed at the Asurite mine, on the Idaho side of the Snake river, has been given trial runs. Development is said to be over 2,000 ft. with a depth of 600 ft. The ore carries silver, copper, gold, and zinc.

The Panhandle Copper Co. plans to diamond drill the Panhandle group this summer.

MICHIGAN

The Copper Country

C. & H. to Reopen Two More Shafts—Mohawk Hoisting at Capacity—Arcadian Out of Vein on Bottom Level

By M. W. Youngs

Houghton—Regardless of the fact that rail rates are approximately 25 per cent higher than the lake tariffs and the copper carrying season on the Lakes is near at hand, the heavy movement of metal by rail continues. It is estimated that Calumet & Hecla shipped 5,000,000 lb. in April. Copper Range also has experienced an almost unprecedented spring business, and Quincy, Mohawk, and Wolverine are cleaning up their surplus stocks.

Calumet & Hecla is planning to reopen Nos. 9 and 10 shafts, South Hecla, on the conglomerate. This will make possible an increase in tonnage. Meanwhile, the work of cleaning out the other shafts already in operation, in the lower levels, is proceeding. Tonnage will increase steadily with the reopening of the shafts. No. 2 shaft is hoisting vein rock for the first time since it started operating. The Red Jacket shaft probably will not hoist stamp rock until late in the summer, on account of the necessity of extensive repairs. Rock tributary to it will be hoisted through No. 4.

Mohawk is hoisting at capacity despite the labor turnover usual in the spring.

Arcadian Consolidated is in a disturbed area 200 ft. from the New Baltic shaft, north, at the 1,100, or bottom, level. It is not unusual to run into such stretches, where the vein takes a sudden bulge, and the drift is continuing north in the hope of soon reestablishing contact. The lode up to this point was rich. The 942 level, south, where several faults were cut, is in 1,200 ft. in mineralized ground.

Marquette Range

Cleveland-Cliffs First Shipper—Isabella To Start Shipping

By William H. Newett

Ishpeming—The Cleveland-Cliffs Iron Co. was the first to enter the iron ore shipping list on the Marquette Range this season. Hard hematite, sufficient for one vessel cargo, was loaded at the Cliffs Shaft mine, Ishpeming, and the Republic mine, Republic, and some soft hematite has been loaded at the company's Salisbury and Angeline mines. The Angeline, which was abandoned in 1921, has some ore remaining in stock that will be cleaned up this season. The local office of the Oliver Iron Mining Co. expects to receive shipping specifications for 1922 at an early date.

Palmer—The Steel & Tube Co. of America has given orders to start shipping ore from its Isabella mine. The property has been working with a small force since last fall, but operations will be increased. There is some ore in stock that will be moved first.

Negaunee—The Mary Charlotte mine, owned by the Marquette Ore Co., and the Rolling Mill property, of the Clement K. Quinn Co., have experienced trouble in keeping surface water from their workings, and extra pumps have been put in place to handle the excess flow. Both properties have been idle for some months, but it is expected that both will be worked during the active shipping season.

Menominee Range

Ore Now Moving to Escanaba Docks

Iron Mountain—The movement of ore from the Menominee Range to the Escanaba docks has started. Few boats have been loaded to date, but the season should be an active one following the setting of the ore prices for 1922. The Oliver Iron Mining Co. has a crew at work at Escanaba putting the crushing plant in condition for operation. This season the crusher will handle ores from the company's Chapin and Aragon mines, in addition to the Riverton ores from the Iron River field.

Iron River—The Mineral Mining Co. has issued orders for the resumption of mining at its James mine. Only about fifty men will be employed at the outset, but the force will be gradually increased.

MINNESOTA

Mesabi Range

Many Properties Preparing for Season's Work

Chisholm—A shift of miners has started work at the No. 3 shaft of the M. A. Hanna Co.'s Leonard mine. The stripping operations will be resumed soon.

Dewatering of the Billings mine (Tod-Stambaugh Co.) is progressing rapidly. Most of the work proposed will be development on the lower level.

Hibbing—The Mahoning open pit (Mahoning Ore & Steel Co.) is preparing to resume stripping operations soon.

Another large stripping operation has been resumed at the Scranton mine. (Pickands-Mather Co.) This work is being done by the Winston Dear Co.

The Buffalo-Susquehanna mine, operated by the Rogers-Brown Iron Mining Co., is to resume operations soon. Two shovels have been placed in the pit, one in the stripping bank and the other for loading ore.

Operations at the South Uno open pit (M. A. Hanna Ore Co.) have been resumed and one shovel is at work. Some underground scram ore will be mined this season and stockpiled in the pit.

Buhl—The Wanless mine (Oliver Iron Mining Co.) is in positon to produce a steady tonnage. During the winter the shaft was deepened and a new level opened.

Work of pumping out the Dean open pit (Tod-Stambaugh Co.) is progressing in preparation for ore and stripping operations.

Virginia—Shaft ore from the Lincoln mine (Interstate Iron Co.) is being sent to the docks daily. The Fay mine (M. A. Hanna Ore Co.) is also making daily shipments from its shaft, and at the Missabe Mountain open pit (Oliver Iron Mining Co.) three shovels are removing overburden.

Cuyuna Range

Cuyuna—The Kennedy mine, idle since last summer, reopened on April 24. Shipping will begin at once, production being carried on by a full crew of thirty gangs of miners.

JOPLIN-MIAMI DISTRICT

Missouri-Kansas-Oklahoma

New Hoisting Record Made at Picher—Barr and Ritz Mines To Be Started

By P. R. Coldren

Joplin—A new hoisting record was hung up for the Joplin-Miami district on April 24, when Frank McWethy, hoistman, and J. R. Corbett, hooker, hoisted 1,068 "cans" of ore from the Black Hawk mine at Picher, on an eight-hour shift. The cans weighed 1,200 lb. each.

The previous record for number of cans had been held by a crew at the Dew Drop mine of the Howe Mining Co., made in November, 1920, when they hoisted 1,034 cans. However, their pull was for a distance of 264 ft. only, whereas the hoist at the Black Hawk was 302 ft. J. A. Cohenour, superintendent of the Black Hawk, vouches for the record.

The Vinegar Hill Zinc Co. plans starting up its Barr mine, north of Picher, early in May, and Smith, Davis & Co. also will start their Ritz mine about the safe time. The two properties have been down for almost a year.

NEW YORK

New Company Formed to Work Benson Iron Mines

Gouverneur—The International Pulp Co. has leased the Freeman talc mine, said to contain a fine grade of talc. Work will be started early in April, and a daily output of from 100 to 125 tons is expected.

Benson Mines—Papers of incorporation have been granted to the Benson Iron Co., of Benson Mines. The capitalization is $300,000. The incorporators are M. D. Sloan, of New York; E. L. Herndon, of Pottsville, Pa., and F. B. Haley, of Camden, N. J. Government cancellation of contracts had a disastrous effect on the old Benson Mines Co., which at the time of the signing of the armistice was furnishing iron ore to the Bethlehem Steel Co., and the mines were closed in December, 1918, and have not since been reopened. The plant and equipment have been kept in good condition, and the mine can be started at small cost.

Port Henry—Owing to increased orders and betterment of trade conditions generally, the Mineville plant of Witherbee, Sherman Co., Inc., began April 24 to operate on a six-day week basis. For some time prior to this date the employees have been on duty three days per week.

The Present Situation at the Mines

Coal Strike Without Apparent Effect — Important Copper Companies Running, With Few Exceptions — Outlook for Lead and Zinc Operators Improved — Situation Much Better in Lake Superior District

By A. H. Hubbell
Associate Editor, Engineering and Mining Journal-Press

AFTER a month's duration of the coal strike, the metal mining districts remain practically unaffected. Though it is reported from Washington that coal stocks in the [illegible] are diminishing more rapidly than was anticipated, metal mining companies seem fairly well supplied for the present, at least, and no unusual effort to insure the future is reported. The expectation that coal prices will be lower in the year probably accounts for the apparent indifference.

In the camps producing the major metals the situation in general is little changed from that of a month ago. The trend is toward betterment. Wages cannot go much lower. Supplies cost but little more, according to Dun, than on July 1 last, the low point of 1921 and the lowest since the Armistice. Freight rates are still high, and the railroads and many mining districts suffer in consequence. Meanwhile, the Interstate Commerce Commission seems unable to decide on a general rate reduction. Labor is quiet, and the supply in general is adequate, though its distribution has changed somewhat owing to the drift to copper camps. Two unimportant strikes, affecting three companies only, marred the month just passed, one in the Joplin district and the other on the Comstock, in Nevada.

A decided change of atmosphere pervades the copper camps. The depressing effect due to plants shut down is gone. Whatever may be the outcome of the producers' policy, optimism rules. Most of the important plants West and East are running. United Verde, at Jerome, the Phelps Dodge branches at Morenci and Tyrone, and a few companies at Butte continue idle.

At Butte 9,600 men are working; also 2,100 at Anaconda's Washoe plant and 1,800 at Great Falls. Both smelters are running at half capacity, the wire plant at 60 per cent and the zinc plant at full capacity. Output is being increased gradually as skilled workmen can be obtained. East Butte's smelter has several hundred men employed and the A. S. & R. four hundred at East Helena. Davis Daly is about to resume, and will ship its ore to the Washoe plant.

The porphyries, Ray, Utah, Chino, and Nevada Consolidated, which started April 1, are working their production gradually up to their objective of 50 per cent capacity. In the Southwest, Phelps Dodge (Copper Queen) and Old Dominion are producing at monthly rates of 6,000,000 and 2,000,000 lb. respectively; Miami is producing at 80 per cent capacity, the same as last year; Calumet & Arizona and New Cornelia at monthly rates of 3,500,000 lb. and 1,500,000 lb. or 60 per cent and 40 per cent of capacity respectively; and Inspiration at a rate of 5,225,000 to 5,500,000 lb. a month with eleven units running.

The Shasta copper belt in California is dead. In Plumas County, the Engels company is making a good production. Granby is producing at three-fourths capacity.

In northern Michigan, Calumet & Hecla is running at 42 at 70, Mohawk at 100, Ahmeek at 80, Isle Royale at 46, per cent of normal, Copper Range at 90 per cent, Quincy and Wolverine at 100. These are the only producers, their combined output of refined copper (including some not smelted) being 44 per cent of normal, against 36 per cent in March, when 8,000,000 lb. was smelted.

The Tennessee Copper and the Ducktown S. C. & I. Co. both continue production, the former at 70 per cent of capacity, the latter at full capacity.

Improvement in the price of lead and zinc ores has brightened the outlook, but as yet without corresponding increase in scale of operations. Butte & Superior, with about 950 men employed, and Anaconda are making a large production of zinc ores. In the Cœur d'Alenes, the Callahan Zinc-Lead Co., normally an important zinc producer, remains shut down. Production in this district is confined to the Bunker Hill, Federal, and Hecla companies, their combined output being about 15,000 tons monthly of lead-silver ore and concentrates. Tamarack & Custer is preparing to resume. Elsewhere in the Pacific Northwest there is increasing activity by small operators where weather conditions permit. Rossland forces have been reduced to save coal at Trail. The Northport smelter is still down.

Ninety-one mines are running in the Joplin-Miami zinc-lead district, compared with eighty-five a month ago and seventy-five on Jan. 1. Production, however, remains around 7,500 tons per week, due, it is thought, to mining poorer ore. Wages have been raised 25c., zinc ore rising to $30.

In the Wisconsin zinc-lead district, production is about one-fifth of normal and is confined to six zinc-ore producers. Labor is plentiful at pre-war wages.

Zinc operations in the Mascot district of Tennessee remain about a third of normal.

The southeast Missouri lead district is running at capacity. The price of lead is encouraging, and output is expected to increase slowly.

Lode, dredge, and placer operations for gold in California are improving slowly. Grass Valley is normal, and activity is increasing on the Mother Lode. A speculative boom is under way at Randsburg. Permits have been issued for many new ventures in the state. Increasing interest is reported in non-metallics.

Conditions are fairly normal in Nevada. Tonopah, the principal camp, is producing bullion at the normal rate of $650,000 monthly. Goldfield, Rochester, and Round Mountain display varying degrees of activity. Pioche shows improvement. United Comstock's miners, who struck, are still out; the company's surface work continues.

In Utah, activity is increasing. At Bingham, Utah Apex is working 100 men and Utah Consolidated is preparing to resume. Salt Lake Valley smelters are taking more siliceous ores. Park City, Tintic, and Bingham are making good productions, their April outputs, respectively, being 11,172, 16,000 and 29,782 tons, against 13,008, 12,000 and 33,867 in March.

Colorado's smelting situation, which has hampered work, is clearing. The A. V. and Durango smelters are to be modernized and to handle all ores, and efforts to adjust freight rates will be made. The Rawley mine will resume. Power rates are not to be increased. Cripple Creek, Leadville, Telluride, and other districts show considerable activity.

Homestake and Trojan continue the only gold producers in the Black Hills, the former at capacity with 1,900 men; the latter a little under normal, April's bullion output for both combined being estimated at $750,000.

Ontario camps are busy, excepting Sudbury, where the Mond only is producing a little nickel. Porcupine, Cobalt, and Kirkland are active. More power is available for Porcupine, owing to recent floods. Kirkland's output should increase with the Tough Oakes mill now running.

The outlook in the Lake Superior iron country is much improved. Several mines have resumed and others have increased their scale of operations. Ore production is at its heaviest since last fall. Some ore is being sold, though no prices have been set. Navigation is open on all the Lakes, and a limited tonnage is moving. Labor is plentiful.

In the Birmingham district ore, coal and coke production is keeping pace with furnace operation. Ore in stock is decreasing appreciably. Iron making is progressing and new furnaces are gradually being put in operation. Indicated pig-iron production is equivalent to about 400,000 tons of ore.

THE MARKET REPORT

Daily Prices of Metals

Apr	Copper, N. Y., net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
27	12.625	30.25	31.125	5.25@5.50	5.25	5.00
28	12.625	30.25	31.00	5.25@5.375	5.20@5.25	5.00
29	12.625@12.75	30.25	31.00	5.25@5.375	5.20@5.25	5.00
May 1	12.625@12.75	30.375	31.125	5.25	5.15@5.25	4.975
2	12.75	30.375	31.25	5.25	5.15	4.975
3	12.75	30.125	30.875	5.25	5.125	4.975

*These prices correspond to the following quotations for copper delivered: April 27 and 28, 12.875c.; April 29 and May 1, 12.875@13c.; May 2 and 3, 13c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Apr.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
27	59	59⅝	64½	151¼	152⅞	24⅜	23⅜	26⅞	27⅛
28	58⅞	59½	64½	151	152½	24⅜	23½	26⅞	27
29	. .	. .	. .	. . .	. . . .	. . .	. . .	. . .	. . .
May 1	59⅝	60¼	64½	151½	152⅞	24	23	26⅞	27
2	60⅛	60¾	65	152¼	153¾	24	23	27⅛	27¼
3	60⅛	60¾	65	150	151⅜	23¾	22⅞	27⅜	27½

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Apr.	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	May	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
27	442	99⅝	67¾	34½	1	442¼	99⅝	68½	34⅞
28	442	99⅝	67½	34⅜	2	442½	99⅝	68¼	35
29	442	99⅝	67½	34⅜	3	443	99⅝	68⅞	35

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, May 3, 1922

The week has been a quiet one, with unimportant changes in prices. The coal strike has so far had little or no effect on consumption, though there is some indication of an unwillingness to contract for customary supplies of metal until the requisite fuel is assured.

Copper

The small amount of copper which was being held at 12⅞c. delivered had virtually disappeared by Friday, and on Saturday some business was done at 13c. At least one producer was willing to book third-quarter business at the fractional figure as late as Monday, however, but beginning yesterday all producers were asking 13c. for near-by shipments, with slight premiums for later deliveries in some instances. The improvement in price in a market which has not been particularly active is an excellent sign of confidence in the future. The wire business continues excellent and the brass companies are taking more and more virgin metal. Rolling mills are working to larger capacity than for some time, owing to improved demand for sheet copper, chiefly for the building trades.

Export demand has been quiet, but prices have advanced slightly, to 13⅛@13¼c. Germany has been practically out of the market recently, though occasional orders are booked for that country.

Average Metal Prices for April

Copper	
New York Elecrolytic	12.575
London Standard	58.799
London Electrolytic	64.028
Lead:	
New York	5.115
St. Louis	4.946
London	22.993
Silver:	
New York, foreign	66.575
New York, domestic	99.625
London	34.080
Sterling Exchange	440.715
Zinc:	
St. Louis	4.906
London	26.576
Tin:	
99 per cent	29.810
Straits	30.605
London	149.840
Antimony	4.980
Quicksilver	52.280
Platinum	87.500

Lead

The American Smelting & Refining Co. continues its official contract price at 5.25c. New York.

The inflation of lead prices has been checked during the last week by a cessation of demand, so that during the last three days the Smelting company's price has ruled for actual business. Some quotations are still heard as high as 5.50c., but only by producers out of touch with the market or not anxious to sell. Only a small amount of spot metal is available, but it is sufficient to meet requirements. Most of the business has been for May shipment. The St. Louis price has also weakened, and plenty of metal was available yesterday and today at 5.15c., with some actual business placed at 5⅛c. The reaction is a healthy one and it is unlikely to proceed much further, for consumption continues on a satisfactory scale. The recent rise was accentuated by an unduly nervous attitude by consumers, and this has now passed. As mentioned last week, a small part of the surplus stocks was released, and this helped to steady the market.

Zinc

The market is weaker, possibly because of a reluctance by galvanizers to purchase zinc under existing coal-strike conditions. Active bidding has taken place for all business available, with the result that today prices have declined to 4.975c East St. Louis. at which level zinc can be obtained readily for prompt shipment. Export business [illegible] contin[illegible] [illegible]ing the last week. Forward deliveries command premiums of 2.5 to 5 points per month. A large proportion of the week's business was for future shipment. High grade business is still satisfactory at [illegible] with freight allowances up to 30 points.

Tin

Demand by consumers has been quiet, advantage being taken of any slight drops in the market. Statistics released by the New York Metal Exchange show the total visible supply on April 30 to have been 22,017 long tons, compared with 22,353 long tons for the month previous. This was about what interested observers expected, and the figures were considered favorable. Apparently, not so in London, however, for the price there dropped off £2¼ today.

Tin for August delivery was quoted throughout the week at ½c. premium over the prices asked for spot.

Arrivals of tin, in long tons: Total for April, 4,995; May 1, Straits, 715; 3d, Straits, 5.

Gold

Gold in London: April 27th, 93s. 3d.; 28th, 93s. 3d.; May 1st, 93s. 3d.; 2d, 93s. 1d.; 3d, 93s. 1d.

Foreign Exchange

Foreign exchanges have been generally quiet during the last week in the absence of definite news from the Genoa conference, and movements were based on technical conditions. On Tuesday, May 2, francs were 9.16c.; lire, 5.325c.; marks, 0.335c.; and Canadian dollars, 98.375c.

Silver

During the last three days of April the London market declined slightly on small offerings and lack of buying orders, and New York also reacted in sympathy. On May 1, however, both the Indian bazaars and China bought, forcing the price up ½d. in London and 1c. in New York. The market closes steady, although the volume of business is not large.

Mexican Dollars—April 27th, 51⅝; 28th, 51½; 29th, 51½; May 1st, 52¼; 2d, 52⅜; 3d, 52⅜.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17.50@18.50c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 5½c. for the week. Market strong.

W.C.C. brand, 6@6½c. Cookson's "C" grade, spot, 9c. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh) nominal at 5¼c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6@7c.

Arsenic—7c. per lb.

Bismuth—$2@$2.10 per lb.

Cadmium—$1@$1.10 per lb., in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Cobalt — Metal, $3@$3.25 per lb., black oxide, $2 per lb. in bbls.

Iridium—Nominal, $150@$170 per oz.

[1]**Molybdenum Metal**—In rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Outside market quiet at 30@33c. per lb.

Monel Metal—Shot, 32c.; blocks, 32c. per lb., f.o.b. Bayonne. Demand improving.

Osmium—$70 per troy oz. Nominal. $70, Los Angeles, Cal.

Palladium—Nominal, $55@$60 per oz.

Platinum—$85@$90 per oz.

Quicksilver—$55 per 75-lb. flask. San Francisco wires $54. Strong.

[1]**Rhodium**—$100@$115 per troy oz.

[1]**Selenium**—Black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $18@$20 per lb.

[1]**Tungsten Metal**—Wire, $35@$60 per kilogram, according to purity and gage.

Metallic Ores

Chrome Ore—Basis 48 per cent Cr_2O_3, 40@45c. per unit, c.i.f. North Atlantic ports. Market quiet.

Iron Ore—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $6.45; Mesabi bessemer, 55 per cent iron, $6.20; Old Range non-bessemer, 51½ per cent iron, $5.70; Mesabi non-bessemer, 51½ per cent iron, $5.55.

Magnetite Ore—F.o.b. Port Henry N. Y.: Old bed 21 furnace, $4.85; old bed concentrates, 63 per cent, $5.75; Harmony, cobbed, 63 per cent, $5.75; new bed low phosphorus, 65 per cent, $8.50.

Manganese Ore—26@27c. per unit, seaport; chemical ore, $45@$60 per gross ton, lump. Nominal.

Molybdenum Ore—85 per cent MoS_2, 40@42c. per lb. of contained sulphide, New York. Quotation purely nominal.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots. Nominal.

[1]**Titanium Ores**—Ilmenite 52 per cent TiO_2, 1½@2c. per lb. for ore. Rutile, 95 per cent TiO_2, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore—Bolivian, 60 per cent WO_3 and over, per unit of WO_3, $3, f.o.b. Atlantic ports. Chinese, $2.25@$2.50. Nominal.

Uranium Ore (Carnotite) —Ore containing 1½ per cent U_3O_8 and 5 per cent V_2O_5 sells for $1.50 per lb. of U_3O_8 and 75c. per lb. of V_2O_5; ore containing 2 per cent U_3O_8 and 5 per cent V_2O_5 sells for $2.25 and 75c. per lb., respectively; higher U_3O_8 and V_2O_5 content commands proportionately higher prices.

Vanadium Ore—$1 per lb. of V_2O_5 (guaranteed minimum of 18 per cent V_2O_5), New York. Nominal.

Zircon — Zirconium silicate, f.o.b. Pablo, Fla., 4½@13c. per lb.

[1]**Zirkite**—According to conditions, $70@$90 per ton, carload lots. Pure white oxide, 99 per cent, is quoted at $1.15 per lb. in ton lots.

Zinc and Lead Ore Markets

Joplin, Mo., April 29—Zinc blende, per ton, high $32.65; basis 60 per cent zinc, premium, $31; Prime Western, $30; fines and slimes, $28@$27; average settling price, all grades of blende, $28.64. Calamine, average settling price, 40 per cent zinc, $16.

Lead, high $71.10; basis 80 per cent lead, $70; average settling price, all grades of lead, $67.82 per ton.

Shipments for the week: Blende, 10,075; calamine, 73; lead, 1,480 tons. Value, all ore the week, $390,250.

Shipments for four months: Blende, 131,593; calamine, 200; lead, 37,103 tons. Value, all ores four months $5,606,930.

Purchases of Western zinc have so far not lessened the increased demand for the product of this district. Report was received that Western ore was being received at a cost of $20 per ton of 50 per cent zinc at the smelters. This scarcely puts it in competition with the slimes of this district; therefore, it is presumed the demand for that class of ore is greater than the local supply.

Platteville, Wis., April 29—Blende, basis 60 per cent zinc, $29 per ton. Lead ore, basis 80 per cent lead, $70 per ton. Shipments for the week: Blende, 348; lead ore, 40 tons. Shipments for the year: Blende, 4,955; lead ore, 760 tons. Shipped during the week to separating plants, 822 tons blende.

Non-Metallic Minerals

Asbestos—Crude No. 1, $750@$900; No. 2, $400@$500; long spinning fibers, $250@$350; spinning fibers, $150@$225; magnesia and compressed sheet fibers, $100@$150; shingle stock, $60@$110; paper stock, $35@$45; cement stock, $14@$17.50; shorts, $7; all per short ton f.o.b. Thetford, Broughton, and Black Lake mines.

Demand is a little better, and stocks are gradually being diminished.

Barytes—Crude, $9 per ton, f.o.b. mines. Ground white, $23, f.o.b. mills. Off-color grades, $16@$21, f.o.b. Southern mills. Foreign barytes, c.i.f. New York, $7.80@$8.25 per ton crude.

Bauxite — American, crushed and dried, $6@$9 per gross ton; pulverized and dried, $12@$14 per gross ton; calcined, $22@$25 per gross ton, all f.o.b. shipping points. Foreign bauxite offered at $5@$8 per metric ton, c.i.f. Atlantic ports, depending upon grade.

Borax—Granulated, crystals or powdered, in bags, carloads, 5¼c. per lb.; in bbls. 5½c.

Chalk—English, extra light, 5c. Domestic light, 4¼@4½c.; heavy, 3¼@3¾c. per lb., all f.o.b. New York.

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[1] Furnished by Foote Mineral Co., Philadelphia, Pa.

China Clay (Kaolin)—Crude, $6@$8; washed, $8@$9; powdered, $12@$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, $13@$20, f.o.b. Virginia points Imported lump, $14@$20, f.o.b. American ports; powdered, $35@$45, f.o.b., quoted at New York.

Emery—Turkish emery, 6c. per lb. American, 4c. Inferior grades, 3½c., f.o.b. from New England points.

Feldspar—No. 1 pottery grade, $6.50@$6.85 per long ton; No. 2 pottery, $5.75; No. 1 soap grade, $7, f.o.b. cars. No. 1 Canadian, $21@$22, f.o.b. mill. High-potash Canadian, $10 per ton, f.o.b. mines.

Fluorspar — Lump, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, $20 per ton; gravel, $17.50. Acid, lump, $40@$50. No. 1 ground, $50@$55, f.o.b. Illinois and Kentucky mines. Lump, $12.50@$13.50; ground, 95@96 per cent, $25@$26, f.o.b. New Mexico.

Fuller's Earth—16 to 30 mesh, $20 per ton; 30 to 60 mesh, $20; 60 to 100 mesh, $17; 100 mesh and over, $15, f.o.b. Pennsylvania points. English, $23@$25, f.o.b. New York.

Graphite—Ceylon lump, first quality, 6@7c.; chip, 4½@5½c.; dust, 3¼@4c. per lb.; No. 1 flake, 7@8c.; amorphous crude, domestic, $15@$25 per ton (f.o.b. cars); foreign, $55@$65 per ton, depending upon quality. Unless otherwise noted, all f.o.b. New York.

Gypsum — Crushed rock, $3@$4.50 per ton, depending upon shipping point. Ground, $4, f.o.b. shipping point.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ¾ in. size, $1.25@$1.75 per net ton; 1½ in., $1@$1.25. Prices for other sizes practically the same. Agricultural limestone, $2.50@$3.75 per net ton, f.o.b. eastern shipping points, depending upon analysis.

Magnesite—Crude, $8@$12 per ton. High-grade caustic calcined, lump form, $30@$40 per ton. Plastic calcined, $45@$50 in bbls., carload lots, f.o.b. California points. Atlantic seaboard, $60.

Dead-Burned — $33 per net ton, Chewelah, Wash.; $58@$64, Chester, Pa. Austrian grade, $28 per ton, f.o.b. Baltimore. (Magnesite brick — See Refractories.)

Mica — India block mica, slightly stained, per lb.; No. 6, 35c.; No. 5, $1.25; No. 4, $2.25; No. 3, $2.90; No. 2, $4; No. 1, $5.20. Clear block: No. 6, 50c.; No. 5, $1.75; No. 4, $3; No. 3, $4.75; No. 2, $6; No. 1, $7.50; A1, $9; ground, wallpaper grade, $90@$200 per ton (depending upon quantity); ground roofing mica, $25@$70, all f.o.b. New York. Water-ground mica, 100 and 160 mesh, 6½c. per lb., f.o.b. Virginia points.

[1]**Monazite**—Minimum of 6 per cent thorium oxide, $30 per unit, duty paid.

Phosphate Rock—Per long ton, Florida ports, pebble grade: 77 per cent tricalcium phosphate, $8.50 (9.50 for hard rock); 75 per cent, $7; 75@71 per cent, $6.50; 70 per cent, $4.50; 68 per cent, $4.35; 68@66 per cent, $4.25.

Pumice Stone—Imported, lump, 3@40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

Pyrites—Spanish fines, per unit, 12c., c.i.f. Atlantic seaports; furnace size, 13c.; Spanish lump, 13@14c.; domestic fines, f.o.b. mines, Georgia, 11@12c.

Silica—Glass sand, $1.25@$2.25 per ton; sand-blast material, $2.25@$4.50, f.o.b. Indiana and Illinois points. Amorphous or decomposed variety, soft silica, 250 mesh, $16; 350 mesh, $20; 450 mesh, $35 per ton. Ganister, crude, $2.50 per ton, f.o.b. Illinois points. Molding sand, building sand, glass sand, $2@$3, f.o.b. Pennsylvania points.

Sulphur—$16@$18 per ton for domestic, f.o.b. Texas and Louisiana mines; $18@$20 for export, f.a.s. New York.

Talc—20 to 200 mesh, $7@$12 per ton, f.o.b. Vermont; $8@$10, f.o.b. points in Georgia; 200 mesh, $16@$26, f.o.b. Los Angeles.

Mineral Products

Copper Sulphate — Large crystals, 5.50c.; small crystals, 5.40c. per lb., f.o.b. New York.

Potassium Sulphate — Powder, domestic, $1 per unit, basis 90 per cent, f.o.b. New York.

Sodium Nitrate—$2.90@$3 per 100 lb., ex vessel, Atlantic ports.

Sodium Sulphate—For 95 per cent material, $12.50 per ton, f.o.b. in bulk, Western mines, spot and six months' contract; $17@$20 per ton, New York.

Ferro-Alloys

Ferrotitanium—For 15 to 18 per cent material, $200@$225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrocerium—Per lb., $12@15.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 11c. per lb. of chromium contained; 4 to 6 per cent carbon, 12c., f.o.b. works.

Ferromanganese—Domestic, 78 to 82 per cent, $67@$69, f.o.b. furnace; English, $62.50, c.i.f. Atlantic seaport. Spiegeleisen, 16@19 per cent, $29@$32.50 per gross ton, f.o.b. furnace.

Ferromolybdenum—Standard grades, carrying from 50 to 60 per cent molybdenum metal, with low sulphur, phosphorus, and arsenic, $2 per lb. of contained metal, f.o.b. works. Imported material, $1.70@$2.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, $38@$40; 50 per cent, $56@$58; 75 per cent, $115@$120.

Ferrotungsten—Domestic, 70 to 80 per cent W, 37@45c. per lb. of contained tungsten, f.o.b. works. Foreign, 50c., duty paid, f.o.b. Atlantic ports

Ferro-uranium—35 to 50 per cent U, $6 per lb. of U contained, f.o.b. works.

Ferrovanadium—$3@$3.50 per lb. of V contained.

Metal Products

Copper Sheets—Current New York list price, 19.25c. per lb.; wire, 14.25c.

Lead Sheets—Full lead sheets, 7¾c.; cut lead sheets, 8c. in quantity, mill lots.

Nickel Silver—26.25c. per lb. for 18 per cent nickel Grade "A" sheets.

Yellow Metal — Dimension sheets, 16.75c.; sheathing, 16.75c.; rods, ½ to 3 in., 13.75c.

Zinc Sheets—$7.50 per 100 lb. less 8 per cent on carload lots, f.o.b. works.

Refractories

Bauxite Brick—56 per cent alumina, $130 per 1,000; 76 per cent, Suprafrax, $200 per 1,000; f.o.b. works, St. Louis and Pittsburgh.

Chrome Brick—$40 per net ton.

Chrome Cement — 40@45 per cent Cr_2O_3, $30@$32 per net ton, and $31 in sacks, carload lots, f.o.b. eastern shipping points.

Firebrick—First quality, 9-in. shapes, $32@$35 per 1,000, Pennsylvania, Ohio and Kentucky.

Magnesite Brick—9-in., straights, $53 per net ton, f.o.b. works.

Silica Brick—9-in., per 1,000, $30 in carload lots, f.o.b. shipping points.

The Iron Trade

Pittsburgh, May 2, 1922

Production of steel continues at the rate of between 36,000,000 and 38,000,000 tons of ingots a year, against rates of about 35,000,000 tons on April 1, 30,000,000 tons on March 1, and 20,000,000 tons during December. Orders on books would justify a somewhat heavier operation of mills in the Pittsburgh and Valley districts.

Railroad buying has continuously trended upward since the first of the year. The automobile industry is even more active than was predicted it would be, and nearly all the factories are running at close to capacity, with not much steel bought ahead.

Pig Iron—There is no regular market, buyers and sellers being alike out. A fair appraisal of values is $24, Valley, for bessemer, basic, and foundry. The Snyder averages for April were $20.54 for bessemer and $19.30 for basic, most of the transactions having been early in the month. The average quotable market on foundry iron was $20.74, Valley.

Coke

Connellsville Coke—Inquiries and offerings are very limited, with occasional transactions at $6 for furnace and $6.50 for foundry coke.

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[1] Foote Mineral Co., Philadelphia, Pa.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York 1921	New York 1922	London 1921	London 1922	Sterling Exchange 1921	Sterling Exchange 1922
January	[illegible]	[illegible]	[illegible]	[illegible]	372.650	421.750
February	[illegible]	[illegible]	34.745	[illegible]	385.932	435.511
March	[illegible]	[illegible]	[illegible]	[illegible]	389.806	436.912
April	[illegible]	[illegible]	[illegible]	[illegible]	391.784	440.715
May	[illegible]		[illegible]		396.580	
June	[illegible]		[illegible]		377.236	.
July	[illegible]		[illegible]		362.565	.
August	[illegible]		[illegible]		364.505	.
September	[illegible]		[illegible]		371.725	
October	[illegible]		[illegible]		386.315	
November	[illegible]		[illegible]		396.315	
December	[illegible]		[illegible]		414.880	.
Year	[illegible]		[illegible]		384.191	

[illegible] London, pence per ounce, [illegible]

Copper

	New York Electrolytic 1921	New York Electrolytic 1922	London Standard 1921	London Standard 1922	London Electrolytic 1921	London Electrolytic 1922
January	12.597	13.465	70.964	65.226	79.119	72.321
February	12.556	[illegible]	70.925	60.250	75.925	66.125
March	11.976	[illegible]	67.565	59.245	71.190	65.739
April	12.438	[illegible]	69.381	58.799	71.786	64.028
May	12.742		73.196		74.298	
June	[illegible]		71.852		75.682	.
July	[illegible]		71.155		75.286	
August	[illegible]		[illegible]		72.705	
September	[illegible]		67.977		72.295	
October	[illegible]		67.327		73.476	
November	[illegible]		66.614		74.386	
December	[illegible]		66.706		74.525	
Year	[illegible]		[illegible]		74.223	.

[illegible] London, pounds sterling per long ton

Lead

	New York 1921	New York 1922	St. Louis 1921	St. Louis 1922	London 1921	London 1922
January	4.821	4.700	4.747	4.388	23.387	23.667
February	4.373	[illegible]	4.228	4.396	20.650	20.681
March	[illegible]	[illegible]	[illegible]	4.421	18.911	21.266
April	4.356	5.115	4.272	4.946	20.589	22.993
May	4.952		4.784		23.399	.
June	4.485		[illegible]		22.563	
July	[illegible]		4.260		23.399	
August	[illegible]		4.217		23.489	
September	[illegible]		4.392		[illegible]	
October	4.690		[illegible]		23.679	
November	[illegible]		[illegible]		24.483	.
December	[illegible]		4.369		[illegible]	
Year	[illegible]		4.363		22.752	

[illegible] and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York 99% 1921	New York 99% 1922	New York Straits 1921	New York Straits 1922	London 1921	London 1922
January	31.470	31.480	36.000	32.100	190.464	163.065
February	28.534	29.835	32.142	30.767	166.250	149.850
March	27.296	28.426	[illegible]	[illegible]	[illegible]	143.152
April	28.990	29.810	[illegible]	[illegible]	[illegible]	149.840
May	[illegible]		[illegible]		177.411	.
June	[illegible]		[illegible]		[illegible]	
July	26.755	......	27.655		[illegible]	
August	25.662	......	26.301		[illegible]	
September	[illegible]		[illegible]		[illegible]	
October	[illegible]		[illegible]		[illegible]	
November	28.592		[illegible]		[illegible]	
December	32.106		32.486		[illegible]	
Year	[illegible]		[illegible]		[illegible]	

[illegible] York quotations, cents per lb. London, [illegible] per long ton.

Zinc

	St. Louis 1921	St. Louis 1922	London 1921	London 1922
January	[illegible]	4.691	25.262	26.321
February	[illegible]	4.485	24.850	24.213
March	4.737	4.658	[illegible]	25.467
April	4.747	[illegible]	[illegible]	26.576
May	[illegible]		26.923	......
June	[illegible]		[illegible]	
July	[illegible]		[illegible]	
August	[illegible]		[illegible]	
September	[illegible]		[illegible]	
October	[illegible]		[illegible]	
November	[illegible]		[illegible]	
December	[illegible]		[illegible]	
Year	[illegible]		[illegible]	

[illegible] and St. Louis quotations, cents per [illegible] London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York 1921	Antimony (a) New York 1922	Quicksilver (b) New York 1921	Quicksilver (b) New York 1922	Platinum (c) New York 1921	Platinum (c) New York 1922
January	5.258	4.463	48.440	49.960	73.400	[illegible]
February	5.250	4.416	49.545	48.295	70.227	89.545
March	5.282	[illegible]	46.796	50.204	72.463	87.500
April	5.137	4.989	45.423	52.280	73.404	87.500
May	5.250		47.000	.. ..	73.740	.....
June	5.087		46.846	......	74.942	.....
July	4.735		44.950	......	70.440	......
August	4.597		45.028	......	73.222	...
September	4.564		42.660	......	75.960	.....
October	5.085		39.840	....	81.800	..
November	4.734		39.804	......	82.609	......
December	4.500		49.212	.	78.192	. .
Year	4.957		45.462		75.033	.

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer 1921	Bessemer 1922	Basic 1921	Basic 1922	No. 2 Foundry 1921	No. 2 Foundry 1922
January	33.96	21.55	31.96	20.15	33.88	21.34
February	28.96	21.46	26.96	19.71	30.25	20.88
March	28.16	21.35	26.46	19.96	27.85	20.83
April	26.96	22.50	24.46	21.26	26.77	22.70
May	26.21		23.84	.....	25.56	.....
June	24.96		22.66	.....	24.38	.....
July	22.84		20.76	.....	22.36	....
August	21.96		20.29	.....	21.53	.....
September	21.96		21.21	......	22.82	.....
October	21.96		20.96	....	22.96	......
November	21.96		20.96	.....	22.74	.....
December	21.96		20.65	...	21.96	..
Year	25.15		23.43	......	5.26	...

In dollars per long ton.

Monthly Crude Copper Production

	1921-22 December	1921-22 January	1922 February	1922 March
Alaska shipments	8,881,013	6,909,383	4,193,357	4,899,827
Anaconda	(a)	(a)	9,503,000	13,100,000
Arizona Copper	(a)	(a)	(a)	(a)
Calumet & Arizona	(a)	(a)	2,462,000	3,167,070
Calumet & Hecla	(a)	(a)	(a)	(a)
Other Lake Superior	5,500,000	6,000,000	6,000,000	6,000,000
Chino	(a)	(a)	(a)	(a)
Con. Ariz. Smelting	(a)	(a)	(a)	(a)
East Butte	(a)	(b) 750,000	(a)	(a)
Inspiration	(a)	(a)	2,485,000	4,965,000
Magma	(a)	(a)	(a)	(a)
Miami	5,030,941	5,348,000	4,918,000	5,242,000
Nevada Cons	(a)	(a)	(a)	(a)
New Cornelia	1,717,183	1,602,909	1,459,063	1,606,977
Old Dominion	(a)	(a)	(a)	(a)
Phelps Dodge	(a)	(a)	4,091,000	5,540,000
Ray	(a)	(a)	(a)	(a)
Shattuck Arizona	(a)	(a)	(a)	(a)
United Verde	(a)	(a)	(a)	(a)
United Verde Extension	(a)	(a)	646,110	2,014,886
Utah Copper	(a)	(a)	(a)	(a)
Others, estimated	8,500,000	11,400,000	10,200,000	9,170,000
Total United States	29,629,137	32,010,292	45,957,530	55,705,760
Imports: Ore and concentrates, matte	14,844,641	7,136,976	5,081,497	3,974,424
Imports of blister, unrefined	14,731,185	5,178,068	18,081,802	17,205,149
Imports of refined and old	2,447,925	565,439	5,024,806	17,943,178
Grand total	61,652,888	44,890,775	74,145,635	94,828,511
Backus & Johnston	822,000	1,118,000	990,000	910,000
Boleo	954,765	1,162,080	954,765	1,117,384
Cananea	(a)	(a)	(a)	(a)
Cerro de Pasco	5,536,000	4,726,000	4,868,000	4,702,000
Chile	4,000,000	4,000,000	4,000,000	4,000,000
Cons. M. & S. of Canada	313,290	97,985	26,000	124,000
Falcon Mines	550,800	582,000	566,800	550,682
Furukawa	3,028,499	2,357,258	2,702,636	.
Granby Cons	2,215,403	1,974,162	955,038	1,922,462
Hampden Cloncurry	(a)	(a)	(a)	(a)
Katanga	6,570,900	6,772,600	5,785,920	6,740,000
Mount Morgan	(a)	(a)	(a)	(a)
Mount Lyell	782,000	1,152,000	1,152,000	.. .
Phelps Dodge Mexican	(a)	(a)	318,000	397,000
Sumitomo	2,732,392	1,439,488	3,089,353	1,806,888
Wallaroo & Moon	954,795	122,575	828,821	....

(a) No copper produced during this month. (b) Estimated.

Comparative Annual Copper Production

	1919	1920	1921	1922
January	135,733,511	121,903,744	90,596,597	32,010,292
February	111,649,512	117,540,000	86,682,941	45,957,530
March	102,040,460	120,309,316	91,046,345	55,705,760
April	98,808,998	116,078,871	46,946,523	...
May	92,652,975	114,964,207	25,310,511	...
June	95,856,570	116,107,856	24,623,693	....
July	100,369,247	109,729,610	22,033,739	....
August	107,994,040	112,460,254	23,248,398	....
September	108,703,075	104,919,562	23,855,316	... .
October	115,143,143	105,231,571	23,231,572	....
November	117,289,735	106,700,178	28,341,442	... ..
December	102,997,633	95,709,009	29,629,137	. ..

COMPANY REPORTS

Consolidated Mining & Smelting Co. of Canada, Ltd.

A report of the operations of the Consolidated Mining & Smelting Co. of Canada, Ltd., for 1921 shows a net profit of $338,447.30. Profit-and-loss account follows:

To ores, metals, and smelter product on hand and in transit Dec. 31, 1920	$[illegible]
Custom ores, lead, and bullion purchased	[illegible]
Freight on ore from company's mines	[illegible]
Mining, smelting and general expenses	[illegible] 78
Development expenses	[illegible]
Capital renewals and depreciation	[illegible]
Bond interest and exchange on coupons	[illegible] 47
Directors' fees	[illegible]
Sundry items written off, including bad debts	[illegible]
Balance profit	[illegible]
Total	$[illegible]
By sales of product and ore	$7[illegible] 22
Ores, metals and smelter product on hand and in transit	2,7[illegible]
Rents, royalties, and sundry revenues	8,574 99
West Kootenay Power & Light Co. Dividends	2[illegible]
	$1[illegible] 52

Balance sheet as of Dec. 31, 1921, follows:

LIABILITIES

Capital		
Authorized 600,000 shares at $25 each	$15,000,000 00	
Issued and fully paid 421,348 shares at $25 each		$10,533,700 00
Ten year 7 per cent bonds		[illegible] 00
Bond interest accrued with exchange thereon		[illegible]
Special loans against capital expenditure in anticipation of financing arrangements		[illegible]
Other current loans and overdraft		3,174,[illegible]
Accounts payable		[illegible],424,[illegible] 43
Profit-and-loss account		
Balance Dec. 31, 1920	$809,114 22	
Profit for year ended Dec. 31, 1921	338,447 30	
	$1,147,[illegible] 52	
Less:		
Taxes paid and reserved for	67,724 [illegible]	1,07[illegible],736 90
		$2[illegible]17,471 17

ASSETS

Mines, mineral claims and shares in other companies		
Balance Dec. 31, 1920	$10,160,767 15	
Expenditure for 1921	223,852 92	$10,384,620.07
Mining, smelting, concentrating and refining plants		
Balance Dec. 31, 1920	$6,244,583 89	
Expenditure for 1921	334,643 35	
	$6,579,227 24	
Less capital renewals and depreciation	105,35[illegible]	6,473,872 69
Ores, metals, and smelter products on hand and in transit		2,7[illegible],434 41
Mines and smelter stores and materials		1,[illegible] 14
Accounts receivable, less reserve		[illegible],788 72
Insurance paid in advance		27,276 52
Cash in bank and on hand		1[illegible],133 72
		$2[illegible]17,471 17

Production amounted to 432,078 tons ore, yielding 56,334 oz. of gold, 1,198,114 oz. of silver, 57,683,328 lb. of lead, 3,056,910 lb. of copper, and 52,988,159 lb. of zinc.

East Butte Copper Mining Co.

A report of operations of the East Butte Copper Mining Co. for 1921 shows a profit of $201,835.48 as follows:

Gross value of metals shipped		$2,4[illegible] 03
Other income		[illegible] 55
Gross income from mining operations		$2,431,638 58
Cost of mining, treatment, freight, refining, selling and cost of custom ore purchased	$2,21[illegible] 52	
Miscellaneous operations	[illegible] 55	2,229,803 10
Profit on copper mining operations		$2[illegible] 48
Less depreciation		27,[illegible] 74
		$173,893 74
Less outside explorations		2[illegible] 25
Surplus from all operations		$15[illegible],772 49

Balance sheet as of Dec. 31, 1921, is given as follows:

ASSETS

Property		$[illegible]
United States Liberty Bonds		[illegible]
Cash [illegible]		[illegible] 22
Accounts receivable		1[illegible],906 18
[illegible] supplies		1[illegible],110 [illegible]
Insurance prepaid		[illegible] 54
		$5,697,415 33

LIABILITIES

Capital paid		$4,242,820 00
Authorized	$6,000,000 00	
Unissued	1,757,180 00	
Accounts payable		992,973 56
Bills payable		142,000 00
Contingent funds		134,523 28
Surplus		18[illegible],098 49
		$5,697,415 33

Production amounted to 14,766,017 lb. of copper, 508,680 oz. of silver, and 990 oz. of gold. Copper cost of production was 11.2804c. per lb. delivered at New York.

Mohawk Mining Co.

A report of operations of Mohawk Mining Co. for 1921 shows a profit of $270,271.80 before providing for depreciation and depletion. Profit-and-loss account follows:

Sales		
1[illegible],011,572 lb. of copper at 12.98c.	....	$1,299,776 17
Cost of sales		
Copper on hand Jan. 1, 1921, at cost	$378,366 67	
Operating expenses at mine	1,305,881 [illegible]7	
Smelting, freight, New York and Boston expenses	227,637 70	
Taxes, exclusive of income and profit taxes	73,972 35	
	$1,98[illegible] 39	
Less copper on hand Dec. 31, 1921, at cost	92[illegible] 88	
Net cost of copper sold	.....	$1,057,926 51
Profit on sales of copper		$241,849 66
Miscellaneous income	$64,045 14	
Discount loss on sale of Liberty Loan bonds	35,[illegible] 00	
		$28,422 14
Profit for the year, before providing for depreciation and depletion		$270,271 80

Balance sheet as of Dec. 31, 1921, follows:

ASSETS

Investments		
Miscellaneous stocks and bonds, at cost		$96,592 27
Current assets		2,204,389.71
Unexpired insurance		2,570 50
		$2,[illegible],552 48
Capital assets (book value)		11,7[illegible] 47
		$14,058,455 95

LIABILITIES

Capital stock		
Paid in on 100,000 shares		$[illegible] 00
Current liabilities		25,802 56
Unrealized appreciation	$[illegible]	
Reserve for depreciation	[illegible]	
Reserve for depletion	[illegible]	
		9,865,081 54
Reserve for contingencies		400,000 00
Surplus and realized appreciation		
Balance Jan. 1	$[illegible] 7	
Add profits for the year	[illegible]	
Appreciation during the year	[illegible]	
Profit on property disposed of	[illegible]	
	$2,[illegible]7	
Deduct depreciation for the year	$1[illegible]	
Depletion for the year	466,727 09	
Income and excess profits tax paid on account of 1920	[illegible] 00	
Reserve for contingencies	[illegible]	
	$647,5[illegible] 52	
Balance, Dec. 31		$1,867,571 85
		$14,058,455.95

Production amounted to 4,054,235 lb. refined copper, which cost 15.598c. per lb. to produce, including depletion, depreciation, and taxes.

MINING STOCKS

Week Ended April 29, 1922

Stock	Exch.	High	Low	Last	Last Div.	
			COPPER			
Ahmeek	Boston	52	51	51	Sept. '20, Q	$0.50
Alaska-Br. Col. Metals	N. Y. Curb	[illegible]	[illegible]	[illegible]		
Allouez	Boston	2[illegible]	[illegible]	[illegible]	Mar. '19,	1.00
Anaconda	New York	54	[illegible]	[illegible]	Nov. '20, Q	1.00
Arcadian Consol.	Boston	[illegible]	[illegible]	[illegible]		
Ariz. Com'l	Boston	8[illegible]	[illegible]	[illegible]	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	[illegible]	[illegible]	*21		
Bingham Mines	Boston	11	[illegible]	[illegible]	Sept. '19, Q	0.25
Calumet & Arizona	Boston	[illegible]	[illegible]	[illegible]	Mar. '22, Q	0.50
Calumet & Hecla	Boston	275	272	[illegible]	Mar. '20, Q	5.00
Canada Copper	N. Y. Curb	[illegible]	*47	*50		
Centennial	Boston	[illegible]	[illegible]	[illegible]	Dec. '18, SA	1.00
Cerro de Pasco	New York	[illegible]	[illegible]	[illegible]	Mar. '21, Q	0.50
Chile Copper	New York	[illegible]	[illegible]	[illegible]		
Chino	New York	[illegible]	[illegible]	[illegible]	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	[illegible]	[illegible]	[illegible]		
Con. Arizona	N. Y. Curb	*[illegible]	*4	*5	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	2[illegible]	1[illegible]	[illegible]		
Copper Range	Boston	44	42	43	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	[illegible]	1	[illegible]		
Davis-Daly	Boston	[illegible]	[illegible]	8½	Mar. '20, Q	0.25
East Butte	Boston	11[illegible]	10[illegible]	[illegible]	Dec. '19, A	0.50
First National	Boston Curb	*85	*75	*75	Feb. '19, SA	0.15
Franklin	Boston	2[illegible]	[illegible]	2[illegible]		
Gadsden Copper	Boston Curb	[illegible]	1	[illegible]		
Granby Consol.	New York	26[illegible]	25	25	May '19, Q	1.25
Greene Cananea	New York	32	29[illegible]	32	Nov. '20, Q	0.50
Hancock	Boston	3	2[illegible]	3		
Howe Sound	N. Y. Curb	3[illegible]	[illegible]	[illegible]	Jan. '21, Q	0.05
Inspiration Consol.	New York	42	[illegible]	41[illegible]	Oct. '20, Q	1.00
Iron Cap	Boston Curb	[illegible]	[illegible]	7	Sept. '20, K	0.25
Isle Royale	Boston	24[illegible]	2[illegible]	23[illegible]	Sept. '19, SA	0.50
Kennecott	New York	32[illegible]	[illegible]	32[illegible]	Dec. '20, Q	0.50
Keweenaw	Boston	[illegible]	2[illegible]	2[illegible]		
Lake Copper	Boston	5	4[illegible]	4[illegible]		
La Salle	Boston	1[illegible]	1[illegible]	1[illegible]		
Magma Copper	N. Y. Curb	30	28[illegible]	30	Jan. '19, Q	0.50
Majestic	Boston Curb	*12	*10	*10		
Mason Valley	Boston	2[illegible]	2	2		
Mass Consolidated	Boston	4	3	3[illegible]	Nov. '17, Q	1.00
Miami Copper	New York	[illegible]	28[illegible]	2[illegible]	Feb. '22, Q	0.50
Michigan	Boston	[illegible]	2[illegible]	3		
Mohawk	Boston	59[illegible]	57	58	Feb. '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	8[illegible]	7[illegible]	[illegible]		
Nevada Consol.	New York	17[illegible]	16[illegible]	[illegible]	Sept. '20, Q	0.25
New Cornelia	Boston	18[illegible]	17[illegible]	18[illegible]	Feb. '22, K	0.25
North Butte	Boston	13	12	12[illegible]	Oct. '18, Q	0.25
North Lake	Boston			*40		
Ohio Copper	N. Y. Curb	*13	*13	*13		
Old Dominion	Boston	25	24[illegible]	25[illegible]	Dec. '18, Q	1.00
Osceola	Boston	36[illegible]	34	35	Jan. '20, Q	0.50
Phelps Dodge	Open Mar.		†165		Apr. '22, Q	1.00
Quincy	Boston	44	43	43[illegible]	Mar. '20, Q	1.00
Ray Consolidated	New York	16[illegible]	15[illegible]	16[illegible]	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1[illegible]	1[illegible]	1[illegible]		
St. Mary's Min. Ld.	Boston	45[illegible]	43[illegible]	43¾	Apr. '22, K	2.00
Seneca Copper	Boston	14	13	1[illegible]		
Shannon	Boston	1	*90	1	Nov. '17, Q	0.25
Shattuck Arizona	New York	9[illegible]	8[illegible]	8[illegible]	Jan. '20, Q	0.25
South Lake	Boston	*90	*78	*80		
Superior & Boston	Boston	1[illegible]	1[illegible]	1[illegible]		
Tenn. C. & C. cfs.	New York	12¼	11[illegible]	12	May '18, I	1.00
Tuolumne	Boston	*70	*66	*68	May '13,	0.10
United Verde Ex.	Boston Curb	*29	*28	*28	Feb. '22, Q	0.25
Utah Consol.	Boston	2[illegible]	2½	2[illegible]	Sept. '18,	0.25
Utah Copper	New York	67¾	64	6[illegible]	Mar. '22, Q	0.50
Utah Metal & T.	Boston	1[illegible]	1[illegible]	1[illegible]	Dec. '17,	0.30
Victoria	Boston	1[illegible]	1[illegible]	1[illegible]		
Winona	Boston	1[illegible]	[illegible]	1[illegible]		
Wolverine	Boston	12	12	12		
			NICKEL-COPPER			
Internat. Nickel	New York	19[illegible]	17[illegible]	18[illegible]	Mar. '19,	0.50
Internat. Nickel, pfd.	New York	84[illegible]	78[illegible]	84[illegible]	Feb. '22, Q	1.50
			LEAD			
National Lead	New York	93¾	91	92	Mar. '22, Q	1.50
National Lead, pfd.	New York	111[illegible]	110¾	111¼	Mar. '22, Q	1.75
St. Joseph Lead	New York	14¾	14¼	14[illegible]	Mar. '22, Q	0.25
			QUICKSILVER			
New Idria	Boston			1[illegible]	....	
			ZINC			
Am. Z. L. & S.	New York	19¾	17[illegible]	19	May '20,	1.00
Am. Z. L. & S. pfd.	New York	44¾	41[illegible]	41¾	Nov. '20, Q	1.50
Butte C. & Z.	New York	7¼	6¾	6¾	June '18,	0.50
Butte & Superior	New York	31[illegible]	28¾	29½	Sept. '20,	1.25
Callahan Zn-Ld	New York	7¾	7	7¼	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	146¾	14[illegible]	14[illegible]	Feb. '22, Q	2.00
Yellow Pine	Los Angeles	*43	*40	*43	Sept. '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills, Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.	
			GOLD			
Alaska Gold	New York	[illegible]	⅜	⅝	....	
Alaska Juneau	New York	1	1	1½	....	
Carson Hill	New York	13[illegible]	12¾	12¾	.	
Cresson Consol. G.	N. Y. Curb	2 9/16	2 7/16	2 9/16	Apr. '22, Q, X	$0.10
Dome Extension	Toronto	...	..	*85	.	
Dome Mines	New York	27¼	26¾	27	Apr. '22, Q	1.00
Florence Goldfield	N. Y. Curb	*30	*25	*26	..	
Golden Cycle	Colo. Springs	*70½	*70	*70½	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*9	*8	*8	Dec. '19,	0.05
Hollinger Consol.	Toronto	9.80	9.50	9.70	Apr. '22,	0.05
Homestake Mining	New York	73	70½	70¾	Apr. '22, M	0.25
Kirkland Lake	Toronto	*47	*45	*46	..	
Lake Shore	Toronto	2.45	2.18	2.33	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	18.80	17.70	18.50	Jan. '22, K	0.05
Porcupine Crown	Toronto	*29	28	*28½	July '17,	0.03
Porcupine V. N. T.	Toronto	*33½	*32½	*33	...	
Portland	Colo. Springs	*31	*31	*31	Oct. '20, Q	0.01
Schumacher	Toronto	*58	*55	*56½	....	
Silver Pick	N. Y. Curb	*20	*16	*18	....	
Teck Hughes	Toronto	*62½	*56½	*61	.	
Tom Reed	Los Angeles	*65	*59	*60	Dec. '19,	0.02
United Eastern	N. Y. Curb	1½	1 7/16	1 9/16	Apr. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*13	*12	*12	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb			*9	...	
Wright-Hargreaves	Toronto	3.00	2.85	2.90	Apr. '22,	0.02
Yukon Gold	N. Y. Curb	1¼	1	1	June '18,	0.02½
			SILVER			
Batopilas Mining	New York	1⅛	1	1⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*37	*34½	*35	May '20, K	0.03
Coniagas	Toronto	1.30	1.00	1.00	May '21, Q	0.12½
Crown Reserve	Toronto	*21	*16¼	*18	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	4⅛	3⅞	4	Apr. '22, Q	0.12½
La Rose	Toronto	*39	*33	*35	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*36	*27	*33	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.10	1.05	1.10	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅛	5⅞	5⅞	Apr. '22, Q, X	0.30
Ontario Silver	New York	8⅝	8	8⅞	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	...	...	*12	Jan. '12,	0.10
Temiskaming	Toronto	*35	*30	*33½	Jan. '20, K	0.04
Trethewey	Toronto	*5	*4	*5	Jan. '19,	0.05
			GOLD AND SILVER			
Boston & Montana	N. Y. Curb	*22	*16	*21	....	
Cash Boy	N. Y. Curb	*4	*4	*4	....	
Dolores Esperanza	N. Y. Curb	2⅛	1⅞	1⅞	....	
El Salvador	N. Y. Curb	*7	*5	*5	..	
Jim Butler	N. Y. Curb	*8	*8	*8	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	*5	*5	*5	June '16,	0.05
MacNamara M. & M.	N. Y. Curb	*12	*9	*10	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1¾	1⅝	1 11/16	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*84	*75	*76	..	
Tonopah Extension	N. Y. Curb	1⅝	1 9/16	1⅝	Apr. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1 13/16	1 13/16	1⅞	Apr. '22, SA, X	0.07½
West End Consol.	N. Y. Curb	1⅛	1 1/16	1 1/16	Dec. '19, SA	0.05
			SILVER-LEAD			
Caledonia	N. Y. Curb	*6	*6	*6	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*98	*96	*98	Dec. '20,	0.15
Chief Consol.	Boston Curb	4	4	4	Aug. '21, Q	0.05
Consol. M. & S.	Montreal	24½	23	23	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†2.05	†1.55	...	July '20, Q	0.10
Daly-West	Boston	2	1½	2	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†3	†2½	2½	Apr. '21, K	0.05
Electric Point	Spokane	*8	*7	*7	May '20, SA	0.03
Federal M. & S.	New York	14	12	13½	Jan. '09,	1.50
Federal M. & S. pfd.	New York	46½	41	44½	Mar. '22, Q	1.00
Florence Silver	Spokane	*23½	*20	*23	Apr. '19,	0.01½
Grand Central	Salt Lake	75	71	*75	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	6½	6	6¼	Mar. '22, Q	0.15
Iron Blossom Con.	N. Y. Curb	*22	*20	*20	Apr. '22, Q	0.02½
Judge M. & S.	Salt Lake	†2.60	†2.40	2.60	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*8	*7	*7	June '21, I	0.02
Prince Consol.	Salt Lake	*4¼	*3	*4	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*4	*3	*4	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*12	*9	*10	.....	
South Hecla	Salt Lake	†*60	†*35	.	Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*17	*15	*17	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*15	*10	*12	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.55	2.40	2.55	Jan. '21, K	0.04
Tintic Standard	Salt Lake	1.97½	1.80	1.97½	Dec. '21, Q	0.05
Utah Apex	Boston	3¾	3⅜	3⅜	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	....	....	*2	Nov. '17,	0.01
			VANADIUM			
Vanadium Corp.	New York	43¼	40½	42¼	Jan. '21, Q	1.00
			ASBESTOS			
Asbestos Corp.	Montreal	61	58	58	Apr. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	80½	80	80	Apr. '22, Q	1.75
			SULPHUR			
Freeport, Texas	New York	17	16⅝	17⅛	Nov. '19, Q	1.00
Texas Gulf	New York	44½	42⅝	43⅝	Mar. '22, QX	1.00
			MINING, SMELTING AND REFINING			
Amer. Sm. & Ref.	New York	58⅜	54½	58½	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	98	97¼	98	Mar. '22, Q	1.75
Am. Sm. Sec. pf. A.	New York	93	92½	92½	Apr. '22, Q	1.50
U. S. Sm. R. & M.	New York	42	39	39½	Jan. '21, Q	0.50
U. S. Sm. R. & M. pf.	New York	.	..	45¼	Apr. '22, Q	1.75

NEW MACHINERY AND INVENTIONS

A Car Dumper That Operates Without Power

Permits Use of Solid-Body Cars—Speed of Dumping Regulated by Oil Dashpot

The need for more rapid dumping of mine cars has brought about the development of several types of revolving dumpers which permit not only greater speed of this operation but also the use of the solid-body mine car, the latter having decided advantages over either the side- or end-dump car.

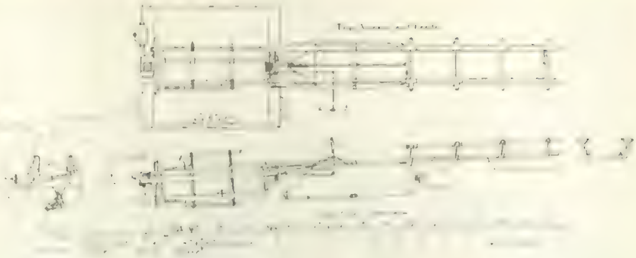
The "Twin-Boy" car dump, shown in an accompanying illustration, differs from other types of revolving dumpers in that its action is automatic, no power being required for its operation. All other revolving dumps are usually constructed of a circular steel frame and revolve through an angle of 180 deg. or 360 deg.

In the construction of the "Twin-Boy," the tracks are mounted on triangular or "Y" shaped spiders, set at an angle of 130 deg. to each other, which are supported by a heavy steel shaft running parallel to the track. The ingenuous design of these spiders is such that one track is off-center of the shaft to the right, and when revolved through its normal angle the other track is off-center to the shaft to the left. When the track is off-center to the right a loaded car causes the dump to revolve to the right and brings the other track and the empty car into normal position. This track then becomes off-center to the left. The next loaded car causes the dump, which is on the principle of a see-saw, to revolve downward on one side, and to elevate the empty car on the other.

The dump frame is mounted on a heavy steel shaft, each end of which is provided with a half shrouded rack and pinion. The rack is substantially held by the outer or stationary frame. With this construction, the weight of the dump, instead of being supported on the gear teeth, is supported by and rolls back and forth on the gear shrouds. This permits the dump to roll freely and with a minimum amount of friction. As the dump revolves it is consequently shifted back and forth alternately with each revolution, by reason of the rack and pinion. The rack and gears work in an oil bath, and are protected by a steel cover.

As the tracks on the dump are off-center, the shifting motion becomes necessary, in order to insure proper alignment of the dump tracks with the stationary track on the tipple. This is accomplished by the rack and pinion.

One of the most important points in the design of the dump is its control. The dump is provided with an oil compression cylinder, the plunger of which is actuated by the piston rod, which is connected to the dump shaft. As the shaft shifts laterally back and forth, by reason of the rack and pinion, it imparts its motion to the piston. The rack and pinion thus performs two functions, namely, alignment of tracks and operation of the compression cylinder.



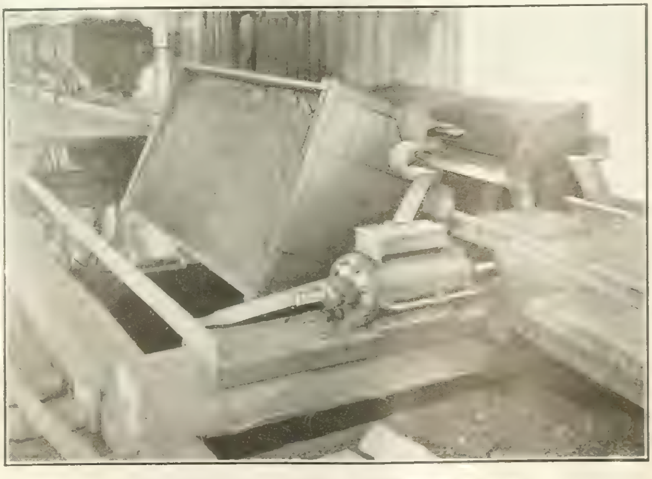
[illegible] of Twin-Boy dump, trip arrester and feeder

The cylinder is provided with a bypass pipe and valve which is connected to each end. As the cars are dumped the piston is driven back and forth and forces the oil through the bypass, and by opening or closing the globe valve, the dump can be regulated to any speed desired. The cylinder contains a number of small ports leading into oil recesses, located at each end and connected to the bypass. The travel of the piston forward gradually shuts off these small ports and produces a cushioning effect.

In operation the loaded car passes on to the dump, strikes a trip lever, which throws a dog in front of the car wheel and stops or spots the car on the dump. This same action releases the alignment latch, and the dump instantly goes into action. The loaded car is dumped on one side and the empty car is raised on the other. The moment the empty car reaches alignment, or its normal position, the dog is thrown out from the front of the car wheel and the dump is latched in alignment automatically by the coil spring, as shown on the side of the dump. The empty car is then immediately discharged.

The car is held, when in an inverted dumping position, by angle bars over the top of the wheels. However, if the design of the car in use should be more easily adaptable to being held by the hubs of the wheels, the axles, or the car sides, any of these methods may be readily employed.

The trip arrester and feeder is an automatic device placed about twelve ft. in front of the dump. It consists of angle bars 14 to 18 ft. long, which swing above the car wheels and engage them as a brake, stopping the trip. The brake is then released, permitting the entire trip of cars to move slowly forward until the weight of the first car depresses the hinged section of rail immediately in front of the dump. The end of this hinged rail nearest the dump, in normal position, is about 8 inches above the level of the dump rail, and upon being weighted down by the first car, an attached bell crank lever again actuates the brake, stopping the second and following car until the first car has passed on to the



Full car dumping, empty car returning to track

A five-ton ore bucket handling frozen iron ore

dump, where it immediately starts to turn over. As the dump revolves and the empty car comes to alignment, the brake automatically releases, allowing the next car to follow. When the entire trip has been dumped the depressing of the hinged rail by the last car leaves the trip arrested in a locked position to brake and stop the next trip. The trip arrester can be regulated to any desired tension, and, being in the form of a brake, it brings the trip to a gradual stop without shock or strain on either cars or tipple structure, which eliminates broken wheels and bent or broken axles.

Loaded cars can be passed across the dump at will, by throwing the control lever into position, which locks the dump and prevents it from revolving. This is particularly advantageous in handling rock cars, and it makes no difference what position these cars may occupy in the trip.

The oil compression cylinder control of the dump allows slow or rapid dumping. Adjustment can be made to handle up to ten cars per minute.

The machine was designed by W. R. Coleman and is manufactured by The Anniston Electric Steel Corporation, Anniston, Ala.

Bucket Loads Own Weight in Material

The loading bucket shown in the accompanying illustration is designed especially to handle coal and ore from stockpiles into boats, or vice versa. An advantageous feature is the closed length of the bucket, which is extremely small as compared with the extended length. This particular phase of the design is necessary when the bucket is lowered into a hatchway of a vessel, as in this application, when opened preparatory to gathering its load, it must take up as little vertical over-all space as possible. The type shown is known as the Algoma ore bucket and is manufactured by the Blaw-Knox Co., of Pittsburgh, Pa.

The following figures show the comparison of work done by the Algoma type of bucket and another clamshell bucket, and furnish an idea of what may be expected from these machines:

	Algoma	Other
Weight, empty bucket, lb...	10,846	11,300
Weight, ore from pile, lb....	9,011	8,263
Weight, ore from boat, lb...	8,500	6,442

Another interesting test which was carried on shows results in the following figures:

Weight of Algoma bucket, lb.......	11,080
Average load picked up, lb.........	11,000

In other words, the bucket picks up its own weight in material.

INDUSTRIAL NOTES

C. M. Hall, formerly in charge of the New York territory for the Dodge Transmission Co., has become associated with the Black & Decker Manufacturing Co. Mr. Hall's headquarters will be in Indianapolis.

Announcement has been made of the establishment of a service bureau of the American Wood Preservers' Association, with headquarters at 1146 Otis Building, Chicago, Ill. The announcement, which may be obtained on request, contains a brief statement of the bureau's activities and a list of members of the association.

W. H. Campbell, for the past two years general sales manager of the Charleston Industrial Corporation, Nitro, W. Va., announces the opening of offices as W. H. Campbell, Inc., at 30 Church St., New York City. This business has been incorporated for the sale of new and carefully inspected used chemical, refrigeration, and power apparatus.

TRADE CATALOGS

Mine Rescue Apparatus—The American Atmos Corporation, of 105 West 40th St., New York City, has issued a sixteen-page bulletin descriptive of the Paul breathing apparatus, which is said to be the first rescue apparatus officially approved by the governments of the United States and Great Britain. It has been stated that the Paul apparatus, since its introduction, has been used in the United States under service conditions more than all other types of miner's rescue apparatus combined during the same period. It is significant to note that there has never been a death during its use nor as a result of its use. In this respect the "Paul" has a record unique in the annals of mine salvage work. It is the only rescue apparatus ever put into general use in which a death has not occurred, and this despite the unusually heavy demands made upon it. The reason for this remarkable record of service is probably that the Paul apparatus is of *positive pressure* design. Scores of tests have been conducted in which it has been proved conclusively that a man may remain in a deadly atmosphere while using the "Paul" when the users of other types of apparatus have had to seek fresh air.

Welding Rods and Electrodes—The Page Steel & Wire Co., of Bridgeport, Conn., has just issued a new handbook describing and illustrating interesting developments in the welding field. A number of useful tables and other information are included.

Powdered Fuel—The Grindle Fuel Equipment Co., of Harvey, Ill., has recently issued Bulletin No. 4, "Grindle Powdered Fuel Equipment," which contains forty pages of text and illustrations dealing with the advantages of powdered fuel in general and the special advantages and operation of the Grindle system in particular. Savings of from 20 to 50 per cent are being made in fuel cost and of from 25 to 75 per cent in labor cost over hand- and stoker-fired furnaces and boilers, and fuel savings as high as 65 per cent over oil-burning furnaces. In addition, there is a reduction in oxidation loss in metallurgical furnaces of approximately 50 per cent.

Oil Burning Appliances—The Aeroil Burner Co. Inc., of 266 Hudson Ave., Union Hill, N. J., has issued Bulletin No. 20, which illustrates and describes a number of appliances, such as burners, torches, and kettles, that are manufactured by the company. A copy of the bulletin will be sent on request.

Microscopical Apparatus — Spencer Lens Co., Buffalo, N. Y., has issued a twenty-four page bulletin descriptive of Spencer products, which include microscopes, projection apparatus, delineascopes, spectroscopes, spectrometers, refractometers, photographic lenses, optical glass, and microscopical accessories.

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Volume 113 New York, May 13, 1922 *Number* 19

The Minerals Separation Settlement

AFTER ELEVEN YEARS of litigation, Minerals Separation and its chief opponents have made peace. The Jackling properties — Butte & Superior, Utah Copper, Nevada Consolidated, Chino, and Ray Consolidated—along with the Miami Copper Co., have made an agreement with the flotation-patent exploiting company which will go far to clear the air and pave the way for the adjustment of other cases. The details of settlement have not yet been announced, but there is little doubt that both sides to the controversy will, in a large way, profit to a greater extent than either would have done by continuing the legal tangle. Vast sums had already been expended in the prosecution of the various cases, and the end still seemed far away.

We wonder if the settlement was hastened by the death of John Ballot, until recently the president of Minerals Separation. Mr. Ballot was known to be unrelenting in his demand for the punishment of alleged infringers of his patent rights, and certainly was not disposed to allow any favors to achieve a settlement with the powerful companies with which agreement has now been made. Mr. Ballot fought for what he thought was right, and did not care to be diplomatic. It may be that his death made it easier for a settlement wherein each of the contending parties made large concessions, as was almost certainly the fact. It would not be surprising if the so-called porphyries may now enjoy a royalty arrangement no more onerous than that concluded some years ago with the Anaconda and Phelps Dodge interests.

The flotation litigation should be a lesson to technical men. It seems to show clearly that lawyers are not capable of satisfactorily deciding upon a highly technical question for which engineering judgment rather than legal judgment is required. The various trials have been singularly disappointing, confusing, and conflicting. As a result of the years of time and the large sums of money which have been spent, practically all that has been decided is that patent No. 835,120 is valid and that when "oil" is mixed with an ore pulp in the proportion of less than 20 lb. of the oil to one ton of the dry ore, the mixture violently agitated, and the resulting pulp subjected to "flotation," the process so performed is comprehended by the patent. If more than 1 per cent of oil is used, the patent is apparently not infringed, but whether oil in circulation in a closed circuit shall be included is open to question.

Users of pneumatic machines, such as the Callow cell, are infringers if they violently agitate the oil and pulp before flotation, but just what violent agitation is, has only partly been defined. The interpretation of patent No. 962,678, which relates to the use of soluble frothing agents, has hardly been touched. What does "soluble" mean anyway? All things are soluble more or less, not least so the "insoluble" often seen on laboratory reports issued by chemists. Does the addition of one of the newer flotation reagents, such as ortho-toluidine, to the launder immediately preceding a Callow cell infringe Minerals Separation patents? We sincerely hope that it will not take another ten years of litigation and attendant uncertainty to find out.

Mr. Callow and Minerals Separation now have the opportunity of doing a great thing for the mining industry if they can arrive at some middle ground of agreement on this question. Flotation operators should not object to a reasonable royalty for the benefit of those who have done most toward developing this highly ingenious process, and it is to be hoped that the royalty can be so adjusted and so apportioned among the contending patentees that all will be satisfied, both in peace of mind and pocket-book.

Several smaller suits are still outstanding, we believe. They are between Minerals Separation and companies of less importance, though the principles involved are of prime interest. For example, the suit brought against the Magma Copper Co., if it is intelligently argued and carried to its conclusion, should establish pretty thoroughly the rights of users of simple porous-bottom cells. Experience, however, makes us think that a long and expensive legal battle would be necessary before any definite results would be achieved, if at all; and we cannot help but think how much more satisfactory it would be if a settlement could be made out of court, as suggested above. Such a settlement would show a particularly conciliatory attitude by Minerals Separation, for that company is now even more powerful and affluent than before, and by retaining legal experts of the highest ability could drag a case along through the courts for years, even though the earlier decisions went against it—which is by no means certain. And it does make a difference how good a lawyer one can afford!

We hope that the gradual elimination of the M. S. opponents will make the members of that organization less secretive in their attitude to the mining engineering profession. Unwilling to release information concerning their processes, they have been keenly alive to learning what they could about others. They have been among our most constant subscribers. Sometimes we wish that we could delete from our subscription list those organizations and individuals that are unwilling to give as well as to receive information. The attitude of Minerals Separation has, of course, been guided by legal advice. We question, however, whether the advice has been good, for a vast antagonism against the patent-exploiting company has been generated in the minds of usually fair-minded persons. Underhanded work has been charged against both sides to the controversies, and the behavior generally has been that of which no engineer can be proud.

Possibly the dawn of a new day has now come, when all flotation plants will be operated in accord with the best metallurgical rather than the best legal practice. The world is gradually straightening itself out, and perhaps that small section of it devoted to making minerals float is no exception.

A Silver and Gold Association

WE NOTE with great interest that the silver and gold industries of the country are to be specially represented by a Silver and Gold Association, of the type technically called trade associations; and we greatly approve of the step. The personality of the management and the extent of participation in the association by gold and silver producers have not yet been disclosed; but it appears that Mr. H. N. Lowry will be one of the guiding spirits; and the record of his work in behalf of the gold industry, conducted under the auspices of the American Mining Congress, is such as to inspire considerable confidence in the soundness and yet boldness of the policies which will guide the new association. Upon the quality of such policies, of course, depend progress and success; but we believe that producers of the precious metals are fully warranted in joining in this association with enthusiasm.

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Gottsberger to Yale

YALE UNIVERSITY is to be congratulated on the appointment of Mr. B. Britton Gottsberger as professor of mining. Mr. Gottsberger has a record of successful mine operation and mine management, combining a close knowledge of the technique of mining with an unusual degree of interest in the human element of mining problems. His highly successful record as general manager of the Tennessee Copper Co. and the Miami Copper Co. is what might be expected from this mental attitude. Mr. Gottsberger is secretary of the Mining and Metallurgical Society of America, and has recently devoted his chief energies to this society, and also to work in the American Institute of Mining and Metallurgical Engineers.

Undoubtedly, the great American mining school, comparable in eminence to the old-time glories of Freiberg, in Saxony, has not yet been developed. Yale is strategically so situated that she has as good a chance at attaining this goal as any other. With neither too much city nor too much isolation (and either extreme probably militates against the maximum development of the ideal mining school), with the stimulating and leavening influences of a great cultural center at hand to assist in fostering intellectual and social growth, the stage is favorably set for the entrance of the personalities who might build up a mining school of national eminence.

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The Ethics of Ordering Supplies

A FIRM manufacturing chemicals and chemical apparatus sends a circular letter to engineers as follows:

"You no doubt have a great many people on the list for whom you are constructing a plant and perhaps adding thereto, so that they perhaps might ask you to order what equipment is necessary for the chemical or physical laboratory.

"Any orders that you may be in a position to divert in our way, we will be very glad to accept and *will allow you a commission of 5 per cent.* If you will take it up with the parties and have them send us a list, we will be very glad to make them our very best prices, instead of our going after it, we will allow you for the information 5 per cent commission in lieu of our going after the business."

The ethics of the mining engineering profession have not been thoroughly formulated; but one thing is established and clear, and generally agreed upon: that it is unethical for an engineer to accept a commission upon supplies which he orders for his client. The firm in question should be aware of this, and that it is no recommendation for it to address communications to engineers, offering them a cash inducement to turn the money of their principal in its direction. An engineer is not a broker, a middleman, a scalper, or a commission merchant; he is a professional man, whose job is to protect his client and see that his money is spent with the merchant who will give him the most for it, in quantity, quality, and valuable service. For any of that money to stick to his fingers would be for him an underhanded and dishonorable thing. Whatever he earns is a matter of open and fair agreement between him and his client, as between gentlemen. Therefore, it does not nurse kindly feelings in the breast of a mining engineer to receive a letter of this sort, for his first reaction is that of being personally affronted. When he studies the letter, however, and detects the disguised marks of a circular letter, he realizes with relief that he has not been singled out for such an unethical proposition. Nevertheless, so far as he is concerned, the standing of the firm suffers, and it is quite unlikely that it will be favored either with protestations or with orders.

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The Genoa Conference

THE GENOA CONFERENCE is of a different type from that held in Washington. The latter put a stop to the race for war preparation, for the common good of the world; that at Genoa subordinates the common good of Europe to the sharp bargaining of nations for their own commercial preferment. To understand the Genoa conference, it is only necessary to observe four factors—France, England, Russia, and Germany. England and Germany, great manufacturing nations, with the need of raw materials and markets, are in so far comparable; they have been engaged in a race as to which shall first exploit Russia. France, a relatively self-contained agricultural country, is in another class. She is interested first and foremost in the German indemnity, which to England is decidedly secondary. The Russian government, unscrupulous and sharp, plays Germany against England, with the ultimate object, openly avowed, of undermining all governments.

The Lenine government is violent and fanatic. "It is a case of communism against capitalism," state the Bolshevist envoys, and as an example of their anti-capitalistic views, they demand capital to the extent of some billions in gold, as a loan! Germany scores with a separate agreement with Russia; but next a great British petroleum company undertakes to make a commercial treaty with the Soviet government, to go in partnership with it in the exploitation of the immense petroleum wealth of Russia.

Principles? They are forgotten in the commercial urge—the rush for wealth. The utter lack of any record for truth, decency, morality, or honesty, or any pretense to it, on the part of the Soviet government, is overlooked by those thinking to enrich themselves by trafficking with it. There is no world-statesmanship at Genoa. There was in Washington.

The United States was wise in abstaining from this conference. She is not ready to treat the Lenine government, foe to every principle of liberty and democracy for which she herself stands, as a crony; she is not ready to forget the standards upon which her institutions were founded, for the opportunity to traffic with a treacherous highwayman. Samuel Gompers has well expressed it: "I can think of nothing that would constitute a more needless and base betrayal of civilization than American recognition of Bolshevist tyranny."

The Front View and the Back

THE Logan (Kan.) *Republican* is a versatile sheet. In a recent issue, we find, in the middle of the first page front, flanked on either side by an advertisement of church revival services, much wisdom as to the ravages of the fraudulent stock-selling sharks.

"Modern highwaymen," it says, "operating as salesmen of fraudulent stocks, appear to have had a rich harvest in this depressed country, and promoters of get-rich-quick schemes have had no occasion to complain of hard times. Scarcely a city of any size has escaped, while many sequestered villages inhabited by retired farmers have been victimized; and the largest harvest of all have been reaped from the prosperous farming districts of the Middle West.

"The conventional reaction is to feel righteous indignation against the stock sharks. Certainly they are a despicable tribe, wholly outside even that criminal class whose boldness and adventure sometimes compel admiration. The old highwayman took a risk; the real robber stakes his life and liberty; these thieves of old men's savings and widows' insurance moneys are not in that class at all." And so on, for two columns—good strong language. This is copied from an article by Henry Ford in the Dearborn *Independent*.

But if we reverse the paper (the Logan *Republican*), we find in the middle of the back page, a full-length advertisement of the Colorado-Utah Mines Holding Co., of which Chas. E. Havener is president. This advertisement contains the following gem:

"Government statistics show the following returns on capital invested: railroads, 3 per cent; national banks, 6¼ per cent; insurance, 11 per cent; lumbering, 14 per cent; manufacturing, 14; and mining, 182 per cent."

The farmer readers of the Logan *Republican* are further informed that "only 36 per cent of all legitimate mining fails, against 54 per cent in all other commercial lines of business."

We gather from the advertisement that the company owns a mine of hematite in Utah (Willard Iron Mountain); and a very advantageous contract to furnish this ore is published, made with the Mineral, Metal & By-Products Co., of Denver, "whose President is Dr. Charles H. Gage, one of the leading Metallurgical Experts of this country." Dr. Gage quotes the Utah company $61 to $65 per ton, f.o.b. mines, for its hematite. "We find that this is a very desirable ore for the manufacture of soil pipe and machine-tool steel which we will produce in our electric furnaces." Dr. Gage further finds that "your iron ore will have a value of $100 a ton, f.o.b. the mines, for the special purpose of manufacturing ferrosilicon." "These prices do not include the values of rare and precious metals such as gold, silver, titanium, nickel, platinum, or copper values which are contained in your Utah property, all of which will be settled for at the prevailing prices at the reduction works."

As an afterthought Mr. Havener sticks in the news paragraphs this advertisement: "The Arizona Co., with over 16,000,000 tons of surveyed 2 per cent copper ore, is now part of our Holding Co."

The Logan *Republican* is thus a Dr. Jekyll and Mr. Hyde. The doings at the churches and the wise warnings of Mr. Ford against buying worthless stock occupy the front page, while it sells its back page for questionable stock-selling purposes.

Yet in some of our mining communities there is an element which opposes all and every form of "blue-sky" legislation, which is designed to prevent just this form of fraudulent stock promotion. Their plea is that such restriction interferes with business. What kind of business have they in mind? Do they want to be confused with the business-getter who preys on the unwise investor?

The Nickel Affair

STRANGE the ramifications of the nickel industry! In Norway they have been having a time in the press and in the Storthing over events connected with the participation of Norwegian capital in the financing of the war-baby British America Nickel Corporation, whose property is in the Sudbury district, Ontario. A Norwegian bank has liquidated as an outcome, it is said, of the Kristianssand Nickel Refining Co.'s association with the Canadian project. Left-handed compliments have flown and charges of official corruption have been made. The government at Kristiania has made an inquiry, and the wolves may yet get the guilty ones, if there be such, it is said. The presence of twenty-nine Communist and eight Socialist members may well render difficult any possible whitewashing.

Do Your Ordering Early

FOR SOME WEEKS preceding the Christmas shopping season the Post Office, the local merchants, and others who anticipate a special rush of business at that time admonish us to do our shopping early.

On each Monday previous to the publication of the following Saturday's issue of the *Engineering and Mining Journal-Press*, it is necessary for us to specify the number of copies that will be required to take care of the circulation for that week.

The number of copies needed for subscribers is furnished us by the Circulation Department, copies for the advertisers by the Advertising Department, and we of the Editorial Department add the number which has been asked for by our contributors or others interested in that particular issue. A certain allowance above that total is made for possible contingencies, but this is kept at a minimum, for obvious reasons.

A notice is sent to our contributors immediately upon the acceptance of an article, and included with this is a request to the effect that those desiring extra copies should notify us at once, so that they may be arranged for. The reason is obvious.

The story is told of a man who continued to smoke in a public building, although a sign in a conspicuous place stated that such was prohibited. When he was taken to task by an official he replied that the sign did not state "no smoking—posi*tive*ly," so therefore, he thought that it was all right to smoke.

Will it be necessary for us to make a similar addition to our notice?

An Industrial Experiment

By T. A. Rickard

On another page of this issue I review a book on the labor problem by Mr. John Graham Brooks. Among the interesting matters discussed by him is the proposal that was made by Haywood, Moyer, and other anarchists, posing as socialists, to buy a mine and run it in the interest of the I. W. W. The idea was to raise capital for the purchase by assessments, and to use the profit for union purposes. It is a great pity that the scheme was not carried out, for it might have been a useful object lesson to all concerned, including the public. It would have been proved, I feel confident, that the so-called practical knowledge of mining possessed by these misleaders of labor was entirely insufficient to bring a mine to economic fruition, and it may be that their deluded followers might have discovered that brawn and brains have something in common, and that they fare best when working together amicably. In our country, if in no other, the attempt to develop class consciousness and even to establish castes in the community is not only highly regrettable but, let us hope, futile, because any such attitude of mind is repugnant to the democratic ideal.

Mr. Brooks, in his book, does not discuss an interesting experiment that is now being made in Kansas: I refer to the Industrial Court. The State of Kansas is a prairie region dependent for its power and heat upon three coal-producing counties in which 705 strikes were recorded in four years. These repeated interruptions to the prosperity and comfort of the community prompted the Governor, Mr. Henry J. Allen, and a Judge, Mr. W. L. Huggins, to recognize the basic fact that industry is "affected with a public interest", and therefore that strikes and lock-outs should be subordinated to that interest for the sake of the commonweal. This idea, that the community has the right to insist upon the settlement of such controversies in accordance with principles of justice, is as old as the common law of the English-speaking peoples; it is an idea that has been pushed into the background too long, and it is well that it should be re-asserted in the face of the vendetta waged so recklessly by the irreconcilable and irresponsible leaders on the two sides of Capital and Labor. For the purpose of establishing the public right to inquire and determine, the State has constituted a court of three persons to whom has been given the power to issue summons to compel attendance of the parties in conflict, to demand the production of accounts and correspondence, to employ investigators, and to hold public hearings. The Industrial Court may act upon its own initiative, on complaint of either party, upon petition of any ten citizens of the district affected; it may act upon complaint of the Attorney General or upon agreement of the parties to refer their quarrel, but only when it is apparent that employers and employees are unable to agree, and when the controversy appears likely to endanger the continuity or efficiency of public service or public health, or cause such industrial strife as will affect the production or transportation of necessaries. There is no overt interference with the right of collective bargaining, which right is specifically recognized, and any judgment rendered by the Court stands only until the parties reach an agreement, when, upon approval of the Court, such agreement supersedes its decision. The danger of becoming autocratic in its dealings with disputants in an industrial quarrel has been avoided, so far, by the Court. It aims to be administrative rather than judicial: to promote industrial peace by facilitating conferences between employers and employees.

The Kansas law prohibits strikes and lock-outs, boycotts and intimidation, but it is supposed to guarantee to every worker the right to stop work when he pleases, to choose his employment, and to make reasonable contracts, to bargain collectively and to organize with his fellows for the purpose of such bargaining. There has been, and there will be, difficulty in reconciling the right to stop work with the ban on strikes. Under the Kansas Industrial Act it is unlawful for any two or more persons to conspire or federate together, or to injure any other persons by means of a strike or boycott, with the purpose of hindering, delaying, or interfering with operations covered by the provisions of the Act. The Supreme Court of the State has modified the rigidity of this enactment so far as to hold that workmen may consult together in order to determine among themselves whether or not it be to their common interest that all of them shall exercise the individual right to quit work at any time, but the line is drawn at such action being taken on the order of the officers of an organization. The Act requires a hearing and an investigation of every controversy without the interposing of a strike or lock-out. It may prove difficult to distinguish voluntary abstention from quitting under order of an organization, but the idea of regarding strikes and lock-outs as contrary to public welfare is one that must be affirmed; such methods are justified only in the last resort, after every other method has failed. The right to strike on the part of the employees or the right to dismiss his workers on the part of an employer has been regarded as inalienable, but the right of the community as a whole to prevent the abuse of the rights of its component elements is even less assailable. Civilization exists only by grace of the concessions made by the individual for the sake of the community. The strike and lock-out are inheritances from the jungle, as is a fist-fight on the street or a duel in the park.

Appeal can be made from the Industrial Court to the Supreme Court of the State, and, strange to say, the latter has been liberal in its interpretation of the Act under which the Industrial Court functions. The main feature of the Industrial Court is that it represents the third party in interest—the community as a whole—and provides means for saving that party from being the helpless victim of quarrels between the two parties that represent capital and labor in the complex processes of modern industry. It gives means for ensuring delay, investigation, and discussion, all of which are needed before public opinion can become intelligent, and therefore effective.

DISCUSSION

Financial Economies Needed in Latin America

Governmental Expenses in the Countries of the Region Require Reduction Unless Higher Taxes or Increased Export Duties Are Forthcoming

THE EDITOR:

Sir—Probably there is no reader of the *Engineering and Mining Journal-Press* in 1922 who is not in some way affected by the problem of foreign exchange and finance. This matter is a daily reality in the Latin-American republics, which are sources of raw materials, and it may be said that the depression in business existing there is connected with that of the European consuming countries, although the present ratio between paper currencies in South America and their par value is higher than that for European paper.

The combined volume of South American export and import commerce has lately touched markedly low figures, though there is hope that at least no worse conditions will be reached hereafter. This slender quantity of business permits dangerous fluctuations in exchange on New York and Europe by the negotiations of relatively small sums, whereas when South American exports were flourishing the sale of small drafts on New York produced no noticeable effect on rates. Now exchange is exceedingly sensitive, with exportation almost stagnant.

Such conditions opened the way in 1921 to the floating of American gold loans for the Latin-American republics and now induce reflections as to their final effect on mining enterprise and on the mutual relations between the United States and the borrowing countries.

It is commonly known that twelve loans, totaling almost $200,000,000 in United States currency, were floated last year in New York for various Latin-American countries and cities. Naturally, these bonds bear coupons payable in United States gold, at the rates ruling in 1921—usually 8 per cent for such obligations—though the bonds doubtless netted the governments interested considerably less than par, as most were offered to the investing public to net more than the nominal coupon rate. (See any bond-house circular at time of issue.)

Under the circumstances it is fair to assume that the net proceeds of such loans ranged from 95 per cent of the face value downward, and the coupons therefore represent to the borrowing governments from 8 to 10 per cent interest.

The final destination of such loan funds cannot be ascertained exactly, but it is safe to say that, in general, these funds represent the inability or the unwillingness of the South American governments to live within their present incomes, after having passed through the era of extravagance and high-living while they were supplying raw materials to the world during the Great War.

It will be claimed that these loans are for rehabilitation of railways and other similar projects, but apologists for the borrowing governments are mute upon the subject of large military and naval establishments, government owned and operated railway systems, heavily staffed civil services, and so on, all of which form the basis of large potential economies if only there existed the will to carry them into effect.

The situation produced by these large loans to the Latin-American states from the financial resources of the United States is of great significance henceforth to mining and commercial interests operating in South America.

Primarily, it is to be hoped that South America will use these loans to put her house in order, while reducing budgets, so that, when the cash proceeds of the loans have been spent, internal resources will meet future needs.

If this elementary step is not taken, the semi-annual interest payable abroad in gold will be found to be a dead weight upon the recovery of the paper currencies in South America. The effects of low exchange rates are always harmful to the population of the country so affected, although the exporter of mine or farm products is favored by the resulting reduction in his labor cost.

It is hardly conceivable that former sources of taxation will balance the South American budgets in an era of depression, and as adequate voluntary economies in government appear to be unlikely in such event, it is almost certain that new taxes are to be provided, probably consisting of a tax on real-estate holdings, a tax on income, and further export duties laid upon commodities and products heretofore exempt.

Taxation on land will be fought bitterly by the wealthy land owners who form the bulk of the governing element in South America, but it is a step that cannot be long delayed; nor the income tax, either, as the "peon" laboring element is already heavily taxed indirectly by the progressive depreciation of the paper currencies, and should be relieved rather than burdened still further.

Adverting to the mineral industry, it seems likely that exporters of metals and minerals of economic importance will find new, or increased, export duties laid on their production in the not distant future. Certainly export duties cannot be opposed as unjust unless they become too burdensome, or, as with sodium nitrate, there is an exaction of 25 to 30 per cent of the value of the world's fertilizer.

Nevertheless, assuming insufficient public economies and only a slow revival of commerce, the paper currencies south of Panama will recover only slowly, and interest on foreign gold loans will compel new taxes.

For example, since nitrate export duties in Chile have shrunk so alarmingly in 1921, the introduction of export duties on copper, to relieve the deficit in part, becomes generally anticipated.

It is a matter for reflection to consider what would have happened in South America in 1921 had no loans been obtainable, and, furthermore, just what fundamental change has been produced by these loans in the relations of the United States with the Latin-American republics which so desperately needed them.

Evidently, our position has been altered from that of the friendly "elder brother"—an interceder in family disputes, and protector against assaults on republican forms of government—to that of the business counsel with a recognized interest in the proper administration of the public affairs of South America.

Giving us at once a plainly legal and honorable stake in the Southern continent should bring about closer relations, and our footing will approximate the financial significance attaching to previous loans by European countries.

As it is well known that export duties on nitrate have provided the bulk of the state revenue in Chile in the past, it is interesting to observe the actual sums obtained thereby or obtainable hereafter.

The duty on nitrate has been set at 2s. 4d. per quintal of 101.4 lb. and this represents from 51c. in United States currency to 57c., depending upon the fluctuation of the pound sterling. During the war a maximum production of about 60,000,000 quintals per year was obtained, due to high prices and an unlimited market, but it was admittedly an abnormal production and not considered possible of repetition at this time. An assured exportation of 40,000,000 quintals per year at this time would be viewed gladly by the nitrate maker.

If we may assume exportation of 40,000,000 quintals per year as a basis, without evoking discussion of the future in store for Chilean nitrate, we may estimate a gross revenue from nitrate of $20,000,000 to $22,500,000 United States money, depending upon sterling exchange rates. For every million quintals less than 40,000,000 per year, deduct about $550,000 from the above-noted revenue sums.

When there is subtracted from this hypothetical future revenue, derivable from nitrate duties, the sum of $22,000,000 in United States money—due annually on the heavy borrowings made by Chile abroad—it is a legitimate cause for wonder as to where an equal additional revenue can be raised in Chile to carry on the existing governmental services, which in the past have consumed all the revenue obtainable from nitrate as well as from other sources.

Two courses are open—either retrenchment or imposition of further taxation to fill the voids in the budget.

Additional loans under the circumstances are as little to be advised as would be the issue of inconvertible paper money which is ruining some European currencies.

Any economically possible export tax on copper could not, for some time to come, go far toward providing for the service of the Chilean debt.

During a stagnant or weak nitrate market there is a corresponding diminishing return from the associated branches of industry dependent on nitrate—one of which is dividends, and hence taxable incomes—so that a probable result will be that every promising source of revenue must be levied upon to meet heavy foreign obligations, including land tax, income tax, and a further extension of export taxes on copper.

Substantial disarmament would be of the greatest help to Chile and to other South American countries.

Guayaquil, Ecuador. DONALD F. IRVIN.

Neglected Opportunities

THE EDITOR:

Sir—If the wails of disgruntled mining engineers, as evidenced in the technical press of the United States during the last year, are as true as they appear at first glance, we of less prominence in the profession are going to have a tough time "making her pay." It is my opinion, however, that there are "neglected opportunities" which concern us as a body.

Mining rightly conducted is an ancient art, a basic industry, by which new wealth is won from the earth and turned into the channels of trade. If we all quit and "let George do it," can we be dispensed with?

Our business is suffering from two diseases: one, the reaction of the World War, from which we are receiving no greater setback than other businesses and concerning which we can only be patient; and the other, our joint shame, the "parasites of our industry." These glib individuals, called mining promoters and mining men, each year in increasing numbers turn vast sums of the public wealth available for the industry into their own pockets and into illegitimate operations (principally precious metals and oil), where the money through bad judgment is generally dissipated in impossible endeavors. By lies and chicanery, exaggeration and misrepresentation, and with the aid of the press of the country, this process has grown to such an extent that the industry is looked upon with suspicion by the layman, and the term "mining" has nothing but regrets for the majority of people.

Are not most of us too bashful, too unbusinesslike, not aggressive enough, or jealous enough of our calling, to allow such parasites to take away from us work which we are able to do efficiently? Does a sick man go to a lawyer, or a man in the meshes of the law to a doctor? No. They know better. Yet Mr. Public generally listens to the promoter and forgets that mining engineers exist to advise him, which is the fault of the mining engineers themselves.

There is a lot of work to be done all around us if we can jointly impress upon the mining investor that we are in this business, at his service, can advise him of his hazards and his chances, and tell him truthfully and fearlessly each set of conditions as they exist. A lot of this work may be negative at first and turn money back into the pockets of the prospective investors. However, if hazards are explained and Mr. Investor is guided in his endeavors he will come back again where the risk justifies the investment, and his money in the end will help produce new wealth and be a benefit to all dependents on the mining industry.

I know of three laymen who have aggregate losses this year of $40,000 because they wanted to interest themselves in mining and did not think it necessary to employ a mining engineer to advise them. They were about as successful as you or I would be if we accepted the other fellow's terms of a contract drawn by his attorney without consulting an attorney ourselves. These parties are disgusted with mining, and the money is lost for legitimate development work.

If each and every mining engineer will make it his business to seek out three such individuals—an easy thing to do anywhere in the world—and sagely advise them that mining engineers should be consulted on mining investments, all would eventually benefit, the industry, the public and ourselves.

San Francisco, Cal. ROBERT J. BURGESS.

Dredge and Power-Plant Construction in the Far East

Equipment Purchased in United States, Modeled on California Gold Practice, a Success in Dredging for Stream Tin in Malay States—Difficulties of Transportation and Installation Solved

By P. R. Parker

DREDGING FOR TIN has been successfully carried on in the Malay States for many years. This work has in most instances followed the primitive though extensive mining by Chinese of the tin placers of that country. Most of these tin-dredging companies are of Australian origin, and without exception all of the dredges are of light construction and are driven by steam engines.

In 1913, a new Australian tin-dredging company was incorporated as the "Tin Bentong No Liability." This company had acquired some tin-placer ground near Bentong, in the State of Pahang, Federated Malay States, and intended to work this ground with a new Australian dredge. The directors of this company were unusually progressive, and as two of them, Mr. Peacock and Mr. Palferyman, had to make a trip to California in 1914 on other matters, they decided to investigate the gold dredging there to see if some of the developments in that industry might not be applied to advantage in tin dredging in the Malay States. They found that the most radical improvement in the California dredges was the electric drive. The California dredges were also heavier and made of special alloy steels where parts were subjected to severe stresses and wear. These points of advantage so impressed these men that they decided to buy a California, electrically operated dredge, modified to provide for sluices or tables that had been especially designed for saving tin instead of gold. It was also necessary to determine the type of power plant best suited to the conditions to be met. An investigation of the streams about Bentong developed the fact that about 1,500 hp. could be generated on the Perting River, near by. This power site made it possible to obtain a drop of 450 ft. with a pipe line about 4,000 ft. long.

Main Street, Bentong

In July, 1915, a contract was placed with the Bucyrus Co., of Wisconsin, for an electrically driven dredge with 7-cu.ft. buckets and a steel hull. A few months later contracts were placed with the General Electric Co. for a 1,000 kva. generator and electrical equipment for the power house; with the Pelton Water Wheel Co., of San Francisco, for a 1,200-hp. duplex-nozzle tangential water wheel, complete with shaft for mounting the generator armature; and with the Western Pipe & Steel Co. for the steel, cut to size and punched ready for rolling, for the power-plant pipe line.

It was foreseen that one of the principal difficulties in the final erection of this dredge and power plant would be its transportation from the sea at Port Swettenham to the site of erection. There is a meter-gage railroad from this port twenty-six miles to Kuala Lumpur, the capital of the Federated Malay States. From Kuala Lumpur to Bentong is fifty miles by wagon road. This narrow road winds up over a mountain pass about 2,000 ft. high, from the State of Selangor into the State of Pahang, and then down the northeastern side of the range to Bentong. The grade is not more than 5 or 6 per cent, but most of the way the road is cut into the rough mountain side and is exceedingly crooked, the turns being so sharp that a motor car has to round them slowly. The center of the road is well paved with broken stone, but this pavement is so narrow that two vehicles cannot pass each other on the paved ground.

To meet these conditions, special trucks were required to transport the machinery over this road. For this purpose two electrically driven trucks were purchased from the Couple Gear Co., of Grand Rapids, Mich. Each of these trucks carried a direct-current generator driven by a four-cylinder gas engine. The current from the generator was used to drive motors in each of the four separate wheels. The four wheels were also used to steer the trucks, and the rear wheels, when turning sharp curves, followed the tracks of the front wheels.

To carry the larger pieces, two trailers were purchased. One trailer consisted of a long truck body with a pair of large steel wheels at the rear end, with the forward end arranged to be mounted on a turntable at the center of either one of the electric trucks. The other trailer had four steel wheels and a swivel bolster mounted in the center.

Unsuccessful attempts were then made to secure space on various steamers which were to sail about the time this equipment would be ready. It happened at that time that the small freight steamer "Manila" (captured by Admiral Dewey in the Spanish war) was for sale in San Francisco and that this vessel was just large enough to carry the entire shipment. It was finally decided to

Transporting spud casing for dredge

purchase it after arrangements had been made for the resale of the vessel later in Shanghai.

The United States shipping laws made it expensive to operate this vessel under the American flag, and as most of the European nations were at war, the "Manila" was finally registered under the Chilean flag.

All of the machinery and equipment for the dredge and power plant were assembled in San Francisco during the latter part of February, 1916, and the S.S. "Manila" was loaded and sailed on March 6, 1916.

I had been employed in July, 1915, as general manager of the Tin Bentong No Liability, and after spending several months at the works of the Bucyrus Co. during the final designing of the dredge, sailed with Mrs. Parker on Dec. 31, 1915, for Singapore, arriving there the end of January, 1916. From Singapore we sailed to Port Swettenham, a night's trip up the west coast of the Malay Peninsula, and were surprised to find a well-equipped shipping port, with steel docks, steel lighters and steam cranes for handling heavy pieces of freight, steel warehouses, and a well-planned arrangement of steam railroad tracks. All worries over the expected difficulties of unloading the "Manila's" cargo were therefore dispelled.

THE JOURNEY TO KUALA LUMPUR

We took the train at Port Swettenham and traveled through rubber plantations and stretches of jungle, which seemed fast giving way to the planting of more rubber, now and then passing a small town with its Indian, Malay, and Chinese inhabitants and its brick shop houses and thatched huts, until we had covered the twenty-six miles to Kuala Lumpur.

Kuala Lumpur is a beautiful city, with a picturesque arrangement of government buildings of Moorish architecture and built of brick, good stores of both native and European wares and supplies, well-kept parks, club houses, and athletic fields. The city is situated at the confluence of two rivers, and its name means "Muddy Mouth," for one of these rivers is extremely turbid. At the fork of the two rivers is a splendid Mohammedan mosque, and across the river not far from the mosque is a Christian church. In fact, Christians, Mohammedans, Buddists, Brahmans, and followers of Confucius are here intermingled on the streets, in banks, in stores, in government buildings, and in almost every place except in private homes.

The principal products of the land are rubber, tin, and coconuts, but the trade in Kuala Lumpur includes all things needed in the lives of the various people and by their different methods of cultivation and mining.

There are a number of iron foundries, machine shops, and structural shops in Kuala Lumpur, some operated by Orientals and others by Europeans. We later found these shops well able to do many classes of work, and they served us well in making repairs for our machinery and even in making new parts for the head works of our hydro-electric plant. Bentong is a smaller city, but it is the seat of government for an extensive and important section. A good government hospital is maintained there. The power site which we were to develop was situated on the Perting River about five miles from Bentong, and the dam and intake were one mile further upstream. A good wagon road ran from Bentong two and one-quarter miles in the general direction of the power site, but the rest of the way was over jungle trails on steep and, in places, rocky hillsides. We investigated the feasibility of transporting our pipe line and power-house material through the jungle on elephants, but were convinced that this was impracticable and that the road ought to be built even if we had to do the work. We finally contracted with the government to build two and one-half miles of this road for not to exceed $12,000, work to be done at the following rates:

Cutting and clearing jungle, 1 chain wide, per chain	$1.12
Earth excavation, per cubic yard	.112
Earth fill or banking, per cubic yard	.123
Rock excavation, per cubic yard	.669
Side drains, per chain	.56
Dry rubble wall, per cubic yard	2.24
Concrete culverts and similar work, per cubic yard	11.20

The average pay for first-class Chinese general labor was 56c. per day. Only Chinese labor was used on this road contract. All of the above figures have been reduced to gold dollars, as are all the cost figures given herein. One hundred dollars Straits was at that time equal to 55.75 dollars gold.

The road crossed many small mountain streams requiring stone or concrete culverts. Large granite boulders and ledges were often encountered, for the road was laid out on grades not exceeding 4 per cent, and the hills were steep and rugged. Heavy, dry rubble retaining walls were sometimes necessary to hold the road in place. In fact, the road resembled the roadbed of a heavy single-track narrow-gage railroad, but it illustrated the substantial way in which the Public Works Department of the Federated Malay States carried out its work.

The road work was divided among six Chinese contractors, and the company supplied them with power and fuse for blasting and even helped them to finance their contracts. This plan worked well, and most of the contractors did all that was expected of them. However, some of them gave trouble and had to be replaced by better men.

A private road was built from our power house, following about a 15 per cent grade most of the way up to the new government road, a distance of nearly half a mile.

The section of the Perting River used for the power development has a drop of a little over 450 ft. in about a mile, but by a survey it was found that a pipe line only 4,000 ft. long would connect the intake with the power house. The river usually carried about 100 or 150 sec.-ft. of water, but in flood the flow increased to about 4,000 or 5,000 sec.-ft. Owing to the steep hills and heavy rainfall, these floods would occur suddenly and would almost as suddenly subside. It was found impracticable when constructing the diverting dam to build the protecting wing dams and bulkheads strong enough to withstand these floods, and these temporary works had to be rebuilt several times. The average annual rainfall for the previous ten years in Bentong was 93 in., and in the surrounding hills considerably more.

Above the power site, many small hydraulic tin mines dumped their tailings into the river, until the stream was forced to carry great quantities of sand and gravel. The settling of this material and its removal from the water before it reached the power house proved to be the greatest problem. To overcome this trouble it was decided to build a settling basin about 1,000 ft. from the dam, 12 ft. deep and of irregular shape to suit the ground but equivalent to about 50 ft. square. The basin was divided into two parts by a skimming-wall 60 ft. long, rising to within 6 in. of the surface of the water. Thus most of the heavy sand was caught in the first compartment, and the finer and lighter sediment was deposited in the second one.

The power plant required not more than 30 cu.ft. of water, and as there was always much more than this in the river, and as there was a 36-in. pipe from the dam to the settling basin, with a 9 ft. minimum difference in elevation of water surfaces, water could be wasted either at the settling basin or from the 36-in. pipe leading to it. Owing to the low velocity in this pipe, a lot of coarse sand and gravel settled to the bottom. To take advantage of this settling, and of the fact that water could be wasted from this pipe, holes 24 in. square were cut in the bottom of the pipe at two points along its length, and over these openings were bolted hopper-shaped iron castings which tapered from the 24-in. square openings at the top to 6 in. diameter, flanged openings about 18 in. below the pipe. To these 6-in. openings, 4-in. flanged nozzles were bolted, which were allowed to run continuously. A great deal of sand and gravel was in this way removed from the water, which added somewhat to the efficiency of the settling basin.

For the diverting dam, 300 bbl. of cement was purchased in Kuala Lumpur at $3.25 per bbl. and hauled fifty-two miles by bullock carts through Bentong to the end of the wagon road, for $1.87 per bbl. It was carried the last three and one-half miles to the dam over jungle trails by Chinese coolies for $2.36 per bbl., making the cost per barrel of this cement, delivered at the dam, $7.48.

After the wagon road had been extended to the power-house site, so that the cement was carried by coolies only three-quarters of a mile to the dam, the total cost of transportation from Kuala Lumpur was reduced from $4.23 to $2.60 per bbl.

The dam was a rubble masonry arch, 60 ft. long, 2½ ft. wide on top and about 10 ft. high, with a 5 x 6-ft. scour gate at one end, set 5 ft. deep in a channel blasted out of the granite ledge on which the dam was built. At the other end an intake chamber 10 ft. wide served to let the water into the pipe line.

On April 14, 1916, the dredge superintendent, Mr. Lepetit, and two American winchmen arrived from California. One of the winchmen brought with him his wife and little daughter, and they proved to be a great boon to the camp.

A site for building the dredge was selected at the extreme lower end of the dredging property, where a long pit had been excavated near the road by early Chinese miners. The bottom of this pit was leveled, and levees were thrown up across it about 200 ft. apart, so that when the dredge was floated by filling the pit with water it would have a suitable pond in which to start digging. Stocks on which to build the dredge were made by placing on end short sections of round logs obtained from clearing this part of the dredging ground.

On May 24, 1916, the "Manila" arrived at Port Swettenham, and her cargo was transferred without difficulty to the narrow-gage railroad, which carried it to the freight yards at Pudu on the outskirts of Kuala Lumpur. The hauling to Bentong by the two electric motor trucks was promptly begun. The trucks were run day and night, with three Malay drivers for each truck. It was found that much of the material could be transported more economically on bullock carts, and as there seemed to be no limit to the number available, no time was lost in making use of them. Each cart was capable of carrying 2,000 lb., and by selecting carts drawn by strong bullocks, this average weight was maintained. The cost was $8.40 per bullock cartload, and each cart made the fifty-mile trip to Bentong in from three to four days.

The total weight of equipment and cement was about 1,100 tons, of which 450 tons were hauled by the trucks at $31 per ton and 650 tons by bullock carts at $10 per ton, making the total cost of the hauling from Kuala Lumpur to Bentong $20,450. These costs include direct supervision and the expenses pertaining to the headquarters maintained at Pudu, but they do not include the cost of the trucks.

The trucks had to haul all the large and heavy parts that the bullock carts could not carry, including the eleven-ton dredge spuds, which were 40 ft. long and for

Settling basin completed and filled with water which a hand-steering gear had to be rigged on the four-wheeled trailer, to negotiate the sharp turns on the mountain road, much as a long piece of city fire apparatus is handled around street corners.

If the trucks had transported all our equipment, the cost per ton would probably not have exceeded $25, but the total hauling would have cost more and taken twice as long, and the construction of our dredge and power plant therefore would have been delayed accordingly.

Power house and Perting River

The dredge was constructed under Mr. Lepetit's direct supervision, but we arranged with a Chinese contractor to supply coolies for 50c. per day and to do all the riveting.

To house these Chinese coolies and mechanics, necessary for the construction of the dredge, we built two large camp buildings called "kongsies," made of split bamboo and thatched with palms. These, with their accompanying cook-houses, cost $445.

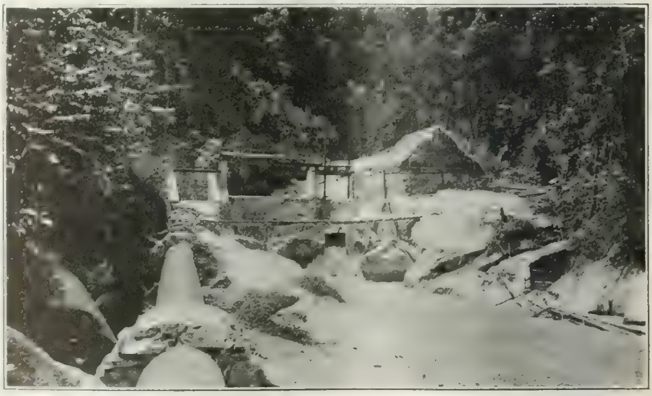
In determining each day the amount due for dredge construction labor, the number of coolies was counted and the figure was agreed upon with the Chinese contractor. The Chinese mechanics were paid individually. The contractor was compelled by law to post in each kongsi a record of the amount earned each day by every coolie. Thus, disputes regarding the amount of time worked by any coolie were not delayed until pay day, but were settled promptly.

It was impossible for the California winchmen, who assisted Mr. Lepetit, to learn and remember the names of even the coolies who were doing more or less special work. They, therefore, gave them names that happened to suit their fancy, or perhaps to describe the coolies. These names were more or less as follows: Shorty, Slim, Smilie, Bill, Jim, Pop, Jack Johnson, and so forth. The coolies soon learned these names, and referred to one another by them when speaking to the Americans. The common language used by all Europeans in talking to the Chinese or Indians, and of course to the Malays, is that of the Malays. The language consists merely of a vocabulary, and as the words do not change in form no matter how they are used, the language is easy to pick up.

The work of the Chinese mechanics, both in amount done per hour and in quality, compares favorably with the work of American and European mechanics. The Chinese riveters were inclined to slight their work, as do many piece workers, until they learned that we would not accept any loose or imperfect rivets and that we made them cut out all such rivets and redrive them. When this was thoroughly understood, we had no more trouble with these men. In fact, the entire work of the erection of the dredge went along smoothly until completion. This was attributable in a large measure to the efficient superintendents, but partly to the good work and sense of fair play of the Chinese coolies and mechanics.

The steel plates for the power-plant pipe line were cut to size and punched in San Francisco, but were shipped flat so as to save space. To roll these pipes a set of power rolls was made in a Chinese foundry and machine shop in Kuala Lumpur and set up near our dredge. The rolls were driven by a gas engine. These rolls were not strong enough to shape the ¼- and 5/16-in. plates used for the 30-in. pipe forming the penstock. These plates, therefore, had to be rolled by a European machine shop in Kuala Lumpur.

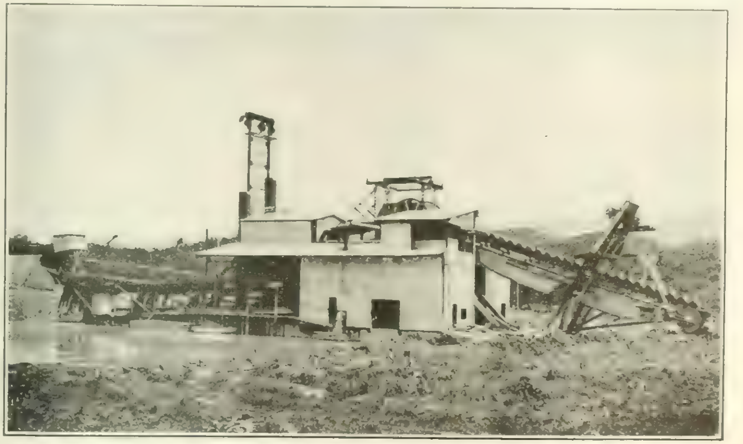
The entire pipe line was riveted together, and the expansion and contraction when the pipe was empty, caused by the great change in the heat between day and night, was taken care of by allowing the pipe to move at each bend. The pipe line was firmly anchored between these bends by large concrete blocks, to which the pipe was firmly fastened by steel straps and anchor bolts.



Dam and intake for power line

The distance from the power house to the dredge along the most practical route for a power line was about four and one-half miles, most of this line being through heavy jungle and part of the way over steep hills. This line was originally surveyed by Europeans, but careful study of the ground made it advisable to change the line somewhat. This work was slow and difficult, because of the thick growth of large trees and vines through which it was necessary to brush out each line that was surveyed. This work was done by Malays under the direct supervision of an intelligent Malay foreman, who was capable of running lines by compass and making maps of this work. We were fortunate in being able to secure native men to handle technical work of this kind.

The contract for clearing the jungle for a width of one chain along the power line was given to a Chinaman for $8.35 per acre. This included cutting any large trees which stood near enough to fall across the power line. After this clearing was done, a contract was given to another Chinaman for building a foot-path 5 ft. wide along this line, for $2 per chain. When this work was completed, the actual construction of the line was begun, and the contract was given for the digging of holes for the power poles at 85c. per hole. These holes were 6 ft. deep and 2 ft. in diameter. The poles were of hard wood, cut in the jungle as near as possible to the power line, and were 7 in. in diameter at the top and about 36 ft. long.


Electrically driven dredge as erected

The power was transmitted at 11,000 v. over No. 4 copper wire to a substation near the dredge, where the voltage was reduced to 2,200. The large motors on the dredge were for 2,200 v., but the smaller motors were for 220 and were supplied with current from the transformers on the dredge. The dredge motors were of the following horsepower:

Digging and ladder hoist machinery	150
Winch for swinging dredge and hoisting spuds	25
Revolving screen	35
Stacker	25
14-in. high-pressure pump	200
16-in. low-pressure pump	150
8-in. gravel pump	50
Total	635

The motor driving the 12-in. pump which supplied the dredge pond with water was of 75 hp. There was also a 5-hp. motor driving a 3½-in. pump supplying the tin shed with water. The total motor horsepower which was necessary to operate the dredge was, therefore, 715.

The company was fortunate in securing the services of Mr. Mudispacher, a Swiss engineer with several years' experience in the Malay States, to build the power house and power line and to operate the whole power plant. He was able to collect a number of Malays with some experience in this work, so that after the construction was completed, a cheap operating crew was at hand that was familiar with every detail of the plant.

When the power plant had been tested and inspected by the government engineer, the 12-in. motor-driven pump at the river was started and the dredge pit filled through the half mile of ditch which had been dug for this purpose. The dredge was floated into position to receive its bow gantry, then turned around, and the stacker and spuds were hoisted into place and their tackles completed. It was then turned around again, and the digging ladder and buckets were installed. All of this work was done by the use of the electrically driven winches on the dredge. This completed the whole equipment, and the dredge started digging in May, 1917.

DREDGE AND POWER-PLANT CONSTRUCTION COSTS

The cost of transportation and construction of the dredge and power plant, including the material purchased in the Malay States, but not including the cost of the equipment brought from America or the expense of the trip of the S.S. "Manila" is given in the table in this column, below the illustration.

The ground contained a large percentage of clay, which made it sticky. When the dredge buckets were filled to capacity they would not always dump, and after a few revolutions of the bucket line the buckets became so choked that they had to be dug out by hand. Consequently, it was found best to fill the buckets only a little more than half full, taking a light cut so that the material would not become packed in the buckets. The output of the dredge was thus kept down to not more than 70,000 cu.yd. per month, whereas its output would have been about 120,000 cu.yd. if the ground had been free from clay.

Power plant, including transportation from Bentong	$48,600
Dredge construction	27,400
Transportation, Kuala Lumpur to Bentong	20,450
Machine and blacksmith shops	270
Tin shed	940
Government road construction	13,300
Government road upkeep	640
Private road to power house	1,440
Water supply for dredge	1,360
General expenses	29,300
Total	$143,700

The operation of the dredge was the same as that of the gold dredges in California, except that the tin-saving equipment differed considerably from that required for saving gold. The fine material and tin, after passing through the holes in the revolving screen, was fed by a distributor to two decks of sluices, one about 6½ ft. above the other. There were eight longitudinal sluices in each deck, arranged symmetrically about the center line of the dredge. All of the sluices were 4 ft. wide. Those in the upper deck averaged 85 ft. long and over-

The dredge in operation

hung the stern 22 ft. The lower-deck sluices averaged 66 ft. long and overhung the stern 10 ft. The total area of these sluices was 4,832 sq.ft. The sluices were made of steel $\frac{1}{4}$ in. thick and had a slope of $\frac{1}{2}$ in. per foot. They were lined on the bottom by $1\frac{1}{2}$-in. hardwood planks, so that they would not be worn out by the chunkles, long hoe-like tools, with which the coolies continually stirred up the concentrate to permit the tin to settle and the lighter material to be carried off by the water. Every eight feet along the sluices 2-in. vertical angle irons were riveted to the sides to hold in place 2 x 3-in. wooden cross-stops used to retard the flow of material down the sluices. When the concentrate filled a section of a sluice, making it level with the top of a stop, another stop was placed on top of the first one until these barriers were built up three or four stops high, which usually took twenty-four hours.

METHOD OF OPERATING THE DREDGE

The dredge was shut down about two hours each day to clean the tables, and advantage was taken of this period to make minor repairs and adjustments. To clean the sluices, the stops were all taken up and a small stream of water was turned on. The concentrate was then worked back and forth with chunkles until this operation had reduced the concentrate to about 30 per cent tin ore, much in the way that a flume is steamed down to save gold, except that in the latter operation the riffles are taken up but a number of stops left in. The 30 per cent concentrate was put into buckets and carried to the tin shed, where it was further treated in short sluices and by hand sieves until it was reduced to about 98 per cent tin ore. It was then dried in special driers, sacked, and weighed.

METHOD OF MARKETING THE PRODUCT

The tin was sold, f.o.b. our shed, to the Tong Shoon Kongsi, in Bentong. This was a Chinese company owning a tin smelter in town and a number of mining properties in surrounding country, including most of the property leased by Tin Bentong No Liability.

The tin mineral, which is an oxide (SnO_2), free from black sand and other such material, was assumed to contain 75 per cent of metallic tin, for many assays gave an average of this value. Concentrate containing 98 per cent oxide therefore contained 73.5 per cent tin. If the price of tin at Singapore was $45.16 per 100 lb., as on July 20, 1917, and the concentrate contained 98 per cent tin oxide, the price at which the concentrate was sold to Tong Shoon Konsi was determined thus:

Price of concentrate at Singapore	45 16 x 73.5	$33 19
Government duty of 10 per cent	$3.32	
Government war tax	.42	
Smelting and transportation	1.58	
		5.32
		$27 87
Lease tribute to Tong Shoon Kongsi, 5 per cent		1 39
Price received per 100 lb. of concentrate		$26 48

The results of the first few months of operation of the dredge in 1917 were as follows:

Month	Cubic Yards	Pounds of Tin Concentrate	Gross Return
June	45,000	33,100	$8,760
July	73,600	70,150	18,650
August	61,000	26,900	7,280
September	68,600	45,300	12,430
October...	71,000	52,650	14,400
Total for five months	319,200	228,100	$61,520

The 228,100 lb. of tin concentrate was probably equivalent to about 168,000 lb. of metallic tin, the average price to Tin Bentong No Liability being about 36.6c. per pound of metallic tin. The average market price per pound of metallic tin at Singapore, during this time, was probably about 45c.

The dredge and power plant have been in operation for four years, and the entire equipment has proved well suited to the conditions. Other dredging companies will no doubt install more electrically driven dredges in the Malay States, because fuel for steam dredges is inconvenient to use and expensive when delivered aboard a dredge and the electric drive is generally more efficient.

Smelter and Refinery Statistics for 1919

A special report to the Senate Finance Committee by the Bureau of the Census shows that in 1919 thirty-four establishments were engaged in smelting and refining of copper. The invested capital was $308,680,268. Salary and wage payments totaled $31,619,716. Officers, superintendents, managers, and other salaried employees numbered 2,309. The average number of wage earners was 17,345. An aggregate of 321,610 hp. was employed. The value of products in 1919 was $651,101,591.

Twenty-five establishments were engaged in the smelting and refining of lead. Their capitalization was $115,676,768. Salary and wage payments totaled $11,281,401. Officers, superintendents, managers, and other salaried employees numbered 915. The average number of wage earners is given as 6,438. The aggregate horsepower employed was 52,565. The value of products in 1919 was $196,794,519.

In the smelting and refining of zinc, the number of establishments is given as thirty-nine. The capital employed is $98,757,355. Salary and wage payments totaled $20,244,747. Officers, superintendents, managers, and other salaried employees numbered 1,107. The average number of wage earners was 13,796. The aggregate horsepower employed was 73,604. The value of products in 1919 was $104,122,938.

Thirteen plants, with a capital of $20,227,544, were engaged in smelting and refining other metals. Officers, superintendents, managers and other salaried employees numbered 318. The average number of wage earners was 2,041. The aggregate horsepower employed was 11,700. The value of products in 1919 was $20,074,504.

Non-Ferrous Metallurgy in Russia

Several Smelters Treated Copper Ores Until Disorganized Conditions Resulted in Virtually Complete Suspension — Some Plants Have Up-to-Date Equipment — Electrolytic Refineries in Moscow and Petrograd — Lead and Zinc Plants Less Numerous

By M. G. Korsunsky

Although copper and lead were mined and smelted in Russia three and a half centuries ago, only crude methods were used up to about 1908, and the production was small. European smelting practice was not sufficiently impressive either as to technique or magnitude to cause the Russians to adopt it. Growing knowledge of American ways and business methods finally impressed the Russian smelters and caused them to undertake progressive innovations, but as the Russian spirit is generally slow-acting, and the period of pre-war improvements did not last longer than about six years, not much headway was made.

At the beginning of the Great War, the Russian copper market was supplied from three sources: The Ural Mountain area; the Caucasus district; and the Siberian region.

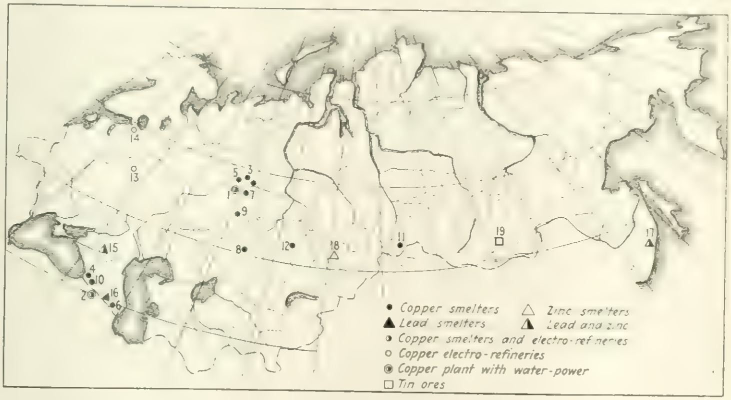
The principal plant in the Urals was the copper smelter of Karabash, belonging to the Kyshtim Corporation, headed by English interests (Leslie Urkhart). The ores were poor in copper but high in silver and gold. They were treated by carefully planned processes, an intelligent duplication of those in use at the Washoe smelter, in the United States. Agglomerated ores were smelted pyritically in a blast furnace to a low-grade matte, and the matte was treated in large basic-lined converters. The resulting high-grade blister copper was refined electrolytically, and the recovered precious metals represented a neat margin of about 20 per cent of the value of the copper. Much thought was given to the recovery of all metals found in the fumes and different tailings; they were concentrated in an immense regenerative Martin furnace, producing a matte of about 10 to 15 per cent of copper. The Kyshtim smelter had an output of 17,000,000 lb. per year.

The Bogoslovsky smelter was much smaller, and produced only 8,000,000 to 9,000,000 lb. of copper per year. The practice here was more varied than at the Karabash smelter, but far more conservative and conducted less efficiently. The metal was sold partly to the rolling mills and foundries and partly to the electrolytic refineries of Moscow and Petrograd.

The Vyisky smelter was the third in the Ural district, having a capacity of about 5,000,000 lb. The technical equipment and methods of work were highly conservative and not especially promising. The existence of this plant depended largely upon high custom duties on imported copper.

A few other smelters existed in the Ural region, but all were either in their infancy (as the Tanalyk smelter), or manipulated with little capital and even less knowledge. Their total output did not exceed about 2,500,000 lb. per year.

The southern slopes of the Caucasus Mountains are rich in copper deposits, but these are distributed in such a way that extensive mining and shipping of the ores to the smelters cannot be successfully undertaken for a long time to come. Therefore, the Caucasus production figures give but a vague presentation of the real possibilities.



Map showing location of copper, lead, zinc, and tin smelters of Russia, arranged according to metals smelted, and size

1. Karabash smelter (Kyshtim district). Dressed ores. Water power. Own cheap coal. High-priced custom coke. Efficient labor.
2. Alla-Verdi smelter. (Sangezur district). Dressed ores. Water power. Expensive coke. Oil fuel cheap. Persian labor of low efficiency.
3. Bogoslovsky smelter. (Bogoslovsky district). Undressed ores. High-priced coke. Cheap coal. Good labor.
4. Dzansoulsky smelter. (Batum district). Dressed ores. Expensive coke. Oil fuel. Labor not efficient.
5. Vyisky smelter. (Vyisky district). Undressed ores. Expensive coke. Peat and wood fuel. Efficient labor.
6. Kedabeg smelter. (Elisavetpolsky district). Undressed ores. Oil fuel. Expensive coke. Inefficient labor
7. Kalatinsky smelter. (Verkh-Isetsky district). Being enlarged.
8. Spassky smelter. (Spassky district). Flotation plant. Being enlarged.
9. Tanalyksky smelter. Small production. Capital lacking. Copper ores contain high gold content.
10. Kvarzkhana smelter. (Batum district). Under construction.
11. Eniseisky smelter. (Minusinsky district). Undressed malachite ores. Cheap wood fuel and charcoal.
12. Pavlodarsky smelter. (Pavlodarsky district). Shut down.
13. Electrolytic refinery of Moscow (formerly Vogau). Custom high-grade copper. Oil and peat fuel.
14. Electrolytic refinery of Rosenkranz (Petrograd). Custom high-grade copper. Imported coal. Oil fuel.
15. Alagir smelter. (Zinc and lead).
16. Alikent smelter. (Lead only). Inactive.
17. Ore dressing plant only. Lead and zinc ores of the Primorsky district.
18. Ekibastus zinc and smelter. (Riddersky district). Under construction.
19. Tin ores of Onon.

The Kedabeg smelter is the oldest large smelter in the Caucasus. It was conducted for about fifty years by the Siemens interests. The process included roasting highly pyritic ores, smelting them to a 35 per cent matte in round reverberatory furnaces of Siemens patent (fired with two steam-pressure oil burners), and resmelting the matte, after preliminary roasting in heaps, to low-grade blister copper (96 per cent and lower). This blister copper was refined in reverberatory furnaces with air-pressure oil burners, and sent to the electrolytic refinery of Vogau, in Moscow. All operations were conducted with heavy losses of metal in slags and fumes. Instead of blister copper, often a mixture of it with a 75 per cent matte was obtained, and the process was never standardized.

Some decades ago, the Kedabeg smelter was connected with the Kelakent electro-refinery, where the Siemens process of extracting copper from matte by electricity was long but unsuccessfully used. It is reasonable to conclude that no scientific process could be a success in this place, where the operators were content to run a slag containing up to 7 per cent of copper out of the old brick-walled furnaces. The accumulated mountains of this slag were, in later years, removed over a steam railroad to Kedabeg, and resmelted to recover the copper.

An important side line of the business consisted in roasting any ore containing less than 3 per cent of copper, in big heaps covering hundreds of acres; leaching the product with rain water; precipitating the copper on scrap iron in big wooden vats; and melting the cement copper thus produced.

The production of Kedabeg was subject to heavy fluctuations as a result of the shortage of sufficiently rich ore, which occurred only in the form of limited lenses.

Far larger were the undertakings of a French concern, working under the name of the Caucasus Industrial & Metallurgical Co. This company bought up the rights of various small landowners and producers in the southern region of Georgia, and began an extensive mining of copper ores in the Sangezour district, shipping them to the Alla-Verdi copper smelter. Here the customary practice consisted in dressing ores by hand and hydraulic methods; agglomerating them in roasting pots; pyritic smelting to a 30 per cent matte; converting the matte to blister copper in acid-lined converters; refining the blister copper in large reverberatories; and shipping a part of the product to dealers, another part being refined electrolytically at the works. Although the Alla-Verdi smelter was not well planned, consisting of a mass of disconnected units, it was capable of doing a good business, and had fine prospects of growth. It produced about 12,000,000 lb. of copper per year.

The third large enterprise in the Caucasus was the Dzansoul copper-smelting works, controlled by English and American interests. Their copper-ore reserves were large, but the ore was exceedingly refractory. So, although highly pyritic, it could not be profitably smelted in the water-jacketed blast furnaces, and a complete plant built for such treatment had to be dismantled after heavy losses. The smelter began profitable work only after the introduction of reverberatories, preceded by ore dressing. Its output was about 8,000,000 lb., but plans had been made for a markedly increased production.

A well-designed pyritic smelter for the treatment of copper-bearing pyrites included in a basic (dolomitic) rock was built by Siemens at Kvarzhana, near Batum, in the neighborhood of Dzansoul. It was planned for the production of about 8,000,000 lb. of copper per year, but had barely begun operating when the war occurred.

The Spassky smelter, in the Kyrgis prairies, was operated at modest capacity for a decade on low-grade ores till it was decided that no headway could be made without installing a flotation plant and suitable smelting equipment. The old plant was therefore dismantled, and plans were made for an equipment capable of producing about 11,000,000 lb. per year, but this plant did not begin operations before the war.

Other extensive deposits of copper ores distributed through Siberia were sufficiently developed to permit of the planning of smelters and their auxiliaries. Nevertheless, the conditions of transport, fuel, and even water supply were so difficult that only a concern with large capital and with a heavy demand for copper guaranteed could afford to start operations. To illustrate: In the Transkaspien district, in a region devoid of fuel, inadequately supplied with water, and subject to many difficulties with regard to the installation of necessary transportation systems, are deposits of sands bearing finely divided native copper in abundance.

WAR'S INFLUENCE ON PRODUCTION

Despite the fact that copper was one of the foremost necessities for successful warfare, the Russian copper smelters experienced heavy setbacks during the war. Even the smelters of the Ural, so remote from the fields of the struggle, gradually declined. In the first place, when no definite mobilization policy was followed, they were robbed of their most skillful workmen, who never returned to the district. Then, when the war became strenuous, these smelters could not get the most necessary commodities, from pure sulphuric acid, needed in the laboratory, to structural and sheet iron.

The smelters of the Caucasus were even more afflicted. They came into real contact with the battlefields, and, as the inadequate railroads were too busy transporting human and other war material, the smelters were cut off from essential supplies of coke and building materials.

RUSSIAN COPPER PLANTS DURING THE REVOLUTION

The tremendous tottering of the Russian currency, which began about three months before the revolution, could not remain unobserved or unfelt by any industry, and the copper smelters were no exception. If one considers that the whole internal output of copper was controlled and mostly paid for by the government on a fixed-price basis, while the costs of production soared divergent and uncontrolled, it can be imagined that this particular industry was highly depressed. The copper-smelting industry could not survive without a broad constructive intervention by the government and the people. Unfortunately, the first provisional government was too weak and too busy to try to cope with the situation, and no strong and constructive forces existed outside of its ranks. Afterward, when the Bolsheviki came into power, they tried to solve every problem of economic life by issuing decrees, planned and introduced into industrial life by young people with no technical knowledge and not a trace of industrial experience. Therefore, all their efforts were doomed to remain either fruitless or destructive.

The marked shortage of domestic copper and the heavy demand for this metal in various war-supply industries were met chiefly by enlarging the quantity of imports. Only a little copper was imported from Japan, most of the total coming from the United States.

RUSSIAN COPPER IMPORTS
In Millions of Pounds

	1913	1915	1916	1917
Total imports	18	45	65	85
Imports from United States	8	37	57	75

Still, the needs for copper were not sufficiently covered, and the amount of this metal used for private and community purposes dropped to approximately 25 per cent of normal.

OUTLOOK FOR THE RUSSIAN COPPER INDUSTRY

There can be no doubt that for a period of not less than five years no hope can be entertained for the resumption of copper production in Russia to its former level. Meanwhile, the country will be in sore need for this metal for reconstruction and progress. The potential Russian demand amounts to not less than 100,000,000 lb. of copper per year.

OTHER NON-FERROUS METALS IN RUSSIA

Metals other than copper were never produced to any material extent in Russia. Lead and zinc ores are found in good deposits, both in the Caucasus and Siberia. A few smelters in the Urals and one in the northern Caucasus turned out about 10,000,000 lb. of lead annually. A quarter of this quantity was produced by copper smelters as a complex copper-lead matte, for the treatment of which ingenious methods were devised by the Russian metallurgists. The rest was produced by the Alagir Chemical Works (northern Caucasus). This plant had an elaborate equipment for coking semi-lignitic coals, recovering byproducts, smelting lead, and distilling zinc.

Zinc was produced in Russia in small amounts, and most of it came from the smelters situated in Poland. These fell into German hands soon after the beginning of the war, and from the former output of 22,000,000 lb., only the Caucasian (Alagir) production of 6,000,000 lb. remained. The latter rapidly declined, owing to the general disorganization of industry and the slight attention given to the question of improving or preserving normal conditions in the zinc trade. It was not difficult for the government to purchase enough foreign zinc to cover the needs of war, and private interests did not continue to require zinc at pre-war rates.

DATA ON RUSSIAN COPPER SMELTERS, 1913-1918

District	Smelter	Type of Work	Refining	Transport Conditions Pre-War	Transport Conditions Second Revolution	Fuel Conditions Pre-War	Fuel Conditions Second Revolution	Power Conditions Pre-War	Power Conditions Second Revolution	Annual Output (Pounds) Pre-War	Annual Output (Pounds) Second Revolution
Ural....	Kyshtim (Karabash)	Pyritic; bas.-convtg.	Electr. on the spot	Fine	Bad	Good	Bad	Good	Fair (water)	17,000,000	-90%
	Bogoslovsky	Combined	Fire; ship. to ref. and trade	Fine	Bad	Good	Fair	Good	Bad	9,000,000	-90%
	Vyisky	Pyritic	Fire	Fair	Fair	Good	Bad	Fair	Bad	5,000,000	-97%
	Tanalyk	Combined	Fire; ship to refin'y	Bad	Bad		.	. .		1,500,000	-100%
Caucasus..	Kedabeg	Roast. and reverb. smelting	Fire; ship. to refin'y	Difficult	Bad	Good	Very bad	Good	Bad	4,000,000 to 6,000,000	-95%
	Alla-Verdi....	Pyritic and acid-converting	Electr. on the spot	Fine	Very bad	Good	Very bad	Good	Fair (water	12,000,000	-95%
	Dzansoul....	Roast. and reverb. smelting	Fire; ship to refin'y	Fine	Bad	Good	Very bad	Fair	Very bad	9,000,000	-90%
	Kvazhana....	Pyritic and bas.-converting	Fire	Fine	Bad	Good	Very bad	Fair	Very bad		
Siberia....	Spassky.....	Flot.; pyrit.; bas.-converting	None	Difficult	Fair	Bad	Very bad	Fair	Bad	5,000,000	-80%
	Tenincy.....	Roast.: smelt.; bas.-converting	Fire	Difficult	Difficult	Fair	Fair	Fair	Fair	2,000,000	-70%
										65,000,000	5,000,000

Nevertheless, extensive plans were laid by the corporation owning the Kyshtim property, to establish an up-to-date zinc plant in the Altai Mountains. This district, commonly known by the names "Ridder and Ekibastus," presents exceedingly difficult problems from the viewpoint of transport and labor conditions, but it has enormous sources of fuel and water power, together with large ore reserves. Although calling for a heavy primary outlay of money, it could supply Russia with approximately 80,000,000 lb. of zinc annually at a profit.

Some extensive deposits of zinc and lead ores are found in the Far East near the shores of the Sea of Japan. The rich ores of this district, even before the war, attracted the attention of the Krupps, and there is no doubt that either these interests, or Japanese companies, will cover this field with the establishment of more stabilized political conditions.

As for the presence of ores of nickel, aluminum, tin, and antimony, little can be said at present. A nickel ore was found at unusually deep levels in the Revdinsky district, in the Ural Mountains. This ore, containing not more than 0.5 per cent of nickel, could not become a source of the pure metal for the domestic market, at least under the technical and economic conditions existing in 1913, but it was regularly mixed with iron ores, and an alloy containing about 2 per cent of nickel was produced as a marketable ferronickel.

Aluminum ores were not found in Russia, despite prospecting work undertaken by governmental and scientific institutions during 1915 and 1916.

Large deposits of antimony ore were known in the southern Caucasus, but they were not mined.

Seemingly important deposits of tin ore were said to exist to the east of Lake Baikal, in Siberia, and both the transport and fuel conditions were favorable enough to warrant starting development work. Nothing was really done, however, and Russia had to depend, right from the beginning of the war, on the tin imported from English producers. The before-mentioned tin ore (and tungsten ore) deposits in Transbaikalia are worthy of serious attention from American prospectors, as they may easily prove far richer than they are popularly supposed to be.

Tin Exports from Bolivia

Vice-Consul Nelson R. Park, at La Paz, Bolivia, cables, according to *Commerce Reports*, that exports of tin concentrate from Bolivia in March, 1922, were 2,702 tons to Great Britain, 1,317 tons to the United States, 103 tons to France, 45 tons to Belgium, 8 tons to Germany, and 4 tons to Chile. In February Bolivia shipped 2,998 tons to Great Britain, 677 tons to the United States, and 211 tons to France, as against 2,593 tons, 1,633 tons, and 50 tons to these countries, respectively, in January.

Selection of Fans for Pipe Ventilation

Theory of Operation and Calculations To Be Made in Choosing Equipment for Assuring Proper Supply of Pure Air and for Fire Fighting—Computation of Characteristic Curves at Different Speeds—Discussion Limited to Small Fans

BY WALTER S. WEEKS

KNOWLEDGE of the method of making the calculations that are preliminary to the selection of the proper mine fan for ventilation and fire-fighting purposes is often of practical use. In this discussion I shall consider only small fans and assume that they are of the pressure type. Although the calculations given here may be applied to the large fans, the selection of such fans entails a consideration of many factors that are beyond the scope of this paper. I shall assume that the reader desires only a working knowledge of the fan, and shall tell only such part of the story as will make it possible to obtain the desired results.

The centrifugal fan produces pressure by whirling the air around in the casing. This pressure in the casing is produced in two ways—first, by the generation of centrifugal pressure by the whirling, and, second, by giving the air a high velocity and then converting this velocity into pressure in the gradually expanding scroll of the fan. Think of a fan as a machine that produces pressure, not as a paddle wheel that pushes the air. If a pipe is connected to the fan the air will flow from the fan through the pipe, not because the fan blades push it, but because the pressure in the fan is higher than that of the surrounding air.

When air flows through a pipe it is impeded by friction between the walls of the pipe and the moving column of air. This resistance to the flow of the air is expressed by the formula $R = KSV^2$, in which R is measured in pounds; S is the rubbing surface of the pipe in square feet (perimeter times length); V is the velocity of the air in feet per minute; and K is the friction coefficient, the value of which depends upon the condition of the surface of the pipe and the density of the air.

When a pressure gage is connected to the air pipe it measures unit pressure in pounds per square foot or per square inch.

The symbol R in the formula represents the total pressure on the end of the pipe toward the fan, necessary to force the air through. R may be replaced by $P \times A$, where P is the unit pressure in pounds per square foot, and A is the area of the pipe in square feet. The formula now becomes

$$PA = KSV^2$$

If we divide through by A we obtain the unit pressure P necessary to force the air through the pipe.

$$P = \frac{KSV^2}{A}$$

The instrument used to measure the unit pressure is a vertical U-tube with water in it. One end is connected by a rubber tube to the pipe at the fan and the other end is open to the atmosphere. The difference in level in inches of water in the two legs of the U-tube, or manometer, multiplied by 5.2, gives the unit pressure in pounds per square foot.

Now, if we assume having 100 ft. of a given size of pipe, and know the coefficient K, we may calculate the pressure P necessary to force given amounts of air through the pipe. If these pressures are divided by 5.2, the corresponding water gages are obtained. These data may be plotted on a chart, such as that in Fig. 1, which is reprinted by permission of the American Blower Co.

As an example of the use of this chart let it be assumed that we desire to force 5,000 cu.ft. of air per minute through 1,000 ft. of 16-in. pipe. What must be the water gage at the fan? Running along the bottom line of the chart we find 5,000. Passing up the 5,000 line we find where it intersects the "16-in. pipe" line. The pressure is read at the left and is seen to be 1.5 in. per 100 ft. As we have 1,000 ft. of pipe it will take ten times this pressure, or 15 in. Unless the fan is able to maintain this pressure at the end of the pipe, this amount of air will not pass through.

SELECTION OF FAN FOLLOWS CALCULATION OF PRESSURE

The calculation of the necessary pressure is thus simple. The next problem is to select a fan that will do the work. Before we can do this intelligently we must study the action of the fan and become familiar with all operating conditions.

Assume that a short length of pipe is to be connected to a fan with a gate on the end of the pipe and a water gage connected to the pipe at the fan. The fan is run at constant speed. The highest pressure that can be obtained will be given when the gate is entirely or nearly shut, depending on the type of fan used. As we open the gate, more air flows and the pressure drops, until, when the gate is wide open, the pressure is slight. If at each gate opening the air is measured and the pressure is recorded, the necessary data are obtained for plotting the pressure-volume characteristic of that fan at that speed. This characteristic forms the basis of all the fan calculations we shall attempt. Such a characteristic is shown in Fig. 2.

A study of the curve shows that when a given amount of air is delivered, the fan is able to maintain a certain pressure. If the volume of air is increased, the fan is able to hold a smaller pressure, and, correspondingly, if the volume is decreased, the fan can maintain a higher pressure. How may we explain this action of the fan?

Consider for a moment a shunt-wound direct-current generator. Assume that a voltmeter is connected to its terminals and no current is allowed to flow. The armature revolving in the field produces a certain voltage or electrical pressure. If a conductor is placed between the terminals, a current flows and the voltmeter shows a lower pressure across the terminals. This is because some of the pressure produced by the generator is used to force the current through the wires of the armature itself. Only such voltage is available for the service of the outside conductor as is not used in the armature.

FAN A GENERATOR OF PRESSURE

Think of the fan as a generator of pressure. Its two terminals are the inlet and discharge openings. The manometer measures the pressure across the terminals. The wheel in revolving produces nearly a constant pressure. As air is drawn from the fan, friction in the fan blades consumes a part of this pressure, so only such portion remains to drive the air through the pipe as is not used in forcing the air through the fan blades. The manometer shows the pressure that is left after the fan itself has taken its toll.

If, to use the example worked out, it is desired to force 5,000 cu.ft. of air per minute through the 16-in. pipe, a pressure of 15 in. of water must be maintained at the end of the pipe. If there is no point on the fan characteristic that shows as much as 15 in. water gage at 5,000 cu.ft., the fan will not do the work at the speed at which the characteristic is made. The speed must be increased or a different fan chosen.

The characteristic curves of all the fans to be used should be known. The characteristic at one speed is enough for a start, because characteristics at other speeds may be calculated as will be shown. If possible, a characteristic curve for each fan should be obtained from the maker. If this is impossible, it may be determined with sufficient accuracy as follows:

Connect 100 ft. of 12-in. pipe to the fan with a gate 20 ft. from the fan. Connect the water gage close to the fan. Run the fan at constant speed and measure the velocity with a high-speed anemometer held in the center of the pipe at the outlet. The reading of the anemometer in feet per minute should be corrected by the friction correction given by the maker. This corrected velocity multiplied by 0.85 will give a close approximation of the average velocity in the pipe.[1]

The average velocity in feet per minute multiplied by the area of the pipe in square feet gives the cubic feet flowing per minute. Seven or eight readings should be taken, starting with the gate closed and ending with it wide open. For each gate opening the water gage and the cubic feet of air should be recorded. These results when plotted will give a curve similar to that in Fig. 2. The fan speed should, of course, be ascertained. A fan may be run at any speed up to its breaking point. The maximum allowable speed should be ascertained from the fan maker.

As has been stated, if we have one characteristic, we may compute others. Let us assume that the characteristic in Fig. 1 was made at 1,000 r.p.m., and that from this we desire to construct characteristics at other speeds. The fan law which applies is this: With

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[1] "A Method for Rapid Removal of Powder Smoke in Tunnels," by Walter S. Weeks and George L. Wolflin, *Engineering and Mining Journal*, Oct. 29, 1921, page 699.

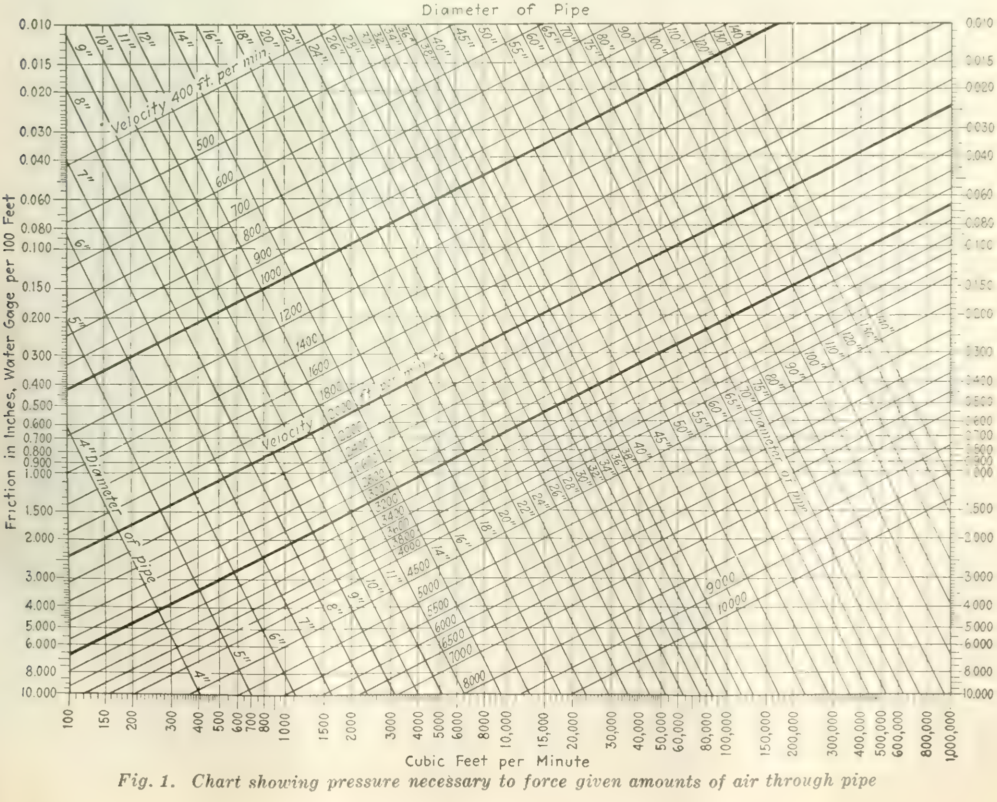


Fig. 1. Chart showing pressure necessary to force given amounts of air through pipe

a given gate opening the volume of air delivered varies directly with the speed and the pressure varies as the square of the speed. For example: If a fan delivered 4,000 cu.ft. at 6-in. water gage at 1,000 r.p.m., it would deliver at 2,000 r.p.m. a volume of 8,000 cu.ft. at 24-in. water gage, if the gate opening is not changed.

To construct the new characteristic, therefore, select any point on the known characteristic and multiply the volume of air by the ratio of speeds, and the corresponding water gage by the square of the speeds. This computation will give the values for a point on the new curve. The full lines in Fig. 3 are a series of curves at different speeds constructed from the curve in Fig. 2.

From the pipe-resistance chart it is evident that for a given length of pipe, different volumes of air require different pressures to make the air pass through. So we may plot a pipe characteristic for a given length showing the pressure necessary to force different volumes of air through the pipe. Characteristics may be plotted for different lengths. The dotted lines in Fig. 3 are characteristics for different lengths of 12-in. pipe.

When a fan running at constant speed is placed on a pipe of given size and length, we have these conditions: The fan can produce only such combinations of pressure and volume as appear on its characteristic and the pipe can have only such combinations of pressure and volume as appear on its characteristic. So the two jockey a bit, and come to an agreement where the two characteristics cross. At this point, with the volume shown on the chart, the fan will produce exactly the pressure that is necessary to force this volume through the pipe.

My suggestion for the rapid selection of a fan to do a given piece of work is this: Plot a series of characteristic curves at different speeds as in Fig. 3, for each size and type of fan. To the same scale plot on tracing cloth a series of pipe characteristics for the lengths of pipe that will be used.

All that is necessary to determine the speed at which a fan must be run to force a given amount of air through a given length of pipe is to place the tracing cloth on a fan characteristic chart and select a crossing at the desired amount of air. Fig. 3 shows how the characteristics will appear when this is done. If, for example, we desire to force 2,500 cu.ft. through 200 ft. of pipe, we see that at that volume the 200-ft. pipe characteristic crosses the 1,400-r.p.m. curve of the fan.

If the motor is direct-connected and its speed cannot be changed, we shall be limited to one characteristic for that fan. Several of such single characteristics may be drawn on one chart. The intersection of a pipe characteristic and any one of these fan characteristics indicates the maximum volume that can be obtained. Anything less than the maximum may be obtained by means of a gate. The fan should be selected that most nearly meets the condition.

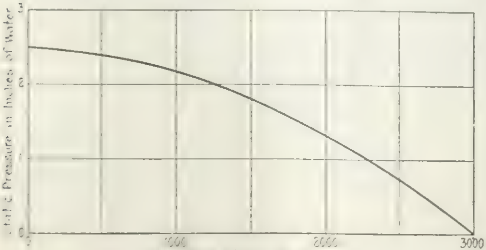


Fig. 2. Fan characteristic

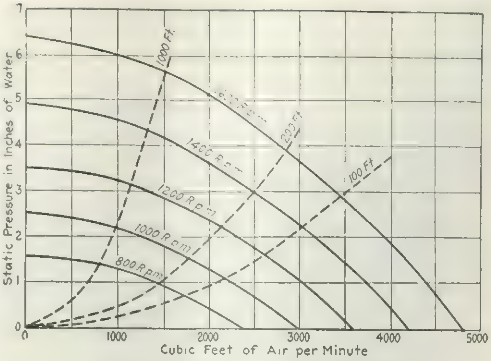


Fig. 3. Fan and pipe characteristics

So far we have considered only pressure fans. If the fan is to be used as an exhauster, increase the amount of air that is actually desired by 10 per cent and use the chart as if dealing with a pressure fan.

It remains now to consider the power necessary. It is safe to assume a 30 per cent efficiency for fan and motor, so the power to run the fan will be:

$$\text{Horsepower} = \frac{5.2\, i\, Q}{33{,}000 \times 0.30}$$

i = water gage and Q = cubic feet of air per minute.

If the fan is throttled by a gate, use the water gage from the fan characteristic that goes with the amount of air actually flowing, for computation with the above formula.

The fan efficiency, of course, will change with every change in the piping. Sometimes it will be high and sometimes low. I selected a low efficiency for use in the formula to allow for most conditions. While the fan characteristic is being determined, the motor should be watched for heating. As the flow of air increases, the load on the motor increases, and the motor is most heavily loaded when there is no pipe or gate on the fan.

California Gold Dredging

In a paper presented to the local section of the A. I. M. E. in San Francisco, Newton Cleveland gave some interesting facts about the California gold-dredging industry. Mr. Cleveland's wide experience in gold dredging and his long-continued study of this industry make his contribution authoritative. He said that 132 gold dredges have been constructed in California up to 1922. At present thirty-one are in operation. Of a total gold production of $124,726,430 by dredging operations, earnings have been returned amounting to $31,000,000 on an investment of approximately $32,000,000 during a period in excess of twenty years. The approximate average return on invested capital is more than 10 per cent. According to Mr. Cleveland, 75 per cent of the dredging companies have paid better than 15 per cent on the capital invested. This is a remarkable result, and indicates the stability of the mining industry when efficiently controlled.

The American Zinc Institute

Association Has Effected Pronounced Changes—Zinc Industry Efficiently Organized and Interested in All Matters Affecting Its Prosperity

By Felix Edgar Wormser
Assistant Editor *Engineering and Mining Journal-Press*

On turning the knob on the door of its modest New York office and entering, a person unfamiliar with the work of the American Zinc Institute would probably inquiringly view the grand assortment of zinc manufactures, shingles, gutters, leaders, and nails, that meet his gaze, and might incorrectly conclude that someone is contemplating building an addition to the office. Zinc producers are so intensely interested in widening the market for their product that they have used their association to gather an interesting and comprehensive collection of zinc articles—a minor phase of the institute's work, but one that is immediately noticeable. Other phases quickly become apparent as one delves into the causes which led to the formation of the organization and learns that in the four short years of its existence it has become the best-organized trade association in the non-ferrous metal-mining industries, with about 95 per cent of the American zinc industry represented in its membership.

Agitation for an association of zinc producers became active during the war and was translated into an accomplished fact on July 29, 1918, when, in St. Louis, an earnest group of zinc miners, smelters, and manufacturers laid the foundation for the present body. Looking back upon that period, one wonders how an industry which has been continually accused of secrecy and backward business methods could have organized so readily, but the credit is placed upon the war, which doubtless caused producers to realize how small their differences were when it came to the great task of winning the conflict. At any rate, opportunity knocked, and the zinc producers bade it enter. Directly responsible for the convocation in St. Louis was the recommendation of Pope Yeatman, then chairman of the non-ferrous metals section of the War Industries Board, that zinc miners and smelters reconcile their quarrels by getting together in a common organization that could co-operate in an effective manner with the Government.

Many Small Plants Engaged in Zinc Production

Zinc mining, it must be remembered, has a peculiar industrial status. A few large producers, such as the New Jersey Zinc Co., the American Metal Co., the United States Steel Corporation, the American Zinc, Lead & Smelting Co., and the Anaconda Copper Mining Co., with an output from their own ores, are most influential in supplying the galvanizing and brass industries of the country, but there are also a host of small producers who mine zinc ore and dispose of it to the large smelters in the Middle West. They are a highly important factor in the industry. The equipment of these small mines is intended for a quick exploitation of the deposits, and, as such, is not often of the most efficient type. The mines being comparatively shallow, production is quickly attained, and if the mining occurs on leased ground, the question of operating before the expiration of the lease is an added incentive of production.

A dollar invested in a Middle Western zinc mine will return an income more quickly than one invested in copper, owing to the simpler quality of the plant required and the generally greater ease in mining. Zinc smelters have in turn become dependent upon the miners for an adequate supply of zinc concentrates, and the fact that they are mutually dependent, that one must buy and the other sell, has frequently introduced a hostile spirit between the two—the miner often feeling that he is being paid poorly for his concentrates and the smelter that too high a price is being paid considering the risk assumed. This feeling was intensified during the war, when prices fluctuated violently and when the industry was overbuilt and overstimulated.

Just before the armistice a Zinc Producers' Committee was to have been formed by the Government, a forerunner of the present American Zinc Institute—to conciliate the various conflicting interests; but the end of the war put a sudden stop to the aid of the Government in ironing out industrial difficulties. Thereafter ills had to be cured by the patients. Thanks to the remarkable change in spirit that had been brought about by the effort to fight a determined enemy, and a realization that internal wrangling was worse than desertion in an army, the various groups in the zinc industry of the United States were prepared to cast off the veil of mutual distrust and secrecy which had done so much to discredit them in the eyes of the public.

Dissension Marked a Few Years Ago

Antagonism not only between miners and smelters but among the smelters themselves was prevalent prior to the war, a spirit not conducive to the development of an industry to its highest point of efficiency and usefulness to society. Looking back upon those days it is no doubt difficult for the operators to realize that they were so stupid in their old attitude, when everyone shifted for himself and when matters common to the whole industry were subordinated to the position of each individual industrial unit.

On July 29, 1918, Victor Rakowsky presided over the first meeting of the new association, which was called by a group of Arkansas, Kansas, Missouri, and Oklahoma zinc producers who had previously conferred with Mr. Yeatman as to the advantages and necessity of organizing the various factions in the industry. Mr. Yeatman gave it his hearty support. At this meeting the urgent need of both miners and smelters co-operating with one another and working whole-heartedly together was emphasized. The field of an American Zinc Institute was debated, and the advantages of promoting the wider use of zinc, establishing uniform systems of accounting, the collection of better statistics of production, consumption, and stocks (prices were not discussed so far as I have been able to ascertain), and the improvement of technical processes in zinc mining and smelting, were too strong to resist. It did not take long to start the wheels of the actual organization machinery moving. In fact, the method pursued is not a bad guide for other industries having under consideration the formation of a similar association.

First, it was resolved to form a nominating committee of twenty-one persons which was to select an organization committee of seven representative persons chosen from the zinc mining and smelting industries. The organization committee was given power to form a plan of organization for the institute, to select a board of twenty-one directors, to nominate officers for the ensuing year, to prepare a report of their transactions, together with a plan of a ballot by mail, and lastly to mail within ninety days to all persons attending the meeting, and to all other persons whom the organization committee desired to invite to become members of the institute, a report of the committee's transactions and papers for casting a postal ballot.

Rakowsky, Ingalls, Siebenthal, H. I. Young, and O. F. Brinton took a prominent part in the organization proceedings. The organization committee as finally selected included W. R. Ingalls, F. C. Heywood, D. D. Dunkin, Fred A. Hale, Jr., G. L. Coleman, J. H. Billingsley, W. B. Shackleford, P. B. Butler, and J. L. Bruce, representing the mining interests, and A. P. Cobb, A. S. McMillan, William A. Ogg, Julius W. Hegeler, George E. Nicholson, Edward Mosehauer, W. H. Eardly, O. S. Picher, E. H. Wolff, J. L. Hauser, and Charles T. Orr, representing the smelting interests. This committee of twenty-one members finally selected a committee of seven including Victor Rakowsky and J. L. Bruce as mining representatives, E. H. Wolff and A. S. McMillan as smelter representatives, and Charles T. Orr, A. P. Cobb, and W. F. Rossman as mining and smelting representatives.

On Sept. 20, 1918, the committee of seven met in Chicago and attended to the formation of the constitution and bylaws of the society, and on Oct. 22, 1919, as a culmination of the efforts to effect an organization, a certificate of incorporation was issued to the American Zinc Institute. The following representatives of the American zinc industry signed the articles of incorporation: James L. Bruce, A. S. McMillan, Victor Rakowsky, William F. Rossman, E. H. Wolff, Joseph Brenneman, C. M. Loeb, Edward M. McIlvan, George E. Nicholson, F. C. Wallower, J. H. Billingsley, P. B. Butler, J. W. Hegeler, C. F. Kelley, W. A. Ogg, Edgar Palmer, G. S. Picher, A. P. Cobb, Charles T. Orr, G. O. Argall, and Arthur Thacher. Charles T. Orr was elected the first president.

The objects of the American Zinc Institute, according to its articles of incorporation, are broadly stated: "The particular object for which this corporation is to be formed is to promote the welfare of the industry by affording a means of communication between members upon matters bearing on their business interests."

Thus was the American Zinc Institute launched. It has been sailing for four years, and although its voyage has not always been under the most perfect conditions it has easily exceeded the expectation of its builders.

The institute has chosen an equitable method of raising funds for carrying on its work. The plan is based upon the production of the various members. The smelters pay 5c. per ton upon their individual zinc production, and the ore producers 2½c. per ton upon their individual production of concentrates running over 50 per cent in zinc, and 1½c. per ton upon production of concentrates running under 50 per cent zinc. Provision has been made for contribution to the support of the institute when the production of a member drops excessively and for contributions from manufacturers of zinc products on a similar basis to that of the smelters. Representation on the board of directors is also equitably arranged, and now includes five directors from the smelting industry, five from mining, and eleven from the combined mining and smelting groups.

PRODUCERS TO IMPROVE THEIR STATUS

The outstanding accomplishment of the American Zinc Institute, and the one which it has driven hard and promises to drive harder before it is through, is the attempt to obtain for the zinc industry its proper place in the business world. To this end, company and individual animosity has been dispelled, the splendid facilities for getting together to discuss the industry's acute problems at the meetings of the institute have been utilized to the full, and the benefit of hearing the collective opinion of miners, smelters, engineers, manufacturers, and others has been thoroughly appreciated. No longer was zinc to be called "spelter"; no longer was zinc to give way to other metals, and no longer was the zinc industry to suffer from erratic price fluctuations carrying it from prosperity to poverty. That was the new temper of the industry.

The members of the newly formed institute early realized the advantages of acquiring a better knowledge of the business conditions of the industry, and took intelligent steps to procure it. Prior to the organization of the American Zinc Institute the larger producers, with their comprehensive organizations, were able to conduct a well-equipped information service to supply themselves with trade information acquired from various points of contact with the activities of the zinc industry. The smaller producers were less fortunate, and were forced to rely either upon Government statistics or such unconfirmed reports as reached their offices. Government reports, except during the war, were issued once or twice a year, and excellently served their purpose, but for only a short time.

FULL PUBLICITY GIVEN STATISTICS

The need of a better statistical service was evident. To remedy this defect the Amercan Zinc Institute soon began to collect statistics of zinc production, consumption and stocks, retort capacity, and activity. At first these reports were kept confidential and the summaries distributed among the members, but through the efforts of the broad-minded and progressive element of the American Zinc Institute, and not without some internal difficulties, it was decided to give the fullest publicity to the composite statistical summaries, and since January, 1922, the association has issued a monthly statement of production, consumption, stocks, retort capacity, and retort activity for the United States that is exceedingly valuable not only to the zinc producers but also to any observer of business conditions. That the zinc industry, which has been so often accused of secrecy and backwardness, should be the first great metal industry to stand for publicity in its current statistical compilations illustrates how completely a new spirit has been introduced in it by the formation and work of the American Zinc Institute.

PRICE TABULATIONS AVOIDED

It must be emphasized that in all the institute's compilation no attempt has been made to gather price statistics. In this way, and by its advocacy of publicity, the institute has cleared its skirts of any suspicion that its statistical compilations have any illegal function. Only one person gathers and issues the completed statistics for the whole industry, and that is the secretary. No competitor knows what his neighbor is doing from any direct report through the American Zinc Institute's offices.

There is so much to be done by the association that it rightly feels it is the height of folly to tamper with any activity that might entangle it with the law. Of course, in the great raw-material industries, whether agricultural or mineral, a broad market usually exists that is exceedingly sensitive to changes in business conditions, and producers may quickly learn what the market level is without statistics. There can be no secrecy in that. Such sources as the grain exchanges, cotton exchanges, the metal quotations of *Engineering and Mining Journal-Press*, and the telephone contact between producer and consumer enable the interested raw-material producer to ascertain what his competitors are doing in the market. This sensitive condition does not obtain in industries dealing with finished or retail products. Hence, the trade association in the raw-material industries has less incentive to deal with price matters. Nevertheless, when it decides not to do so its action is commendable.

AMERICAN ZINC INSTITUTE ADVOCATES TARIFF

A problem that has bothered the whole zinc industry greatly has been, and is, the tariff. The American Zinc Institute is splendidly suited to take up this question, and judging from the protection accorded zinc in the tariff bill as presented to the Senate it has been highly successful in its work. Without going into the merits or demerits of the tariff, it is not difficult to see that the full influence of the American zinc industry through its organization could easily be brought to bear upon Washington. Its secretary maintains close contact with activities in the Senate and the House. and has frequently hurried to the Capital from New York to urge upon Congressmen the wish of the zinc industry to be adequately protected from importations. From the standpoint of Congress and the industry it has been more efficient to deal with a spokesman or a few spokesmen of an industry than with a scattered, unorganized group.

The contact which the American Zinc Institute maintains with Washington is exceedingly valuable from many angles. Recently, it was discovered that the Post Office Department had under consideration renewing old street letter-boxes in the eastern part of the United States. Sensing a possible outlet for zinc in these wholesale renewals, the American Zinc Institute proposed that the new boxes be constructed of zinc instead of iron, which corrodes much easier. The matter is now in the hands of the department, and may open an additional use for zinc.

The fact that prospective production is larger than prospective consumption has made the principal object of the American Zinc Institute the stimulation of wider uses of zinc. This is a tremendously important and difficult problem. Prior to the war zinc had practically only two outlets in this country—the galvanizing trade and brass manufactures, galvanizing consumption being the most important. Hence the prosperity of the zinc business was rather firmly interwoven with that of the steel trade.

SHEET ZINC HAS MANY USES

At first blush it may be difficult to think of any important independent industrial applications of zinc that give much promise of affecting production. However, the home wash-board, fruit-jar tops, tips for shoe laces, buckets, pails, alarm clocks, dry-cell batteries, hot-water bottle caps, window glazier-points, refrigerator linings, table tops, sinks, nails, toilet-preparation boxes, picture frames, cameras, humidors, and many other common examples of the interior use of zinc may be mentioned. But the greatest effort to widen the consuming channel at the present time, and one that gives much promise, is the exterior application of zinc to shingles and other building materials where the ability of zinc to withstand corrosion can be utilized to good advantage. Unfortunately for zinc, however, the competition for the roofing business is intense; in fact, the prospective home or factory builder may become quite perplexed nowadays over the choice of a proper material with which to build a roof. Should he use zinc or copper, asbestos, rubberoid, slate, terra cotta, iron, tin or nickel plate, lead or aluminum—or go back to wood? Many of these substances are being vigorously pushed as excellent roofing. Naturally and oddly enough, they all possess merits that can be enlarged upon to furnish ammunition to the advertiser and confusion to the buyer. Cheapness, cold- and heat-resisting qualities, and durability have all been stressed. Zinc compares well with other materials, and has a record of successful use in building construction that speaks better than any theoretical considerations. European builders have used zinc for a longer time than those of the United States. Many roofs said to have been built in Belgium between 1820 and 1850 are still giving service. The application of zinc for this purpose in the United States is only now beginning to look promising and successful. Early attempts to use zinc as a roofing were sometimes failures, due to an inferior quality of metal or to improper application. Then again, quality of permanence is not as important a factor in building in the United States as it is abroad. But zinc has proved so well adapted to roofing in Europe, and has been so little used in the United States, that an excellent field is open to its more extensive application for this purpose. Through the efforts of the American Zinc Institute and the individual shingle manufacturers the public is being educated to the benefits of using zinc for roofs.

The meetings of the American Zinc Institute have been exceedingly valuable in opening discussion as to methods of stimulating zinc consumption, and have brought about a unity of effort that could not have existed without some common meeting ground for a collective consideration of zinc's problems. The institute is now working upon a "Zinc Workers' Handbook," which will describe the proper application of the metal to roofing and supply data to architects and builders that will enlighten them as to the advantages and proper application of zinc roofs. It is an adaptation of a volume published by the Vieille Montagne Co., in Belgium. Communications are constantly coming to the secretary requesting information about the advisability of constructing a zinc roof under certain conditions and requesting sources of additional information, which seems to indicate the great public interest in the work.

The zinc industry is not content with merely pushing into the roofing channel, and has its ear trained to catch any other sounds that would help consumption. Its research work has not reached a stage that can be called perfect, but the industry is not asleep, and the spirit shown in its work since the organization of the institute argues well for an intensive investigation of the market for zinc. The slogan "Make It of Zinc" needs substantial support to make it effective. No one will make it of use unless shown that it is to his particular advantage—that it means dollars and cents to him. The grouping of the zinc trade of the United States, with its national association, is an assurance that this support will be forthcoming. In fact, the collective advertising of zinc products has been under consideration for many months.

STANDARDIZATION WORK AIDED

It is important in dealing with any commodity to know exactly what each trade term signifies. This is no less true of zinc ore and its products than of any other material, so that the American Zinc Institute is now engaged in the standardization of trade terms and has a committee to assist in the international standardization of zinc ore, slab zinc, and sheet zinc specifications. This work was initiated by the Belgian Standardization Association and is being aided by the American Society for Testing Materials and the American Engineering Standards Committee.

Although the American Zinc Institute is a business organization, and must stand or fall as such, many discussions that have been quite technical have occurred at its meetings and been recorded in its reports. It is entirely natural that this should be so; in fact, I look to an expansion of this activity of the institute, for when practically all the units of an industry are gathered in one organization its meetings are ideal occasions at which to discuss technical matters of concern to that particular industry.

There has not been the freedom and interchange of technical information among zinc smelters that has been the practice and custom among other metal producers, and it is highly questionable whether this secretive attitude has benefited anyone. Now that the entire industry is gradually dropping its cloak of mystery, it would be most impressive and encouraging to see it introduce a wider exchange of technical information. A beginning could be made in a small manner, and from the record of the society during the last few years I believe that the movement would gather momentum and become an important function of the institute.

AMERICAN PRACTICE SHOULD BE IMPROVED

George C. Stone, probably the best-informed zinc metallurgist in the country, made a careful investigation of European smelting conditions in 1920 for the American Zinc Institute, and at a meeting pointed out the differences in American and European zinc-smelting practices. He started an interesting discussion, and his talk was replete with stimulating ideas for research work in zinc metallurgy. He left the impression that there was much work that could be done to improve American processes, European methods being more efficient than American. If the zinc industry can combine to improve its position in business matters affecting the entire industry, it should also be able to perform similar work in its technical problems, for in the last analysis perfection of technical processes and lowering of costs are just as vital to the prosperity of the industry, if not more so, than the need for, say—a tariff.

It may be something of an innovation for a trade associate to discuss strictly technical matters, but the institute has already done so, and business and zinc technology are so closely allied that certain measures of each can be advantageously treated together.

In any industrial organization success depends upon the guidance by its officers. The American Zinc Institute was fortunate in having for its presidents two men, Charles T. Orr and E. H. Wolff, whose ability and whole-hearted wish to further the interests of the American zinc industry have helped greatly in the formative years of the institute.

The secretary of any trade association is without doubt the most important officer in the direction of its current affairs. A good secretary can make, and a poor one easily break, the organization. A good secretary must have the ability of a diplomat and the capacity of a horse for work. There are naturally many duties of a conciliatory nature to be performed among the several groups in any trade association. Mr. Tuthill has devoted himself unstintingly to serving the American Zinc Institute, and has turned his office into a clearing house of information about the industry. His vigilance keeps the organization informed of activities in Washington and elsewhere that affect its prosperity, and the monthly bulletin which is issued under his direction keeps members abreast of the institute's work.

The outstanding feature of the American Zinc Institute's activities is the fact that it has been able to accomplish so many useful and valuable changes in the industry. It has set a hot pace for itself, and if that pace is kept up no one should be amazed to see further marked changes. Much remains to be done—which no one knows better than the American Zinc Institute—but with the progressive attitude of its officers, and the support that has been given them, other fields will doubtless be conquered.

MORE COST DATA DESIRABLE

Charles M. Schwab, speaking before the institute's annual meeting at St. Louis in 1920, expressed surprise that the zinc producers were so reticent about an exchange of cost information among themselves. His speech is well worth reading again by the producers. The soundness of the friendly after-dinner advice which he gave two years ago is just as apparent today. His theory in accounting for the failure of the zinc business to receive a proper return upon its invested capital was that the zinc producers were not close enough together. His reference to cost information was an illustration of that condition.

G. C. Stone, in a friendly criticism of Professor Hofmann's new book, "The Metallurgy of Zinc and Cadmium," remarks: "If in places it is not as full as we could have wished, the zinc smelters have only themselves to blame. If all of them had given information as freely as a few of the larger ones did, Professor Hofmann would have had the information that would have enabled him to write an even better book."

As soon as the zinc industry follows the copper industry in learning that an interchange of technical information is mutually beneficial, a distinct step forward in producing cheaper zinc will be made.

However, the zinc producers should not be too severely criticised. Highly important changes have been wrought in the industry by the American Zinc Institute since the war, and it is too much to expect a complete eradication of all its defects in four years. Improvements must necessarily be slow, and credit is due the miners, smelters, and rollers of zinc for the admirable spirit they have exhibited at so early a period in their organization. If its record in the past is any indication of what is ahead, a great future may confidently be predicted for the American Zinc Institute.

USEFUL OPERATING IDEAS

Preparing Two Stamp Battery Foundations

Novel Method Used To Make Unreliable Shale Formation Safe—Molten Sulphur Employed To Cement Fractured Concrete

By Bernard MacDonald

THE article entitled "Applying the Cementation Process to a Stamp Battery Foundation," which appeared in the *Engineering and Mining Journal* of March 25, interested me, inasmuch as I had a somewhat similar experience in two instances. Perhaps the facts and the remedies employed may be found of interest by others.

In 1910, I was engaged by the Alvarado Mining & Milling Co., of Parral, Chihuahua, to plan and supervise the building of that company's sixty-stamp cyanide mill at Parral. The rock underlying the mill site was a thin blocky shale, the bedding planes of which had a strike diagonal to the center line of the mill, with a dip of 30 deg. Between the bedding planes of the shale there were knife-blade seams of greasy clay, so that the shale strata could be easily lifted one from the other by pick or bar. Evidently, this was an unreliable foundation for heavy machinery, especially so for the concrete block that was to carry the stamp batteries.

The remedy applied was as follows: On the bench graded for the battery foundation a trench 2 ft. deep by 6 ft. wide by 102 ft. long was excavated in the shale. In the bottom of this trench, holes 3 in. in diameter spaced 3 ft. apart were drilled into the shale to the depth of 5 ft. Into these holes pieces of old 16-lb. rails, 9 ft. long, were dropped. Where these rails rose above the collars of the drill holes they were bent from 15 to 30 deg. and leaned irregularly in all directions. A 2 to 1 mixture of sand and cement was poured into the holes around the rails and allowed to set. The lumber form for the concrete block to carry the batteries was then built, the pipe casings for the holding-down bolts were suspended from the battery template, and the concrete was poured. The concrete block measured 10 ft. in height above the bench floor (12 ft. from the bottom) by an over-all length of 102 ft., with a cross section measuring 7 ft. at the bench level by 3½ ft. at the top or mortar base.

The concrete block was a solid monolith, except that a tunnel 2½ ft. by 2½ ft. ran longitudinally through it on the bench level to give access for the removal and replacement of the holding-down bolts in case of breakage. No movement or cracks developed in this foundation block.

The second instance, which I wish to cite more closely, resembled the one referred to in the *Journal* of March 25.

In 1907, the Veta Colorada eighty-stamp cyanide mill, also near Parral, was being constructed, but work was suspended on account of the panic that occurred that year. Four years later, in 1911, the company arranged to complete the construction, and I was engaged to supervise the work. I found then that the concrete foundation blocks for the batteries which had been poured in 1907 had developed a series of horizontal cracks from 4 to 6 in. apart and extending continuously around the blocks to the depth of 2 ft.; that is, from four to six cracks extended horizontally around the foundation block. The cracks varied from a sixteenth to a quarter of an inch in width. A blow from a hammer on top of the concrete block gave out a cracked sound and would perceptibly jar the block 10 ft. away. These cracks, too, were doubtless due to "badly prepared and badly stamped concrete," and perhaps one layer of the concrete was allowed to set before another was poured on it. After some deliberation the following remedy was decided upon:

A series of 1-in. holes spaced 2 ft. apart was drilled vertically from the top of the mortar blocks to a depth of 30 in., which carried them down through and 6 in. below the cracked zone into the solid portion of the block. Into these holes, pieces of ¾-in. octagon drill steel 30 in. long were dropped, so that their top ends came flush with the top of the concrete blocks. The holes were allowed to dry out for a few days, and then molten sulphur was poured into the holes around the pieces of drill steel. The molten sulphur flowed into all the horizontal cracks and perfectly cemented the parted layers of concrete together, as well as cementing the pieces of drill steel to the sides of the holes. After being set for a few days, the blow of the hammer on the blocks brought out a solid sound and caused no vibration on the top layer.

The battery mortars were mounted on the blocks, and during subsequent operations of the stamp batteries no trouble developed, and the old cracks cemented by the sulphur never reopened.

Checking Assay Samples by Screening Analysis

By A. W. Allen

In the wet-chemical, bulk treatment of ores, the extraction is based usually on the difference between the amount of metal in the charge and in the residue samples. The theoretical estimate often tallies closely with actual recovery, depending largely on the avoidance of mechanical losses and on the accuracy of sampling and assaying. A discrepancy or an excess in yield may be due to a number of circumstances. In some instances a loss may be apparent rather than real, arising not from the disappearance of metal but because the estimate of the amount in head sample or in residue is in error. A simple method of checking the result, to encourage accuracy in one particular at least—in the sampling—is to see that the screening analyses of both are in close agreement, for the metal is seldom distributed evenly among the various sizings.

It sometimes happens, on drying a residue sample of crushed ore after wet-metallurgical treatment, that a cohesion of the finer particles occurs; this affects the screening analysis, particularly when mechanical sizing of samples is being practiced in the laboratory; for under normal circumstances it is difficult to insure the breaking up of small agglomerations of fine material that are mechanically associated with particles of rock of approximately the same diameter. In such cases it is sometimes found desirable to wet the head sample retained for screen analysis, afterward subjecting it to a drying and screening treatment identical to that given to the residue sample. It is possible, if this precaution be taken, to compare closely the screening analyses of heading and residue, and without the need for an allowance in consequence of the cementing of the finer particles in the residue.

It is seldom practicable, in routine work, to make screening analyses by a method or combination of methods that insures absolute accuracy. Dry screening, by means of a mechanical separator, is customary; but it is recognized that the coarser particles in the separated sizings may be coated with a minute proportion of fine dust, and that small agglomerations of slime cannot always be broken up completely by customary methods. Routine screen analysis is essentially for comparative purposes—to demonstrate that, as determined by empirical results, desirable conditions are being maintained. The essential precaution under such circumstances is to see that the physical characteristics of the material and the conditions of the test are maintained constant in every respect.

Surface Arrangements for Hoisting

For cage hoisting, the landing deck arrangements are comparatively simple. The landing deck in almost all cases is placed on one side only and may be covered with steel plate or served by tracks leading to the collar. In the latter case, cross-overs are necessary. The tracks which connect with the plate floor or collar are extended to the ore bins and waste pile. Ore bins, stockpiles, and waste dump are placed as close to the shaft as can conveniently be done.

In skip hoisting, two landing levels are required, one for the skip and one for men and supplies and for changing skips and cages. The skip landing point is of necessity placed above the other landing, to give sufficient height for the bin and chutes. By the use of deflecting aprons, ore and waste can be sent in separate directions.

Two methods for skip and cage changing are in use. In the first the guides are hinged above the collar for a length equal to the maximum length of the cage or skip. The hinged portion is free from the upper and lower sections of the guides. In removing a cage, the hinged portion of both guides in the compartment is turned to one side, the cage hoisted opposite the break and a block and tackle attached to the lower edge of the cage, the upper end of the block being attached to a point above and a moderate distance in front of the shaft collar. The cage is then swung out from the shaft, and, by lowering on the hoisting rope and tackle, it is lowered upon a small flat car. The method requires several men. In the second method, the section of guide timber is pivoted on one end and the lower end swings on an arc. The cage or skip is lowered into a pocket on one side of the shaft collar and below the landing platform. By this method one man can change from skip to cage in about two minutes.

For vertical shafts, bucket dumping arrangements of many different types are in use. Probably the simplest device is a heavy door on which is a short length of track. The door is counterweighted and in position covers the shaft compartment. The bucket is hoisted, the door lowered, and a mine car run over the compartment.

The relative positions of the headframe and hoist depend upon the type of hoist used and indirectly upon the dimensions of the drum. The angle which the hoisting rope makes with the head-sheave plane is called the fleet angle, and is limited to a maximum of 2 deg. The hoist must therefore be placed far enough away from the shaft collar to avoid a larger angle.

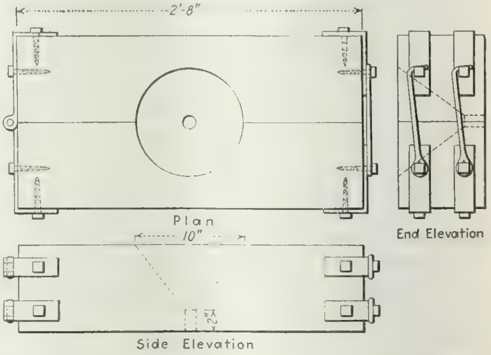
Device for Oiling Hoisting Rope

By Harold A. Linke

A useful device for oiling a hoisting rope may be made as follows: Two pieces of 8 x 8-in. timber 2 ft. 8 in. long are laid side by side, hinged together at one end and hooked at the other end, as shown in the sketch. The timbers are surfaced where they join, so as to make a tight, neat joint. Strap hinges made of $\frac{3}{16}$ x 1½-in. iron are attached at one end with $\frac{3}{8}$ x 4-in. lag screws. The hook angles shown are made of $\frac{3}{16}$ x 1½-in. iron, fastened with $\frac{3}{8}$ x 4-in. lag screws. Hooks are made of ½-in. round mild steel.

Where a lathe is available, a funnel-shaped depression is cut in the timbers as shown, ending in a cylindrical hole 2 to 3 in. long at the bottom. This hole is bored to the same diameter as the rope which is to be oiled.

To use this oiling device, two timbers are laid parallel across the shaft collar and about 10 in. apart, one on either side of the rope. The oiling device is then swung open on its hinges, placed crosswise on the two timbers so that the rope passes through the funnel-shaped hole. The timbers are then fastened together with the two hooks.



Device of timber for oiling hoisting rope

As the cage or bucket is lowered, oil is poured into the funnel in such quantity as may be required. If the rope is to be lubricated with grease, the grease must first be warmed.

Credit for this device is due John Hosking, assistant superintendent of the Arevalo mine of the Cia. de Real del Monte y Pachuca.

THE PETROLEUM INDUSTRY

Oil in the Quadrant Formation in Montana

By O. W. Freeman

OIL was first discovered in Montana in the Quadrant formation of the Devil's Basin about fifteen miles north of Roundup, in November, 1919. A few months later the important Cat Creek field, sixty miles east of Lewistown, was discovered, and in March, 1920, oil was struck forty miles south of Hardin, in the Soap Creek field. The oil of Cat Creek comes from the Kootenai, and though the production is chiefly from the top sand of this formation, some has come from another sand about 200 ft. below the first. This lower sand has been called the Lupton sand. The oil of Soap Creek comes from near the base of the Quadrant and from what probably corresponds to the Tensleep formation of Wyoming. At present there are over seventy producing wells at Cat Creek, five at Soap Creek, and two in the Devil's Basin. Only Cat Creek, however, is served with a pipe line. No oil has been marketed from the Devil's Basin and Soap Creek except for drilling purposes.

Cat Creek Oil Unusual

The oil of both Soap Creek and the Devil's Basin is a heavy black oil. It is low in gasoline but high in lubricating oil. The oil of Cat Creek analyses over half gasoline and is not a normal oil, as it has neither a paraffin nor asphaltic base and contains almost no lubricating oil. It appears to have been fractioned and filtered before collecting in the Kootenai sands, probably by passing through other sedimentary rocks after migrating from its source, which is believed to be a considerable distance stratigraphically below the Kootenai.

In addition to these fields, oil has been found in the Quadrant near the eastern end of the Little Belt Mountains, and oil and gas from the top of the Ellis beds near Kevin, Mont. These cannot be classed as proved fields, however. The oil is a normal, paraffin-base product, dark brown in color, of about 30.1 Bé. gravity. It contains some sulphur and resembles Ohio crude in some respects. The gasoline content is average.

There is a nearly complete Paleozoic series of rocks in Montana. The Cambrian is about 1,000 ft. thick, and next above are found beds of black shale and bituminous limestone usually referred to the Devonian. The Devonian is a source of oil in northern Canada, but in Montana it is an improbable source of oil, as the limestones are exceedingly dense and sand appears to be lacking. Overlying the Devonian is about 1,000 ft. of blue-gray limestone, called the Madison, that is of Mississippian or Lower Carboniferous age. Next above comes the Quadrant, followed by the Ellis and Morrison beds, of Jurassic age, and then the Kootenai, of Lower Cretaceous age. The Colorado shale overlies the Kootenai, and Reeves, of the U. S. Geological Survey, believes it to be the source of the oil in the Cat Creek field. He classifies the chief producing sand of Cat Creek, which occurs just below the shales of the Colorado, as being part of the Colorado itself.

Evidence Tends to Disprove Old Theories

I cannot agree with this interpretation. If the oil came from the Colorado shale or from the Kootenai itself, other suitable closed structures should also be found to contain oil in the Kootenai. In the last two years more than a score of such structures in Montana have been tested to the base of the Kootenai without finding oil, so that it seems improbable that the source of the oil was from the Cretaceous strata. The Kootenai formation itself contains beds of coal and shaly matter derived from plants, but as the formation is terrestrial in origin it contains no animal fossils. Few geologists believe that petroleum is formed chiefly from plant matter, and it is improbable that the oil originated within the Kootenai itself. Regarding the age of the top sand at Cat Creek, which Reeves called Colorado and others have called Dakota, on insufficient grounds: I consider it to be Kootenai, as the Colorado is a marine and the Kootenai is a terrestrial formation. About twelve miles west of Cat Creek this sand outcrops at the surface, where it is cross-bedded and conglomerate in character, thereby indicating an origin either from streams or as the last shore deposit made before the advance of the sea in which the Colorado shales were laid down.

In northern Montana there are sandstone beds within the Colorado; in favorable structures it seems probable that oil could accumulate whose source was the shale of the Colorado, but at Cat Creek it is most likely that the petroleum came from sources below the Kootenai. The Ellis formation, of Jurassic age, contains thick beds of black shale that might have furnished some oil, but the most probable source is the Quadrant formation, which is still deeper.

Cat Creek Field in a Region of Faulting

Many structurally perfect areas in Montana have been tested by the drill through the Kootenai in the last three years, and if only one field has produced oil, one naturally wonders what features are lacking in the others. Most of the structures tested have an adequate drainage area and are perfectly closed. The chief difference is that Cat Creek has been tremendously faulted. There are not any faults of great displacement in the field, but there are scores of faults of from 20- to 100-ft. throw. These faults have an effect upon the location of producing wells, and therefore do not appear to disappear at shallow depth. It appears highly probable that the oil from the Quadrant and possibly from other formations migrated upward through these faults until the sands of the Kootenai were reached. Further migration would then be prevented by the impervious Colorado shale that overlies the top sand of the Kootenai. During the migration the petroleum would be altered and fractioned by filtering through strata of different character. Oil has therefore not accumulated in the other structures that have been drilled to the Kootenai, because there were either no faults to permit the migration of the oil upward from deeper formations, or in some instances the deeper formations may not have been petroliferous in that locality.

If we assume that the Cat Creek oil has migrated from the Quadrant, as seems probable from the evidence available, then the location and character of the Quadrant is of paramount importance to the prospection for oil in Montana.

Paleontologists who have studied collections of fossils from the Quadrant in Montana are not agreed as to its exact age. It is usually classified as Pennsylvanian or Upper Carboniferous. But fossils from the lower part of the formation closely resemble some of the Mississippian fossils, and those from the upper part are similar to fossils that occur in the Red Beds of Texas and Oklahoma. Accordingly, it is possible that part of the formation may be considered of Permo-Carboniferous age.

Wide Variation in the Character of Formation

The Quadrant formation is extremely variable, both in thickness and in the character of the rocks composing it. It may vary hundreds of feet in thickness within a few miles, and stratigraphic section may vary in short distances. Since drilling for oil has extended down into the Quadrant many operators claim that the logs of their wells are identical with Soap Creek or the Devil's Basin wells, which is taken as a sure sign they will find oil. The facts are that the Quadrant is so variable that probably no two wells drilled through it will have the same log. For example, the logs of two wells near Judith Gap, drilled within a few hundred feet of each other, were entirly different. Again, the discovery well in the Devil's Basin found oil in a conglomerate, called the Van Dusen sand, a few feet thick, but in an offset well a short distance away this oil sand did not exist, and the test resulted in a dry hole. Thick beds of oil shale outcrop in the Quadrant around the Big Snowy Mountains in central Montana, but twenty miles south in the Shawmut dome—a favorable structure superficially—no black shale was found in a hole drilled through the Quadrant and well into the Madison limestone. The Quadrant was much thinner at Shawmut than it was a few miles north, and petroliferous material appeared to be entirely lacking, so a splendid structure was non-producing because of the lack of a source of oil.

The Front Range of the Rockies in Montana runs from the northwest to the southeast, and, in the center of the state, anticlinal mountains extend for many miles almost due east from the Front Range. These are the Little Belt and Big Snowy Mountains, which are separated by a syncline a few miles wide called Judith Gap.

In an investigation of oil-shale deposits carried on by the U. S. Geological Survey the richest shale from Montana was secured from the Quadrant near the Little Belt Mountains. The formation is also exceedingly thick here, aggregating 1,400 ft. near Utica and Tyler and averaging at least 1,000 ft., although south of the Belts in the Castle Mountains the Quadrant is only 400 ft. thick and consists of shallow water deposits, with little black marine shale. As one goes west it is found that the Quadrant thins out and finally disappears. Near Stockett and Sand Coulee the Jurassic rests directly upon the Madison limestone and the Quadrant is also absent in the north half of the Front Range of the Rockies in Montana.

Theory of Occurrence

It is therefore believed that there was an extensive land mass extending through Montana during Quadrant time in the approximate locality of the Rocky Mountains, and that this land probably extended east as far as the Missouri River in the latitude of Great Falls. As the Quadrant is thickest eastward along the Little Belt and Big Snowy Mountains, and contains much coarse material there, it seems probable that a great river or ocean current was the cause of the greater amount of sedimentation there.

The Quadrant again outcrops around the Judith and Moccasin Mountains about twenty miles north of the Big Snowies. On the south side of the Moccasins there is an abundance of coarse sediments in the Quadrant, but on the north side the beds are mostly shale. Going north, no further exposures of Paleozoic rocks are found until the Little Rocky Mountains north of the Missouri River are reached. Here the Quadrant has been reported to be entirely absent by the Geological Survey, but it may possibly be represented by a few feet of shale. At any rate, the Quadrant as a mapable formation disappears at about the latitude of the Missouri River.

It is also probable that the Quadrant thins out in eastern Montana. In no place have I noticed any angular unconformity between the Madison and Quadrant. Sedimentation seems to have been continuous, although the deposits were made in shallow water in the Quadrant. It is not known if there was land in Quadrant time in northern Montana, but, if so, its elevation must have been slight, as the sediments seem to have come entirely from the west and not from the north.

A mistake has been made by oil drillers in central Montana in trying to apply the names of the subdivisions of the Upper Carboniferous of the Big Horn Mountains in Wyoming to the Quadrant beds of mid-Montana, when, as a matter of fact, there is present no exact counterpart of the Tensleep, Embar, and Chugwater. The Soap Creek field is comparable, but it would be much better to use local names for the subdivision of the Quadrant further north.

Names Suggested for Newly Identified Series

Around the Little Belt Mountains, W. H. Weed, in U. S. Geological Survey Folios 55 and 56, divides the Quadrant into the Kibbey sandstones and Otter shales. The Kibbey was intended to include the lowest beds of reddish and yellow clayey sandstones and included some reddish shale and gypsum beds. These were overlain by the Otter shales, which vary from black and purple to a vivid coppery green and contain interbedded layers of limestone. To these names I would add two more. Around the Big Snowy Mountains are a series of hogbacks and sloping benches formed by an excessively hard gray fossiliferous limestone that weathers red. This is well exposed on top of Alaska Bench east of the Snowies. A broad valley has been carved in the soft shales and sands that occur below this hard lime. The name of Alaska Bench limestone might well be applied to this bed, which, on Alaska Bench, is 100-150 ft. thick. Just below it are white to red sandstones 300 ft. thick interbedded with varicolored shale. This is beautifully exposed at the east end of Middle Bench a mile west of the post office of Tyler, and might well be called the Tyler sand. Next below are the green shales and limestone of the Otter; at the base are the Kibbey beds.

Above the Alaska Bench cap rock of limestone are beds of black shale usually classified with the Quadrant, but these beds are non-fossiliferous and in part may belong to the Ellis. They are overlain by sandstones and limestones containing Jurassic fossils.

A generalized section of the Quadrant in central Montana would be as follows:

Description of Rock	Thickness Feet	Name of Formation
Black shale	100	
Limestone	50 150	Alaska Bench limestone
Gray shale	100	
Red and white sandstone and sandy shale	300	Tyler sandstone
Gray to black shale and bituminous limestone	400	Otter shales
Green and gray shales	200	
Brown, red and yellow sandstone with shale and gypsum beds	200	Kibbey sandstone

In any specific locality the beds would not coincide exactly with this section, as the formation is variable, but the general sequence will be found to be approximately correct.

If my contention is correct, and the Cat Creek oil in the Kootenai sandstone has been derived from the underlying Quadrant formation by migration through faults, then, so far, all the commercial oil production in Montana has come from rocks of Carboniferous age. In prospecting in new fields it would be wise to select areas known to contain the Quadrant and not to stop drilling until the Madison limestone had been reached.

QUADRANT IN CAT CREEK FIELD SHOULD BE TESTED

It is highly desirable that the Quadrant in Cat Creek be thoroughly tested, which could be done with a well about 3,000 ft. deep, and it is probable that the discovery of a large deposit of black low-grade oil would result. Unless wells in northern Montana, and for fifty miles east of the Front Range of the Rockies, find oil in the Blackleaf sands which make up the lower part of the Colorado formation in that region, or in the Kootenai and Jurassic, deeper drilling probably would be useless, as the Quadrant does not exist there. However, if the new well at Kelvin, which is believed to have entered oil in the top of the Ellis, with an estimated production of ten to fifty barrels per day, proves to be a success, it will pay to test the Jurassic in all the structures of northern and central Montana where it can be reached at reasonable depth. Because the best oil shales have been found in the Quadrant of central Montana, and since good reservoir rocks are closely associated with them, it would seem wise thoroughly to prospect all favorable structures in this vicinity down to the Madison limestone; and it is probable that good discoveries of heavy black oil would be made in the Quadrant.

The Tyler sand, Kibbey sand, and sandy and limy zones in the Otter shale would apparently be satisfactory reservoir rocks. But it must be remembered that any particular bed may become thin or change its character laterally, so that the uncertainty of drilling even in a proved field may be somewhat increased.

In the eastern third of Montana are several large excellent structures in which the Kootenai lies 3,000 to 3,500 ft. below the surface. To test the Quadrant would therefore require a well about 5,000 ft. deep, which would not be practicable at present; and, in eastern Montana, if oil is not found in the Colorado or Kootenai, drilling should cease.

Oil-bearing marine shales have been found in the Soap Creek field north of the Big Horn Mountains and in the Devil's Basin southeast of the Big Snowy Mountains. What the character of the Quadrant is between these two localities is not definitely known. If the absence of black shale and bituminous limestone at Shawmut is a criterion, however, it is possible that the Quadrant is only a few hundred feet thick and probably contains fewer marine deposits in the Musselshell and Yellowstone valleys than south and north of there; accordingly, it would not be as likely a source of oil.

The most favorable sites to test the Quadrant should be between the Yellowstone River and the Big Horn Mountains, and around the mountain uplifts in central Montana. If one were prospecting for oil in the Colorado formation, the most favorable localities to test would be east of the Rockies from fifty to seventy-five miles, and north of the Missouri River, where better sands in the shale beds exist. If a test is desired of the Cretaceous formations above the Colorado—called the Montana group—the best localities would be in east-central and northern Montana. But I believe that the Quadrant affords a better probability for finding oil in Montana than either the Kootenai or the Montana formation.

American Oil Magnates in Mexico Conclude Agreement with De la Huerta

"The Mexican government has shown us every courtesy, and Minister De la Huerta has been most generous in giving us fully of his time in order to cover the various matters under discussion. Much consideration has been devoted to tax problems, and results satisfactory to both parties have been reached.

"As to production taxes, a basis of valuation of petroleum products has been agreed upon, using actual selling prices as a criterion, and providing, moreover, for an increase in the rate of taxation as selling prices advance.

"As to export taxes, the arrangement made by the Mexican government with the committee on Sept. 3 last remains effective, and it is expected that during a conference which the secretary (De la Huerta) will have in New York with bankers, a final disposition of this matter will be reached.

"Views on the future development of the petroleum resources of the republic have been exchanged, and at a later conference it is hoped that a satisfactory understanding may be reached."

The above statement was made at the conclusion of a conference in Mexico City by Walter C. Teagle, speaking for the other members of a committee made up of J. W. Van Dyke, president of the Atlantic Refining Co.; E. L. Doheny, president of the Mexican Petroleum Co.; E. C. Lufkin, president of the Texas Co., and Harry F. Sinclair, chairman of the Sinclair Consolidated Oil Corporation.

Mining Engineers of Note

B. BRITTON GOTTSBERGER

IN OUR undergraduate days we were wont to look askance at professors, believing them to be more or less unapproachable beings. Since then we have discovered that professors are human, very human, and that the aloofness with which we credited them was merely a fabrication of our own weaving. This characteristic perhaps is more desirable in those having to do with the education of mining engineers than with many of the other professions, for certainly the mining engineer requires an understanding of human relations if he is to be a success as an executive. We have heard and read many arguments concerning the ratio of the theoretical and the practical in their relation to the mining engineer's curriculum, but not infrequently that important consideration, the choice of a guiding personnel, is overlooked. In an editorial in this issue we have already pointed out the fact that Yale University is to be congratulated on its selection of B. Britton Gottsberger as professor of mining, and we also feel that Mr. Gottsberger should be felicitated on his choice. His career has been marked by continuous achievement, and that he will make a similar success of his new calling there is no doubt. Mr. Gottsberger was born in Brooklyn, N. Y., in 1874, the son of Francis Gottsberger, who was a native of New York. His mother was Eliza Peck, of Colonial ancestry with New Haven connections. Young Gottsberger attended the Brooklyn Polytechnic Institute, and upon completion of his studies there entered the Columbia School of Mines, where he received the degree of Engineer of Mines in 1895. His early experiences carried him far afield, his first job being that of assayer for the Montserrat Consolidated Mining Co. at Yuscaran, Honduras. In 1897 he was appointed engineer for the El Oro Mining & Railway Co. at El Oro, Mexico. In 1900 he returned to the States and became mining engineer for the Tennessee Copper Co. at Copper Hill, Tenn., ultimately rising to the position of general manager for that company. His excellent work at Copper Hill led to the selection of Mr. Gottsberger as general manager for the Miami Copper Co. at Miami, Ariz., in 1909. This company was just beginning operations at that time, and it was due to his efficient management that the properties have become among the great copper producers of the Southwest. In 1920 he resigned active management of the Miami and moved to New York City, where he has since engaged in consulting practice. Upon the resignation of F. F. Sharpless as secretary of the Mining and Metallurgical Society of America, Mr. Gottsberger was selected for that position, which he has filled admirably. His participation in the various activities of the society, as well as in the American Institute of Mining and Metallurgical Engineers, has evoked most favorable comment, and his example is one which can well be followed by other mining engineers who have the welfare of their profession at heart. Particularly notable has been his work in connection with the recent investigations of mining engineering education which has been carried on by the Mining and Metallurgical Society and the activities of the Mining Methods Committee of the Institute. Essentially an outdoor man, Mr. Gottsberger has always interspersed his professional activities with plenty of exercise, which is one of the rules of successful management. He has been keenly alive to the necessity for recreational enjoyment among the men with whom he has been associated, and his record shows that his success has not been attained merely by technical ability.

B. BRITTON GOTTSBERGER

Few men have to their credit as brilliant a record of management as the new Yale appointee has established during his twenty years of experience. He is considered by those who have been intimately associated with him as one of the best qualified American mining engineers who could be chosen for the task of developing a department in Yale University which is of large importance to the expansion of engineering instruction. Beyond question, Mr. Gottsberger—or Professor Gottsberger, as we will now call him—will meet with the same degree of success in his new field that he attained while *major domo* in the Southwest.

SOCIETIES, ADDRESSES, AND REPORTS

American Zinc Institute Meets at St. Louis

E. H. Wolff Re-elected President—Need of Fund for Advertising Zinc Emphasized—Thacher Asks More Accuracy in Reports of Output and Stocks—Philip N. Moore Optimistic

BY P. R. COLDREN

By telegraph to the Journal-Press

E. H. WOLFF, vice-president and general manager of the Illinois Zinc Co., was unanimously re-elected president of the American Zinc Institute at the close of the annual convention at the Statler Hotel at St. Louis on May 9. He has previously served two terms in the office.

The vice-presidents chosen were: A. P. Cobb, of New York, vice-president of the New Jersey Zinc Co.; Cornelius F. Kelly, of New York, of the Anaconda Copper Mining Co.; and F. C. Wallower, of Joplin, vice-president and general manager of the Goldenrod Mining & Smelting Co.

More than 100 men engaged directly or indirectly in the zinc industry were present at the convention. A report from the board of directors showed that the institute has weathered the period of depression well, and a spirit of optimism, due to the improvement in conditions in recent weeks, prevailed.

The convention was opened at noon May 8, when there was a short talk by the president, E. H. Wolff, followed by an address of welcome by Edwin R. Kinzy, of St. Louis, and a response by C. T. Orr.

IMPORTANT ADDRESSES FEATURE MEETING

Two unusually interesting addresses, each illustrated by lantern slides, featured the afternoon program. One was by R. G. Hall, formerly resident manager for the Burma Mines, of India, who told of the difficulties of mining zinc in that country. He declared that on account of the high cost of labor, caused not by high wages per man, but by inefficiency, and by reason of the remoteness from transportation and the difficulty of securing fuel, the Burma Mines could never compete with producers in the United States.

The other address was by Dr. Charles H. Fulton, director of the Missouri School of Mines, who discussed the practicability of the new process of electro-thermic smelting of zinc. His conclusion, after much experimentation, is that the process may be expected to produce slab zinc from 60 per cent ores at a cost around $13 a ton, exclusive of office expense and roasting of the ores.

Arthur Thacher, chairman of the advisory committee of the Mississippi Valley experiment station, argued for a more accurate report on zinc-ore production and stocks in the Tri-State field. It was the sentiment of the convention that this, if it can be accomplished, will be generally helpful to the entire zinc industry.

The principal social session of the convention was the annual dinner, on Monday evening, A. P. Cobb acting as toastmaster.

BAD ACCIDENT RECORD SCORED

Both praise and friendly criticism of the mine operators of the Tri-State field was offered by Francis P. Sinn, of the New Jersey Zinc Co., in discussing "What Safety Means to the Zinc Industry." In part, he said: "I know of no other operation in the mining, smelting or manufacturing game, where, with so little equipment, so much work is done, so much per man, and so cheaply as in your mines and mills.

"But what of your accident record? For every 1,000 underground workers working 300 days, 4.91 are killed. That means that five men are killed out of every 1,000. In 1917, 1918, and 1919 one-third of the underground workers were injured seriously enough to lose one day or more of time. This record is not a good one." Mr. Sinn urged the zinc producers to pay increased attention to safety work, declaring it would be effort well expended.

C. H. Stewart, of the American Zinc Products Co., read a paper, in which he urged people of the zinc industry to prove their faith in the metal by using more of it.

MORE MINES RUNNING THAN LAST YEAR

In review of the Tri-State field, Otto Ruhl, of Joplin, stated that production recently has increased from around 7,000 tons per week to about 9,000 tons, and said that approximately 100 mines are operating, against an average of sixty last year. He expressed much optimism as to the outlook. Brief reviews of other districts also were given by A. M. Plumb, Howard I. Young, and Charles Bocking.

MUST ADVERTISE ZINC

An appeal for the raising of a fund for advertising zinc, not to exceed $200,000, was made by the publicity committee of the institute. Its chairman, Edwards Gallatly, pointed out that intensive advertising campaigns are being carried out by other makers of roofing material, notably the copper people, and urged that something be done by the institute in making a start at least toward similar advertising of zinc.

"The general subject has been discussed at the annual meetings for several years," he said. "While it has always been one of the important issues at our convention, it has been impossible in the past to treat the subject more than academically, since there has been no real competition and the entire industry is now facing a situation wherein conditions are entirely changed and where real constructive selling and publicity promotion work must be immediately inaugurated if the industry is to progress."

The report was approved by the convention, and the directors were requested to carry out the suggestions made to the fullest extent possible.

PHILIP N. MOORE OPTIMISTIC

One of the most important addresses was made by Philip N. Moore, past president of the A. I. M. E. He showed by the use of graphic charts that the demand and production of zinc, lead, and copper and several other mineral products has been steadily upward since the middle of the nineteenth century, advancing at a great rate when considered in units of decades rather than comparatively brief periods. The natural deduction, he inferred, is that these increases are to continue and the zinc industry must profit accordingly. In part he said: "These cheerful facts teach inevitably that if the producer will hold himself well in hand, will finance himself to produce from an intelligently chosen ore deposit or in a wisely designed plant, guarded against sudden financial surprise, he may go on his way safely, assured that the demands of this land and the outer world will take the product, and if his enterprise be wisely founded, it will, in the period, compensate him satisfactorily for his effort."

It was decided to take a postal vote of the membership to determine whether the 1923 convention be held in St. Louis or in Atlantic City.

Mathewson and Van Law Address New York Section of the Institute

Two hundred members of the New York Section of the A. I. M. E. listened to illustrated talks by E. P. Mathewson and C. W. Van Law at the regular monthly meeting at the Machinery Club on the evening of May 3. The meeting was preceded by a dinner.

[illegible] Lester, who presided, explained that Mr. Mathewson had been commissioned by the New York Section to go around the world and to report what he saw. Having an invitation to [illegible] a small smelter problem in India, Mr. Mathewson had undertaken the task. His route has been through London, Paris, Port Said, [illegible], Colombo, Rangoon, Penang, Singapore, Hongkong, various cities of Japan, and thence to the Golden Gate. His impressions of these places were related in Mr. Mathewson's own, not-to-be-imitated style. He described [illegible] scenes at Port Said; he explained ancient methods of mining and smelting by the Chinese; he described Burma elephants, described tiger hunting by others and by himself; and he declared his belief that the Japanese were "the most wonderful people on the face of the earth." He told of their remarkable achievements of half a century.

Mr. Van Law's most recent travels had taken him through Peru. Among others he showed pictures of the remarkable Central Railway of Peru that runs inland from Callao, crossing the Andes at an elevation of 15,665 ft.; the Cerro de Pasco mines and plants; the unique port of Mollendo; and, most interesting of all, the amazing masonry of the ancient Incas at Cuzco. As to the future of Peru, Mr. Van Law explained that the high cost of trans-Andean transportation was a serious obstacle.

MEN YOU SHOULD KNOW ABOUT

Alfred James is in Mexico City.

H. C. Dudley is at Chihuahua, Mexico.

J. MacDonald Mitchell has returned to New York from Bolivia.

D. M. Riordan left San Francisco recently for an extended stay at San Diego.

D. W. Brunton passed through San Francisco on his return from Tahiti to Denver.

J. A. Burgess is making a geological examination of the Comstock Silver property on the Comstock.

C. D. Kaeding, of San Francisco, has been inspecting operations at Rochester and Candelaria, in Nevada.

J. J. Mac Donald is now at Crown King, Ariz., in the interests of the Crown King Consolidated Mines, Inc.

Harold Stotesbury, consulting engineer, of San Francisco, has been in Reno and Tonopah, Nev., on professional business.

J. T. Shimmin, superintendent of mines for the Chino Copper Co., at Hurley, N. M., is now in New York on business.

J. D. Sears, James Gilluly, and **W. H. Bradley** will do geological work in Moffat County, Col., during the coming field season.

A. F. Fath and **W. W. Rubey** are to make a study of oil prospects in the part of eastern Wyoming which borders on the Black Hills.

Kuno B. Heberlein, president of the International Process and Engineering Corporation, is now in Europe on an extended business trip.

Charles Butte is investigating the stratigraphy and the paleontology of the lower paleozoic formations in Georgia, Alabama, and Tennessee.

Henri A. Cardozo, manager for the Societe d'Alectrometallurgie de Dives, operating near Grenoble, France, is visiting our Western copper mines.

A. M. McDermott, general manager of the El Fuerte Mining & Smelting Co., of Los Angeles, Cal., is in Mexico City on business for the company.

John H. MacKenzie moved to new offices on May 1. His address is now Room 1312, California-Commercial Union Building, San Francisco, Cal.

A. J. Collier has been sent by the U. S. Geological Survey to study the geology of the region near Avon, Mont., as a result of the discovery of oil there.

C. E. Dobbin, A. H. Redfield, and **J. E. Hoffmeister** have been assigned to work on the coal fields of Garfield County, Mont., for the U. S. Geological Survey.

A. J. McQuatters has retired from the presidency of the Alvarado Mining & Milling Co. He has been president of the company since its incorporation in 1910.

Shigeichi Sugihara, a Japanese mining engineer, is studying copper mining and milling processes in the Southwest, at Nacozari, at the Chino mines, Miami, and Ray.

W. W. Wishon, recently elected director of the White Hills Mining Co., of Mohave County, Ariz., has just completed an inspection of the properties of that company.

W. S. Greene is leaving for Mexico, having been engaged as designing engineer for the construction of the 250-ton cyanide plant of the Cia Minera Mexicana, Las Tejones, Yaga, Nayarit, Mexico.

Charles F. Jackson, for the last four years connected with the mining engineering department of M. A. Hanna & Co., Cleveland, is now associated with Crowell & Murray, Cleveland, as mining engineer.

Ivan J. A. Diamond will leave the Kambove mine, in the Belgian Congo, some time in June. His address after July 15 will be in care of the Institute of Mining and Metallurgy, Cleveland House, City Road, London, E. C.

W. H. Webster, who has been connected with the Copper Queen Branch of the Phelps Dodge Corporation, and latterly as assistant manager, was recently tendered a reception and banquet by his friends in Douglas. Mr. Webster is leaving for New York.

Rowland King, of the C. M. Fassett Co., Inc., at Spokane, has been chosen first president of the International Association for Mining Development, an organization formed this spring for the purpose of bringing owners and capital together for the development of Northwest mining properties of merit.

Mining and metallurgical engineers visiting New York City in the week ended May 6, included: **Elmer Bird**, of Little Rock, Ark.; **D. R. Semmes**, of Tampico, Mexico; **W. A. Reiter**, of Dallas, Tex.; **H. A. Barker**, of London; **E. W. Engelmann**, of Salt Lake City, Utah; **R. H. Townsend**, of Mexico, D. F.; **Guillermo Machado M.**, of Caracas Venezuela; **H. Hardison**, of Santa Paula, Cal.; and **John Daniel**, of Calumet, Mich.

OBITUARY

C. H. Ellsworth, of Goldfield, Nev., died on April 25, 1922. Mr. Ellsworth was born in 1871 at Chico, Cal. He entered the employ of Abbot Hanks in the early 90's and remained with him for seven years. When he left for Goldfield he was in charge of the Hanks's assay laboratory. At Goldfield he was solution man in the Combination mill. In 1905 he started an assay office in Goldfield for himself.

Stephen Rickard, assayer and chemist of Denver, Co., died on April 8, at the age of sixty-seven. He was born in London, England, the son of William T. Rickard, and became an American citizen in 1896. In his early life Mr. Rickard was associated with his father in the operation of mines successively in Sardinia, Newfoundland, Arizona, and Nevada. He was assayer and chemist at Anaconda from 1884 to 1887, and later occupied a similar position at the Argo smelter, at Denver, until 1898, when he opened an assay office of his own at Denver, conducting this business successfully up to his death.

William J. West, for the last five years manager of the eastern district on the Mesabi Range, for the Oliver Iron Mining Co., with headquarters at Virginia, Minn., died on April 25 at the Presbyterian Hospital at Chicago, Ill. Mr. West's first experience in iron mining was at Tower, Minn., where he superintended the development of some properties in the late 80's. In 1900 he was in charge of the Sparta mine, at Sparta, and later at the Sharon properties at Buhl, Minn. In 1905 he was made general superintendent of the Oliver properties at Hibbing, remaining there until he moved to Virginia as district manager. Mr. West was a prominent figure on the Mesabi Range, and his loss will be mourned by many friends. He was an able executive, a keen sportsman, and a thoroughly lovable character.

New Books

A Study of Conditions Affecting The Manual Worker

REVIEWED BY T. A. RICKARD

Labor's Challenge to the Social Order. By John Graham Brooks. The Macmillan Company. $2.50.

This is a book that should be read by engineers, and others responsible for the employment of labor in industry. The author, John Graham Brooks, is well known as an earnest student of sociology. I have heard him lecture and I have read his 'Social Unrest'; he gives the impression of sincerity of purpose—and that, with intelligence is what we ask of any writer on such a serious topic as the labor problem. In this book he gives the reader the result of his "study of power rapidly and in part accidentally acquired by labor". It is a study of the effects of the War on the laboring class, an examination of the advantages and disadvantages that have accrued to labor in consequence of that great upheaval in the structure of human society. "The same applied science which tightens us into world unities has in a thousand ways put dangerous tools within easy reach of many. The wider education has scattered explosive ideas, while popularized chemistry with other sciences has given to the masses the readiest access to material weapons which the more reckless will never leave unused. Here again, war has been a terrible instructor." He insists that the dominating power of organized labor must be recognized and that the obvious thing to do is to obtain the "assent and co-operation" of the best men in the ranks of labor. "The class which Burke called 'swinish' and Hamilton 'the beast' is now so far in control that it cannot be dislodged. It will retain its power and add to it. Very wastefully and with many rank abuses labor is now to try its hand in managing politics and industry. It has come to believe and upon the whole rightly believe, that the upper classes alone are at the end of their rope; that they are incompetent any longer to direct social forces without disaster to us all."

The author is of the opinion that it is wise to let labor try its experiments, but his mental pose evidently is too detached to be convincing to those who actually employ large forces of men industrially; his cheerful acquiescence in the dominance of the less educated members of the community will irritate many of us in the professions. "So far as it is the aim of these attempts to keep labor from trying out its own revolutionary program, they will as certainly fail as the futile 'Antis' will fail to stop the woman's vote, or as Mr. Gompers will fail to keep the unions long out of politics. We in the United States drift steadily toward the European situation. Labor there at the present moment holds a balance of power which alters every factor in the problem. Before we are prepared for it it will be true in our own country." To which I demur in part: the separation of the classes in Europe is more definite and more fixed than in our country; moreover, the distribution of property—of homes, bank savings, and bonds among our working people is such as to bridge the gap between capital and labor in the United States, as in Canada; Mr. Brooks is laying too much stress on the class consciousness of the American laborer; the laborer of today is the manager of tomorrow; we as a people have the ability of social self-extrication in such measure as is rare in Europe. However, I agree with him heartily when he says that "for capital, the day of the lone hand has closed"; also for others because the playing of the lone hand is a poor kind of a game; systematic co-operation is the keynote of progress in human affairs, for individuals and for nations. Class feeling like nationalism, has been perverted to anti-social uses. The hope of mankind lies in the recognition of the fact that these inter-class and international feuds are mutually destructive. As our author himself says, in another chapter: "For any real approach to humanized relations among the nations there is one test: the acquired habit of working openly and generously together as if the prosperity of one was the prosperity of all".

In another chapter Mr. Brooks discusses the spread of unionization to classes other than labor and the consequent new alliances that are available to labor in its effort to secure political power. It is only too sadly true that unorganized employees are at a great disadvantage in protecting themselves against unfair treatment from their employers. The school-teacher and the college professor are examples of unorganized groups that fail to protect themselves. Many of them refuse the protection that might come by means of unionization, largely because such organization savors of the 'unprofessional'; it is tainted with social vulgarities and misdemeanors; it is repugnant. Nevertheless, it seems certain that the time will come when all forms of labor—by brain as well as by brawn—will find self-organization the most practicable method for redressing social injustices. The employer class is thoroughly organized: every corporation is a union of stockholders; corporations make unwritten agreements among themselves in regard to ways and materials; the Government itself represents the unionization of a political party for the obtaining of power and the distribution of patronage. In co-operation there is strength. Again, the lone hand is a poor game.

An interesting chapter is devoted to "syndicalism". This, as most of my readers are aware, is a term and a method that originated in France; it stands for the sympathetic strike, for the federation of all classes of labor in the effort to assist any one class in obtaining its demands. It has been called "a protest against a State corrupted by capitalism." In the United States we associate syndicalism with the Industrial Workers of the World, a movement that has aroused widespread agitation, contempt, and opposition among the employers of labor. Mr. Brooks says that the I. W. W. movement has defects that are "common and vicious", but he insists that it can not be dismissed with disdain; that it must be studied carefully and opposed intelligently. Indeed that is the consistent undertone of his writings; he pleads for a scientific, and also a sympathetic, examination of these manifestations of labor unrest, insisting rightly that only by a correct understanding of the motives and purposes of such manifestations is it possible to use what is good in them and to fight what is bad in them. "These social maladies, as causes, can no more be disconnected from phenomena like the I. W. W. than tuberculosis and high infant mortality from rickety and sunless tenements." What is needed is insight and sympathy. The annual labor turnover among the I. W. W. is over 500%. Much of this vagrancy is due to the fact that they belong largely to the hobo or tramp type of human derelicts. Fully 90% of them are unmarried; they are "womanless, voteless, and jobless". They are the product of the lumber camp and of other temporary communities of the less civilized kind. Many of them are the result of the injustice to which they have been subjected. "The shacks in which they were housed", says Mayor Ole Hanson of Seattle, "were unsanitary, and the men were marooned in a wilderness without any amusement whatsoever, even a chance to read. When they were paid off and visited Seattle, nobody greeted them but the I. W. W. agents, and the only places where they got any welcome were the saloons, where they dumped their dunnage and even deposited their pay-checks." So the Mayor used nails in default of the law and closed the 'wobbly' halls. He suggested "more cemeteries" as the only cure for the evil. That is the kind of social philosopher he was, and yet he was acclaimed at public meetings all the way from San Francisco to Boston. His idea of a method for suppressing the I. W. W. and others like them is the one that meets the approval of the unthinking because it is the 'direct' method; and yet when the labor-unions start to use a 'direct method', we find a wholly different public reaction. Lawlessness is lawlessness whether invoked by a mayor or a hobo. The cure is education, the intelligent discussion of economic problems, and a fixed purpose to be just to all members of the community.

Only "a little less than one hundred years ago, men trying to get collective bargaining were hung. There was a popular fury against them closely akin to the New England mania over witches. All dangers to society could be put upon these new conspirators just as our I. W. W. are now made a scape-goat for every sin, real or imagined". There is some truth in this, but it is exaggerated. We do not impute "all dangers to society" to the I. W. W. and their likes; most of us are willing to lay some of them to the unreasonable and unintelligent opposition of the unprogressive representatives of entrenched capital to [illegible] Judge Gary, who choose to regard the labor problem merely as a [illegible] matter, which is exactly what Mr. Brooks reprobates. As he suggests, what is needed is co-operation between the thoughtful and well meaning—that [illegible] the sufficiently social [illegible] its economic [illegible] on both sides. They can work together to transform the existing system "by slowly putting something better in its place". Among the labor leaders there are many whose methods are not those of delirious persons who cannot wait for things to happen". For instance, it is well to give the theorists among the radical laborites a chance to learn by experiment. Concerning the proposal to run a mine, Mr. Brooks says: "The supposition that the least skilled of the labor mass, if once given a chance, can take over the management of industry is among the most fantastic of utopian freaks".

The proposal was made by Moyer, Haywood, and St. John that the I. W. W. should buy a mine with union money and run it, just "to show the world what could be done in the way of business". They were to levy assessments to get the money needed to buy the mine and they would set aside the profits for union purposes. The mining enterprise would serve as a test of industrial democracy as they understood it. The leaders had said that "capital got three-fourths of the product" of mining enterprise; their own experiment would have shown them better. It was a pity the idea was not put into action. They would have discovered that in the running of a mine, as in running their own organization, they were lacking in business experience; they might arrange for the world's financing, but they could not conduct a relatively simple undertaking. "The mine would have failed, but one of those elementary lessons which go-it-alone-labor has got to learn would have gone on record." Perhaps if "a few hundreds of them had put their money into it with that 'practical knowledge of mining' which they said they possessed far more than directors and owners, some sense of proprietorship would have developed among the I. W. W. investors". They might have been shown the falsity of their 'philosophy' and the untruth of the first plank in their platform: "The working class and the employing class have nothing in common". On the contrary, as Mr. Brooks says, "there is a vast network of up-and-down ties between employers and workers in which economic interests of the most vital sort are strictly in common. This common interest moreover will hold until labor learns its own independent superiorities in producing and distributing wealth. It may some time accomplish this, but its success at every step will depend on a long co-operation with industry in the hands of employers. Labor is not through with this schooling." Of course, not; labor is at the beginning of education in such matters. The community as a whole is only beginning to study its own economic problems, and the education in them, like education generally, must filter down, from the few to the many.

The I. W. W. movement in its unreason and criminality represents a social disease; as an expression of anarchy it plays the part of a social drain-pipe. Our author quotes the Webbs approvingly: "If the anarchist creed did not exist, it would almost be necessary for the socialists to invent it, as the drain-pipe to carry out of their organizations those nuisance-elements of revolt, envy, mortified vanity, and the impulse to bear false witness against one's neighbor". To which Mr. Brooks adds: "Each society has its swampy miasma to be made wholesome by social engineers who know their business too well to revive again the ways of the medicine man. A traveler, quoted by Fraser, tells of a tribe stricken by miasma. The mists they said were full of devils only to be driven off by howlings and throwing of spears. It was not a question of drainage or destroying mosquitoes, but of drums, shouting and hurling of darts. This was the local patriotism of the time. We are not yet rid of the medicine men. Some sit in Congress and other high places. They still put faith in noisy activities having as little relation to the causes of our trouble, as the contortions of their ancient brothers. In method they are strictly on a par with the I. W. W." Again he says: "When shall we get statesmen with sagacity and forehandedness enough to recognize that heavy-handed ways as crude as this [the suggestion of 'plenty of rope'] merely close the factional strife and apathy within radical labor ranks, thus arming them with the very weapons they most need? There is at this hour, no danger so great as this playing into the hands of the least responsible in the labor class." This is the main thesis of the book, together with insistence upon investigation of the causes of trouble and the need for co-operating with the intelligent leaders of labor in a sincere effort to promote both social peace and industrial welfare. For example, I suggest, when the 'wobblies' came to Seattle it would have been better for the city, as represented by its Mayor, to provide clean lodgings and a little wholesome soup, together with some elementary information on social economics, by printed word or spoken utterance, than to treat these vagrants as if they were already—what they were likely to become—the bubonic rats of the social *ménage*.

I have quoted enough from Mr. Brooks to indicate the style of his writing, which is colloquial. He, like many writers ranking above him, such as Bryce and Wells, shows no evidence of having studied the technique of the art of writing; a few simple lessons would help him greatly. In this respect he resembles many who live by publishing books; and that is why so many books are hard to read. His own, the book under review, is so full of information and suggestion, it is so suffused by keen intelligence and sincerity of purpose, that its infelicities of diction can be forgiven. It is a book that the mining engineer ought to read because it will give him not only a valuable insight into a pressing problem, but suggestions to be used by himself in his management of employees at mines and smelters.

An Economic Geology for the Student

General Economic Geology. A Textbook by William Harvey Emmons, Ph.D., McGraw-Hill Book Co., New York. 1922. $4.

One would have said that there was no further room for textbooks on economic geology; yet there is room for this new one by Professor Emmons, who is in a fair way to establish himself as the foremost writer of textbooks on his specialty.

The present volume is, as explicitly stated, a textbook. It is not so much for the geologist as for the student, whether in college or outside. Its great merit is that it presents in a relatively small compass the essential features of the geology, not only of the metals, but of the so-called non-metallic ores, and of the fuel minerals—coal, oil, oil shale, and asphalt. The subject of coal is first presented; then that of petroleum and gas; then the question of metallic ores is taken up from the genetic standpoint—possibly a shade too much so in consideration of the general simple purpose of the volume, though to be sure it is always easier to criticize than to improve. At any rate, the explanations are clear and brief. Then come building materials; then the "nonmetallics," like mica, graphite, magnesite, phosphates, and sulphur, which get short shrift in the normal economic geology textbook. Then comes special consideration of iron; and then successively appear gold and silver, zinc, and lead; and finally the less important metals.

Of course, the book is a compilation, and one can see the process of compression and assimilation from Professor Emmons' other textbooks, and from the books of other authors. But it is an intelligent, carefully weighed and mixed menu, into which the author has put his own very considerable experience and judgment. J. E. S.

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Human Relations

Pulling Together. By John T. Broderick. Robson & Adee, Schenectady, N. Y. $1.

This valuable little book is an interesting presentation of the problem of co-operation between employer and employee, through shop committees and other devices. The argument is presented as a conversation between a manufacturer, a salesman, and the author, in a smoking compartment of a railway train.

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Metal Prices and Production

Metal Statistics, 1922. The American Metal Market, New York. $1.

The production of all the more important metals over a long period of years is given, as well as consumption, stocks, grades, imports and exports, and prices as published in the daily editions of *The American Metal Market*. This little red book is well and favorably known to the metal trade.

THE MINING NEWS

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Leading Events

THE 10 per cent tariff on potassium cyanide provided for in the McCumber-Fordney bill has been the subject of a debate in the Senate, there being a difference of opinion among the Western Senators. The minority report on the tariff bill has been made.

On the Rand, recovery from the effects of the recent strike will require six months, according to advices received in Washington. Reuter's Agency states that an indemnity bill has been debated rather bitterly.

Cessation of smelting operations at its Cockle Creek works has been found necessary by the Sulphide Corporation, New South Wales.

Mount Morgan's future is still in doubt, despite its Government subsidy—this being on account of the metal market situation.

The outlook continues improving in the Lake Superior iron country. In particular, the Oliver Iron Mining Co. has just issued orders to increase the scale of its operations at four mines on the Gogebic Range.

Reorganization of the Sydvaranger company, in Norway, has been effected, and operations will soon be resumed at its iron mines, the most northerly in Europe.

Work on Middle Mines Group on Comstock Dropped

By Telegraph to "Engineering and Mining Journal-Press."

Virginia City, Nev., May 8—All work was stopped on the Middle Mines group at Virginia City on May 3 by orders from New York. No reason was given, and future plans were not announced. Local opinion in general is that development to date has been satisfactory, with the most promising ground ahead. A payment is due June 1.

The operations just discontinued were being conducted by the Paramount Comstock Mines Co., an organization recently effected by Dr. R. M. Ward, of Philadelphia and New York, and associates, who took the group under option after the previous option held by the Boericke interests was dropped

Replogle Steel to Resume

The Replogle Steel Co. will start one of its two blast furnaces at Wharton. N. J., about May 15 on stock ore. Work will probably be resumed at the mine and mills also not long thereafter.

Recovery from Strike on Rand Will Take Six Months

In a memorandum issued by the executive committee of the association of Chambers of Commerce of the Union of South Africa, it has been estimated that the various labor disturbances, strikes, and rebellion during January, February and March cost the public at least £9,000,000, according to the Department of Commerce.

The loss of this huge sum has affected every section of the South African community, the farmer, the wholesale and retail merchant, the industrialist, the forwarding and shipping agent, and the body of workers. Business has been badly shaken, and although the lessons to be derived from the manner of settlement inject a hopeful confidence for the future, allowance must be made for the time necessary for full recuperation, which, according to a report of the Standard Bank of South Africa, Ltd., will take at least six month.

By Reuters Agency

Capetown, April 22—In the House of Assembly today the Indemnity bill arising from the Rand revolution was read for the second time. The opposition speeches were marked by the same bitter attacks on the Premier and Chamber of Mines as characterized the debate on the first reading. The Minister of the Interior, P. Duncan, announced the appointment of a committee to investigate claims and to make recommendations regarding compensation for damages. General Smuts, replying during the debate in a vigorous fighting speech, said that the commission appointed to investigate the recent strikes was more necessary than ever, because, owing to the mine owners' victory, there were dangers that employers would refuse to take into account the voice of organized labor. The government (he said) could not countenance tyranny by either side.

Butte & Superior's Settlement

It is reported that Minerals Separation will settle its flotation litigation with the Jackling companies for something under $5,000,000, of which Butte & Superior's share will be about $800,000.

Oliver Iron Orders Full Time at Four Gogebic Mines

By Telegraph to "Engineering and Mining Journal-Press."

Iron Mountain, Mich., May 8—Orders have been issued by D. E. Sutherland for the Oliver Iron Mining Co., that 2,000 men at the Norrie, Aurora, Pabst and Puritan mines are to increase their work from half time to full time on May 8. It is also reported that similar action has been taken at all other mines of the company in Michigan.

La Rose Mines Appeal Dismissed

The appeal of La Rose Mines, Ltd., of Cobalt, Ont., in connection with the O'Brien-Violet case, has been dismissed with costs, the O'Brien cross appeal being allowed, with costs. It is thought by the O'Brien officials that the decision puts the 600 ft. shaft 20 or 30 ft. on the O'Brien side of the boundary line. D. Lorne McGibbon, president of the La Rose company, states that no decision has yet been reached as to whether or not the case will be taken to the Privy Council.

Against Raw Asbestos Embargo

President W. G. Ross of the Asbestos Corporation of Canada, Ltd., addressing the annual meeting of the company at Montreal on April 26, said that the placing of an embargo on the export of raw asbestos, as had been advocated, would kill the asbestos-mining industry. If this policy were adopted, he said, the world's supply of raw asbestos would be drawn from Rhodesia, Russia, and the United States, and Canada could mine only sufficient to supply her own needs.

News from Washington

By PAUL WOOTON
Special Correspondent

Duty on Cyanide Causes Debate in Senate

McCumber's Allegation That Protection Is Needed Denied by Pittman—Smoot Against Tariff

The Western Senators, without regard to party, are divided in their opinion as to whether or not cyanide should be on the free list. The Republican members of the Ways and Means Committee of the House put it on the free list. Republican members of the Finance Committee of the Senate amended the bill so as to take it off and make it dutiable at 10 per cent ad valorem.

Senator Oddie, Republican, and Senator Pittman, Democrat, both of Nevada, are leading a determined fight in the Senate against the action of the Finance Committee. Senator McCumber, the chairman of the Finance Committee, made the following contribution to the debate:

"We have a monopoly in Germany, a monopoly in Canada, and a monopoly in the United States. There is no question that if any one of those three were left entirely alone to fix the prices, we would undoubtedly pay rather heavily for our cyanide. There is competition between the Canadian monopoly and the American monopoly, and also some competition between the German cartel or monopoly and the American monopoly.

"The Senator will remember that when we got into trouble and needed this cyanide or sodium cyanide very badly, the price went up from about [illegible], I think, to practically $2 per lb. That shows the situation we would be in whenever we were not producing it in the United States. Is there not some danger that if we do not protect this home industry, even though we have but one manufacturer, as against another manufacturer in Canada and another manufacturer in Germany, and if we put the American entirely out of business, that the other two may easily combine and fix our prices? Is it not best, if we can do it, to maintain an industry in the United States even though it costs on the basis of what may perhaps in the near future be the equivalent of an ad valorem duty of [illegible] per lb. and if it comes down to [illegible] per lb., the old price, it would be simply 1 cent per lb?"

In reply, Senator Pittman said:

"I will answer the Senator directly and say that this duty is not essential at all—and I do not believe he thinks so—in order to keep the Roessler & Hasslacher Chemical Co. going in this country. I think that the profits of that institution, as shown by the report of the Alien Property Custodian, and as shown in the hearings of the committee, and never denied by the Roessler & Hasslacher Co., prove that they could sell the material for about half what they are now selling it for."

Senator Smoot, among other things, said:

"Just as surely as we live, that is what is going to happen if we put cyanide upon the free list: So far as the manufacture of cyanide in this country by the Roessler & Hasslacher Co. is concerned, it is going to cease, for they can make greater profits by buying cyanide in Germany and selling it in this country than they can if it is put on the free list, and selling it in competition with Canada.

"I am as sure as that I live that that will be what they will do; they will import it into this country, and they tell me that is what they will do under the 10 per cent duty."

Coal Strike Situation Unchanged

The beginning of the second month of the coal strike found each contender well dug in, and prepared to settle down for an indefinite period of trench warfare. Despite the fact that a score of coal specialists in Washington are constantly on the watch for any sign which may have significance, they could point to no important change in the situation at the end of the first week in May. The worst feature is that no one sees a prospect of anything more than a makeshift peace. Secretary Hoover admits that something more fundamental must be done than try to patch up the present quarrel, but that is as far as he is willing to go at this time.

Shasta County Taxation Case Not To Be Reviewed

The U. S. Supreme Court has refused to review the lower court's decision in the case of the County of Shasta, Cal., vs. The Mountain Copper Co. and The Balakala Consolidated Copper Co. In this case Shasta County failed in its effort to increase the valuation of the copper companies for taxing purposes.

Government's Silver Purchases

Purchases of silver by the Bureau of the Mint during the week ended May 6 amounted to 1,610,000 fine ounces. This brings the total purchases under the Pittman Act to 109,471,356 fine ounces.

Potash in New Area of Texas

The discovery of potash in a new area in Texas is announced by the U. S. Geological Survey. The find is brought to light through the analysis by the survey of drill cuttings collected from the Santa Rita No. 1 well, drilled by the Texon Oil & Land Co., in the southwest corner of Reagan County, Tex. The sample, which, according to the driller's log, was taken from bailings after drilling from 1,150 to 1,165 ft., contained the equivalent of 2.46 per cent of K_2O; that from 1,175 to 1,182 ft., 5.63 per cent; 1,155 to 1,265 ft., 5.65 per cent; 1,265 to 1,275 ft., 2.50 per cent; 1,275 to 1,283 ft., 6.38 per cent; 1,283 to 1,293 ft., 7.88 per per cent; 1,293 to 1,300 ft.

Minority Report on Tariff Bill Before Senate

Alleges Lack of Rule for Measuring Protection — Beneficiaries Seek High Profits, It Charges

The Senate received the minority report on the tariff bill on May 6. Among other things the report declares:

That there is no definitely fixed rule to measure the amount of protection accorded.

That the aggregate burdens imposed on the people by the tariff bill will be greater than the burdens imposed by direct taxes levied by the revenue bill—between three and four billions of dollars.

That the standard of wages in foreign competing countries is today more nearly equal to the American standard than ever before.

That the cost of products bears a much slighter relation to daily wage paid to labor than in former times.

That selling prices neither in this country nor in foreign countries are measured by the cost of production and that profits constitute a far larger element in these selling prices than all other elements.

That the tariff beneficiaries believe that embargoes and prohibitions upon foreign imports will enable them to reap the exorbitant profits of war times.

That the bill ignores the principle of imposing rates to measure the difference in labor costs or in production costs here and abroad.

That the so-called invasion of our markets by foreign countries amounts only to 4 per cent of our annual production, whereas our invasion of foreign markets amounts to 7 per cent of our production.

That if American goods can compete with foreign goods in the markets of the world they can compete with the same goods in our own markets without entailing any disaster.

That the rates of the bill are from 40 to 50 per cent higher than the Payne-Aldrich bill, considering the present higher prices of imported merchandise. In many instances they are absolutely prohibitive.

That the Senate has not improved the Fordney bill.

That in substance the present bill if properly entitled would be "an act to mortgage the country and its resources to the protected and monopolized industries."

No Review of Quicksilver Case

The U. S. Supreme Court has declined to review the decision of the lower court in the case of the American & British Manufacturing Co. vs. McNear. McNear recovered on contracts for the sale of quicksilver by the American & British Manufacturing Co.

News by Mining Districts

London Letter

City Deep Shows Total Profit of £711,516—Development Tonnage Drops; Cost Increases

By W. A. Doman

London, April 26—The City Deep report for 1921 has now come to hand. This mine is one of the most interesting properties on the Rand. For years after the amalgamation took place, it was the sport of rumor; a dead set was made against it, but the predicted failures never materialized. The company has continued to pay dividends, and though the amounts have varied, it is worth noting that to the end of last year it had distributed £3,760,250 from the milling of 7,095,943 tons and the recovery of 3,140,963 fine oz. of gold. This is not a bad record. Like other companies on the same field, it has benefited greatly by the so-called premium on gold, for last year this additional price accounted for 62 per cent of the total profit earned. With gold at 84s. per oz. the profit was £270,140; the additional revenue from premium brought in £441,376, and the total working profit was £711,516. With miscellaneous revenue, the amount was raised to £718,585. From this amount must be deducted capital expenditure, £96,203, and taxes, £114,439, or, altogether, £210,642, leaving available for distribution from the year's operations, £507,943.

Gold account was..........	£2,198,825
Available on the year......	£507,943
Dividends paid	£485,625
Dividends, per cent........	37½
Per cent of gold recovered distributed..............	22

The company has a substantial carry-forward, but percentages can be cal--culated only on actual distributions.

Working costs were a shade below those of 1920—that is, 29s. 11d. per ton—against 30s. 2d. per ton. A better comparison perhaps is to be got by taking the cost per oz. In 1920 it was £3.70 and last year £3.554. A heavy item in expenses apparently was development, for each ton milled was debited with just over 3s. per ton, as against a little more than 2s. 6d. per ton the previous year. To appreciate the actual position, however, it is necessary to look at the fresh tonnage opened up. The figures are:

	1920	1921
Pay tons developed..	598,500	342,200
Average value dwt. .	8.9	9.4
Cost of development.	£108,890	£149,265
Cost per ton	3/8	8/9

This is a substantial increase in costs, and a heavy fall in tonnage developed. The explanation, of course, is that an abnormal amount of dead work, nearly 8,000 ft., was necessary, and opened up no ore. It will be noticed that the average value of the new ore is ½ dwt. higher. This increase, however, does not mean that any general improvement in value has taken place, but that in view of the decreased selling price of gold, and the fact that working costs are not likely to decrease as rapidly, the pay limit taken for estimating the payable ore reserves has been raised. The stoping width has also been increased. The ore reserves have declined in the following manner:

	1919	1920	1921
Tons....	3,418,050	3,099,200	2,428,300
Average value dwt.	9.4	9.0	8.8

The Main Reef Leader is the chief gold carrier, and last year, of 1,130,917 tons mined, no less than 1,056,148 tons was stoped from this body. Extraction has reached a high pitch, for the actual of 96.3 per cent in 1920 was raised last year to 96.7 per cent. The average of the 12.1 per cent of waste rock discarded was .2 dwt. gold per ton. At the end of the year, the No. 2 incline shaft was 5,312 ft. vertically below the surface. It has another 200 ft. to go for its destined depth of 5,512 ft. The south shaft has reached a vertical depth of 4,470 ft. The quantity of sand lowered into the mine during the year was 137,711 tons.

An attempt is being made to reopen the Great Laxey Mines, in the Isle of Man, partly to give employment and partly to get the lead.

CZECHOSLOVAKIA

Four Out of Twenty-four Iron Furnaces in Blast—Seek to Merge Companies

Prague, April 25—Recently the iron industry of Czechoslovakia has made the most strenous efforts to form a concern including all the leading works of the country. The three largest iron works of the republic, the Prague Iron Industrial Co., the Witkowitz Iron Works, and the Mining and Metallurgical Co., which combined, represent about three-fourths of the total Czechoslovakian iron production, have already installed a common sales office and are now about to associate with all the smaller companies.

At the end of April, the situation of the Czechoslovakia iron industries leaves much to be desired. Of twenty-four blast furnaces only four are running, and even these are working only half the time. The industry is hampered by three circumstances—namely, a 30-per cent tax on all furnace coke, which constitutes a charge of at least 15 crowns on each double quintal of iron; the extremely high wages as compared with those in Austria, Germany, and France, and by the fact that the individual plants are still too little organized and specialized. The iron prices are almost prohibitive for export trade. It is, however, hoped that with the large influx of foreign capital (Stinnes, Schneider-Creusot and others) and the intended specialization of the largest works the situation will improve.

Melbourne Letter

Sulphide Corporation Ceases Smelting—Waihi Grand Junction Stops Crushing Pending Development

By Peter G. Tait

Melbourne, April 3—The Sulphide Corporation, Ltd., has advised producers of silver lead concentrates that no ore will be received at Cockle Creek, near Newcastle, N. S. W., after April 13. The following notice was posted at the works:

"In consequence of the decrease in the tonnage of ore received at the works, it is found impossible to keep even the small smelter running. The output of lead concentrates of the mine at Broken Hill has fallen off by more than one-third. Supplies from other sources have fallen off to an even greater extent. As the corporation cannot keep one smelter going economically, it has made arrangements to smelt its ores at Port Pirie, and as soon as the ore in stock is used up its smelting and refinery works at Cockle Creek must close."

In future the company will act as a buying agent for the Broken Hill Associated Smelters, Port Pirie. The fertilizer (superphosphate) department will be continued.

Operations are now confined to the Mount Lyell's North Lyell mine, the output being approximately 7,000 tons monthly. At the reduction works the new smelting program as outlined in a previous letter is in full swing. There are now 350 fewer men employed at the mines and works as a result of the retrenchment policy.

The Waihi Grand Junction Gold Mining Co., Waihi, New Zealand, has temporarily ceased crushing pending the carrying out of an underground development policy as laid down by the company's consulting engineer, H. Stansfield, formerly general manager of the Talisman Consolidated at Karangahake. The mill comprises sixty heads of stamps, but latterly it has been crushing up to only two-thirds capacity.

Muir's Gold Reefs, Te Puke, New Zealand, which has been engaged on development work for some time, has installed a twenty-head battery and will crush 125 tons per day. The ore in sight averages 71s. per ton. The general manager of the company is J. R. Noble.

W. H. Woodhead, chairman of the London directors of the British Broken Hill company is at present visiting Australia. It was the British mine that first announced the intention to resume operations to demonstrate the impossibility of making ends meet under the present wages award at the low market prices. The British company in common with other Barrier mines ships its concentrates to the Broken Hill Associated Smelters, Port Pirie. In the early days of the war the Prime Minister announced that all lead concentrates must be treated in Australia and it was only by coercion on the part of the company that the British company was induced to enter into the contract with the Associated Smelters. The company now claims that as it can sell its concentrate for shipment abroad more advantageously, the privilege of a free market should be allowed, and there is good reason to believe that unless the local smelters are able to offer terms comparable with those obtainable from buyers for export, present arrangements will be cancelled.

Queensland

Future Doubtful for Mount Morgan, Despite Resumption—Drop in Premium Shocks Producers

From Our Special Correspondent

Brisbane, April 9.—The Mount Morgan mine and works resumed operations on March 20, just twelve months after closing down. In the final settlement the government increased its promised subsidy by £100 per week.

When this big mine closed down at Easter of last year, and when the experts engaged to investigate the position of the company reported that, even with the proposed reduction, work could not be carried on at a profit, the market price of standard copper was about £70 per ton and gold was worth £5 6s. per oz. Unfortunately, just before the resumption and since, both metals have continued to drop further in price, so much so that copper is now below £58 and the price of gold is £4 13s. per oz. Under the agreement now consummated there is a provision for increases in wages on a sliding scale as the price of copper improves, but further reductions in market values were not provided for, and how long the company will be prepared to keep going under existing circumstances is a question that all concerned are anxiously considering. It is estimated that at least £300,000 has been lost in wages during the twelve months' strike.

Naturally, the closing down of Mount Morgan had a disastrous effect on the total gold output of the state for 1921, the official statistics connected with which have just been completed. Of the yield for 1920 (about £490,000) this mine contributed a little over £385,000, or nearly 78 per cent; last year the total output was but £171,500, and of this Mount Morgan returned only 42 per cent.

Queensland benefited last year to the extent of £111,578 from the contributions of the Gold Producers' Association, whose total payments to its members throughout Australia from premiums on the sales of gold for that period aggregated over £840,000. But for these contributions it is doubtful whether some of the gold mines that made profits would not have been forced to close down. The recent heavy fall in the premium on gold has given a decided shock to the industry, which is accentuated by the fact that as yet there has been no corresponding reduction in the cost of production. Only one gold mining company has paid a dividend this year.

Johannesburg Letter

Wolhüter Gold To Pass Dividend—Rhodesia's Mineral Output Increases—Heidelberg-Roodepoort Under Option

By John Watson

Johannesburg, March 28—A message from Brussels says that the Colonial Council has ratified draft decrees approving of the order of the Vice-Governor of Katanga Province, Belgian Congo, dated Dec. 19, last, suspending prospecting along the Lulna River, and approving the concessions and cessions of territory sanctioned by the local authorities; also the agreement made on Feb. 10, between the government of the colony and the Belgian Congo company.

The annual meeting of the Wolhüter Gold Mines, Ltd., was held in Johannesburg on March 23. The chairman, A. F. Mullins, stated that in consequence of the strike, the mine would experience a loss of about £16,000 for the first three months of 1922 and that no dividend could be paid for the six months ending April 30 next.

It is reported from Cairo that an extensive mineralized area has been discovered by prospectors employed by the Nile and Congo Syndicate, which belongs to the Tanganyika Concessions group. The discovery is described as alluvial gold, which has been traced in several rivers. What is believed to be the source of this gold has also been discovered in the form of an auriferous belt extending for several miles.

The Rhodesian Chamber of Mines has re-elected Sir Bonchier Wrey as president. Last week, in his presidential address at Bulawayo, he stated that the total mineral yield of Rhodesia for 1921 was of a value equal to £4,720,375, an increase of nearly £270,000 over that of the previous year. This was due largely to the gold premium, now dwindling. The dividends paid by Rhodesian mining companies had dropped from over a million in 1920 to £663,000 last year.

J. G. McDonald criticized recent statements by the secretary of the Rhodesian branch of the South African Mine Workers' Union, following the break-up of the conference on the wages question. This secretary was urged to give up a policy of bluff to both workers and owners, or it was said that he would not be received by the latter.

The annual meeting of the Transvaal Chamber of Mines was held in Johannesburg on March 27, when the President H. O. Buckle, reviewed the industrial situation. He set forth the conditions which would govern their future policy with the unions.

The total gold output from the Transvaal for 1921 was 8,114,586 fine ounces, a decrease of 39,586 oz. compared with 1920. For the last five years the amount of gold annually produced had been diminishing, as mine after mine has been compelled to close; nor does it look as if this tendency was likely to be reversed soon.

General Frank Joubert is now in the Heidelberg district. He has been many years in Europe and now represents a Belgian firm and is said to have taken an option on the old Heidelberg-Roodepoort mines, with a view to working them for their iridium content as well as gold.

BRITISH GUIANA

W. J. La Varre Seeks Concession for Diamond-Bearing Ground

Georgetown, April 9—Following investigations carried out during several years of exploration in British Guiana, William J. La Varre has applied for location papers for a large concession of Crown land bordering the Merume River, a principal stream of the Mazaruni diamondiferous area, extending for a distance of ten miles along the Merume and containing an estimated area of 6,000 acres. No information is available as to the nature of this concession, but it is understood that it contains the richest discovery yet made in Guiana.

According to Mr. La Varre, native prospectors in March produced 16,000 carats valued at $400,000.

NORWAY

Sydvaranger Company, Reorganized, to Resume Work at Iron Mine—Clash Threatened With Danish Interests in Greenland

Kristiania—The Sydvaranger company's iron mines, the largest in Norway, and at latitude 70 deg., probably farther north than any other of the kind in the world, show signs of resuming operation after two years' shutdown. The large central steam power plant at Kirkenaes has started. The company has for some time been undergoing drastic reconstruction on the following proposed lines: The share capital is to be written down by 19,550,000 kroner to 3,450,000 kroner, and new shares will be issued to bring the capital up to 25,000,000 kroner. Liabilities would thereby be reduced to 16,250,000 kroner, including a loan of 3,176,000 kroner from the Bank of Norway. In addition, the state is to grant to the company an effective loan of 4,000,000 kroner. Finally, a further amount of 5,000,000 kroner is to be obtained from the Central Banken of Norway toward an operating account. The share issue is stated to have been subscribed, and the new share capital is given at 25,000,000 kroner.

The tenor of the Sydvaranger ores is 36 per cent iron, similar to that of Dunderland; but, unlike the latter, the ore is a magnetite, free from iron glance, and lower in phosphorous. The output in 1913 was about 450,000 tons of concentrate running 67 per cent iron, nearly half of which was briquetted. The improved lay-out now warrants an output of 650,000 tons. Professor Vogt places the ore available by open cut at 100,000,000 tons.

O. A. Bachke, a mining engineer of Trondhjem, Norway, has petitioned the government for 50,000 kroner, toward the cost of his research expedition to Scoresby Sound, East Greenland. He reminds the government that, in anticipation of Denmark annexing Greenland, it is advisable to secure, beforehand, a permanent footing in East Greenland. Private interests have assured a contribution of 20,000 kroner.

The proposed expedition has evoked much criticism in the Danish press, in which it is claimed that the Danes have long exploited the region around Scoresby Sound. The chairman of the East Greenland Co. has said that he could not imagine that the Norwegian government would agree to a proposition clashing with Danish work in Greenland.

SPAIN

Bilbao Mine Owners Ask Bounty on Iron Ores

Madrid, April 15—The Bilbao mine owners still complain of the lack of sales and point out that there is over 2,000,000 tons of ore at the mines and that it is no longer possible to remain with folded arms in face of the competition of other ores such as those from the African coast. The owners demand a bounty on Spanish ores similar to that which exists on Spanish coal.

The labor situation in the Bilbao mining region is unsatisfactory, owing to the lack of discipline among the communist workers, who are agitating for a general strike in order to avoid a reduction in wages. The workers belonging to the Socialist party appear to be less intransigent.

KOREA

Oriental Consolidated's April Output Drops Slightly

Unsankinko—The Oriental Consolidated's April clean-up was $89,500, compared with $91,303 in March. In March 17,450 tons was milled. The new shaft was deepened 191 ft. in that month.

CANADA

British Columbia

Granby Consolidated Planning Hydro-electric Plant

Anyox—it is stated that the Granby Consolidated Mining, Smelting & Power Co. is planning to install a new hydro-electric plant at Anyox this summer. The company prefers to use hydro-electric power altogether, it is said. As a preliminary step, a water-storage dam is under construction. The contract for this work has been given a Vancouver firm, known as Dredging & Contracting, Ltd.

Stewart—The Big Missouri property, in the Salmon River Valley is to be developed this summer. Trites, Woods and Wilson are reported to have taken a working bond on this property.

Trail—Ore received by the Consolidated smelter from April 22 to 30 inclusive totaled 9,173 tons. Shippers were: Black Rock (zinc), Northport, Wash., 37; W. E. Brown, Eldon, Alta., 3; Ottawa, Slocan City, B. C., 11; Renner & Drace, Ewings Landing, B. C., 31; Republic, Republic, Wash., 45; Silversmith, Sandon, B. C., 31; Wind Pass, Chu Chua, B. C., 23, and company mines, 8,992.

Ontario

Teck-Hughes Cuts New Ore on Seventh Level—Dome Mines Continues Operation on High-Grade Ore

Kirkland Lake—At the seventh level of the Teck-Hughes, while a station was being cut at the winze, ore was found, which, it is understood, is equal to the average of the mine. It is of good width, but will probably not be energetically developed until the work of continuing the winze to 980 ft. is completed. It is unofficially stated that South African interests will take over the control of Teck-Hughes by purchasing stock from large shareholders. The report says that the new company would have a capital of $6,000,000.

Porcupine—Recently the Triplex gold mine, operating in Shaw Township, Porcupine, purchased a fourteen-drill compressor, which is now being delivered. The shaft is now down over 100 ft., and as soon as a station is cut it is intended to crosscut the banded iron formation, in which the Triplex veins occur. This has a width of from 50 to 100 ft.

The work of dewatering the Porcupine Vipond mine is now well under way, and the surface plant is in condition for the starting of underground operations, which will probably be in three or four weeks. The management expects to continue the main shaft to a depth of 750 ft., where a station will be cut and some lateral work done, then to sink to 900 ft.

Diamond drilling on the Dome Mines continues to indicate big bodies of ore lying beyond the present points of development, and these tend to hold out good prospects of ore, reserves being materially increased in due course. It is stated that these new bodies show gold contents ranging from $8 to $1,000 per ton. It is also stated that the mill treats an average of approximately 1,000 tons of ore daily and is recording an output of around $10,000 a day. This continued operation on high-grade ore is one of the more favorable features in connection with gold mining in northern Ontario. In the meantime, the huge tonnage of medium-grade ore being placed in sight as a future asset is increasing in an important extent from week to week and is pointing the way to an exceptionally long life.

On April 27 McIntyre cut a north section of No. 7 vein at the 1,875 level, and on May 2 cut into the south section of the same vein, after passing through about 20 ft. of low grade. The north section shows 8 ft. of excellent ore, and judging from diamond-drilling indications, the south section at this point should have a width of about 20 ft. There are now 100,000 tons of broken ore ahead of the mill.

CALIFORNIA

Bureau of Mines Expects More Support From State Than It Gets—Carson Hill Producing $125,000 Per Month

San Francisco Correspondence

San Francisco—According to local reports, the U. S. Bureau of Mines is not altogether satisfied with the failure of California to co-operate in supplying funds for research work. At present the Bureau enjoys quarters, light, heat, and janitor service at the University of California, but little other support is given. Director Bain is reported to have said "that the amount of co-operation offered the Bureau from other states is large, and it becomes a difficult problem for an administrator to justify any increased expenditure in a state which does not itself take part in or assist in the work."

In view of the fact that other states are anxious to co-operate, it would appear that California is in danger of forcing a termination of its arrangement with the Bureau.

In northern California, reports are given out that the Estabrook dredge is to resume operation. The Adrian and Leavitt ranches, not far from Lewiston, have been bonded to a dredging company. Prospecting and drilling are to be undertaken by the company.

Derrer and Caughlin have resumed work at the Eastman mine, south of Goodyear Bar, Sierra County.

The Bullion Exploration Co., of Grass Valley, is preparing to unwater and reopen its property.

The present production of the Carson Hill mine, controlled by W. J. Loring, is stated to be $125,000 per month. The aggregate production since the property was taken over is stated to have been $3,000,000.

The Pacific Gas & Electric Co. reports that within the last few months power contracts in excess of 1,000 hp. have been signed in Tuolumne County for mining use. In Stanislaus County, a new dredge on the Tuolumne River, taking 600 hp., has been recently placed in operation. Revival of mining is attributed to the lower cost of labor and materials and the abundance of hydro-electric power at moderate sales.

A new strike is reported from the Randsburg district between Mohave and Randsburg. The prospect is known as the Mispah, the vein being discovered at a depth of 110 ft.

Arizona Corporation Commission May Not Prosecute

The Arizona Legislature has refused the Arizona Corporation Commission permission to proceed summarily or generally against about 30,000 Arizona corporations that are delinquent in annual filing fees to the gross amount of $4,000,000. Many have failed to report since 1912. It is apparent that the commission is endeavoring to find a way to annul charters without filing separate suits in the Arizona courts.

New Mill at Talache, Idaho, erected by Armstead Mines, Inc., and recently sold to A. H. Burroughs and associates

NEVADA

United Comstock Strike Still On—Orleans Hornsilver Mine Closed Pending Outcome of Suit

From Our Special Correspondent

Virginia City—There is no material change to report in strike conditions in the United Comstock underground operations. Conditions are slowly improving and the men are returning to work. As previously reported, surface construction work has not been delayed, and the mill will be completed by October.

On April 25, fire broke out in an old stope on the 1,650 level of the Con Virginia. The burning area was sealed off by concrete bulkheads without trouble or accidents. This stope has given trouble of this sort since the bonanza days of the Comstock, and it is considered doubtful whether the danger can ever be entirely removed without flooding.

Mina—The Simon Silver-Lead Mines Co. is producing about 180 tons daily. This tonnage is said to approximate hoisting capacity at present. The company is planning to sink a new three compartment shaft to a depth of 600 ft. This will permit an increase in tonnage to at least 500 daily. Repairs to the roasting plant in Goldfield are practically completed, and shipments of zinc concentrates will be started during May. A favorable railroad freight rate has been obtained from Mina to Goldfield and from Goldfield to Harbor City, effective May 11, the through rate being about $5.60 per ton.

Tonopah—All mines in this district are operating at capacity, with no new discoveries of importance reported. As soon as the new pumps of the Tonopah Extension Co. are placed, important work will be started to the west. This is important to this part of the district, as developments have always been stopped because of excess water as depth was attained. The Halifax Co. reports continuation of favorable developments on the 900 level. Shipments of about 30 tons of ore per day are being made by this company.

Hornsilver—The Orleans Hornsilver mine has been temporarily closed until the suit filed by C. A. Terwilligar, of Goldfield, against J. W. Dunfee has been settled. Dunfee, who, with Terwilligar, was the original bond holder, disposed of the mine to the present company. He claims that Terwilligar relinquished his claim in the bond four years ago, but the latter denies this.

Pioche—The Combined Metals mine has started to ship about forty tons of ore daily to the Garfield smelter. The ore runs .04 gold, 8.2 oz. silver, 8 per cent lead, and 18 per cent zinc.

Development work has been started on the Virginia Louise mine, adjoining the Prince Consolidated. The work is being done on the 500 level to prove the further extension of the big fluxing beds.

Shipments for the week ended April 27 were: Bristol Silver, 310 tons; Black Metals, 225; Mendha, 45; Hamburg, 50; total, 630 tons.

Goodsprings—Several lots of cobalt ore, averaging from 6 to 28 per cent cobalt, were recently shipped to the Shepherd Chemical Co. at Cincinnati, Ohio, from the Goodsprings district, the ore coming from the Copper Chief, High Line, and Columbia mines. A considerable tonnage of cobalt ore assaying 10 per cent is available in this district. The mineral occurs in the form of oxides and is known as heterogenite. Vanadium ore also has been mined from the Hoodoo, Spelter, and Whale, all of which are near Goodsprings.

Eggers and Fredickson, leasing on the Anchor mine, about four miles south of Goodsprings, have about 100 tons of high-grade lead ore ready for shipment, also some marketable lead-zinc ore.

Ely—All departments of the Nevada Consolidated are now active. Six ball mills, with a daily capacity of 2,500 tons, are running. Two steam shovels are employed in the Ruth pit. About 250 men are working underground and in the shovel pit at Ruth. The new reverberatory at McGill, 27 x 134 ft. inside measurement, has been completed, and another of similar size is ready for operation. But one will be fired at this time. About 35,000 tons of high-grade ore from the Ruth orebody are on hand at the smelter, and this tonnage will be smelted direct with the concentrates derived from the milling of the disseminated porphyry ores. Five hundred men are working at McGill.

IDAHO

Talache Mines' Production Rapidly Nearing Mill Capacity

Talache—The mine, mill and other holdings of the Armstead Mines, Inc., which were recently sold to A. H. Burroughs, Jr., and associates are now operated by a new company known as Talache Mines, of which the officers are: A. H. Burroughs, president; A. H. Burroughs, Jr., vice-president; H. S. Brown, secretary-treasurer and C. C. Dula, J. Peterson, Karl Jungbleeth, and H. D. Kingsbury, directors.

The name of Armstead Mines, Inc., will be retained by H. H. Armstead for other operations which he may conduct.

The mine is now developed with about 20,000 ft. of drifts, crosscuts, and raises on twelve levels, thus giving 1,700 ft. of backs on the Little Joe vein. Stoping is being done on the 400, 600, 700, and 800 levels yielding 100 to 125 tons of ore per day. With the opening of new stopes it is expected to reach the maximum mill capacity of 150 tons daily soon.

The new mill, which was designed by the General Engineering Co., of Salt Lake City, is recovering 96 per cent of the silver, which is the principal value in the ore, and is producing a concentrate running .71 oz. gold, 160.7 oz. silver, 53 per cent lead, 6.2 per cent copper, 8 per cent insoluble, 30 per cent iron, 1 per cent manganese, and 3.7 per cent zinc. Mill operation is continuous; and concentrates are being hauled daily by motor trucks to the Northern Pacific at Sagel, Idaho, six miles away, from which point shipments are being made to the East Helena smelter.

The plant recently completed includes a 150-ton flotation mill using Callow cells, a 1,600-cu.ft. Ingersoll-Rand compressor, and eleven-mile transmission line, a central heating plant, and hoisting and haulage facilities.

Warren—The Unity Gold Mining Co.'s property is in the Warren district about forty miles from the railroad. Considerable development has been done on the mill level, and several parallel veins of gold-bearing ore have been opened. One orebody has been opened for a horizontal distance of over 900 ft. and the other for more than 300 ft. The veins are 14 in. to 20 in. wide and the ore averages about $40 a ton, mostly gold. The ore is higher in grade in places. Prior to the present development on the mill level, it was generally believed that the ore deposits of the district were more or less superficial. Development has reached a depth of 600 ft. below the outcrop. The ore appears to be primary, and the outlook for favorable development at greater depths is encouraging. The present amalgamating and concentrating mill will be remodeled and flotation equipment added. The power plant will be moved about five miles to the Salmon River, where there is an abundance of water the year round. The power will be ample for all needs when the new plant and transmission line are installed.

The company will raise about $100,000 by issue of treasury stock, to finance the above mentioned improvements and leave satisfactory working capital. With the new mill and power plant installed, the company can treat over fifty tons of $40 ore per day, at a cost of less than $15 a ton. The present ore reserve is ample to justify the improvements now under consideration, and the new financing may be regarded as a modest capitalization of the promising orebodies opened in the last few years.

UTAH

Bingham Busier—International Smelter Receiving Ore—Chief Consolidated Interested in Apex Standard—New Lease on Gemini

From Our Special Correspondent

Bingham—Additional miners are being put on by the Utah Apex, and at present between 125 and 150 men are employed. During the latter part of the month up to three cars of ore per day were shipped.

At the Utah Consolidated sixteen men were added during the last part of April in cleaning up and repair work, and it is probable that operations will be resumed before long.

The International Smelting Co., at Tooele, is receiving ores from the Ophir Hill mine, at Ophir, and a considerable tonnage from the Tintic Standard; also other ores. The Walker Mining Co.'s mill, in Plumas County, Cal., is expected to start up some time this month, and the concentrates will be shipped to the International. About 100 men are now employed at Tooele. It is thought that smelting operations will be started some time in June.

Eureka—Ore shipments from the Tintic district for the week ended April 28 amount to 174 cars, compared with 180 cars the week preceding. Shippers were: Chief Consolidated, 48 cars; Tintic Standard, 48; Colorado, 16; Grand Central, 15; Iron Blossom, 14; Eagle & Blue Bell, 10; Victoria, 9; Swansea, 5; Centennial-Eureka, 4; Eureka Hill, 2; Gemini, 2; Mammoth, 1; Dragon, 1; Sunbeam, 1.

The lower levels of the Gemini are to be unwatered and reopened under lease to S. M. Soupcoff, Edgar Newhouse, and other Salt Lake mining men. The mine has been operated to the 1,900 level through the 72 winze, where excellent ore was opened. The water level was formerly about 40 ft. below the 1,600 level, but recently has receded to near the 1,700 level, on account of pumping in the neighboring Chief Consolidated. Pumps are being installed and the 72 winze will be unwatered and pumped into an open fissure or cave on the northeast 1,600 level, which is expected to take care of the flow. Pumps capable of handling 500 gal. per minute are to be used. Additional pumping units will be added as development progresses. Lead ore running well in silver is exposed on all of the levels, 1,700, 1,800 and 1,900, in this section.

At the Grand Central mine, at Mammoth, many changes and improvements are being made. It is controlled by the Chief Consolidated and is responding favorably to the campaign of development now under way. The surveys are practically completed and geologic mapping is in progress. Correlating and locating the favorable limestone beds which have been productive in neighboring properties, many of which have been but little developed in the Grand Central, is being done. The hoisting plant is to be electrified soon and a new electric signal system and telephones are to be added to the equipment. A new electrically-driven Sullivan angle-compound has been installed, and another unit may be added. At present 117 lessees are working.

The extensive development campaign mapped out by the company will be done largely on the night shift. Drifting is to be started on the 1,300 and 1,600 levels. Improvements to the tramway and loading station make it possible to handle three cars of ore in eight hours. Fifteen cars of ore were shipped the week ended April 29, but despite this much ore remains broken and ready for shipment, and many lessees are still crowded with ore. Paul Hilsdale is in charge.

The Copper Leaf and Central Standard have been consolidated into one company to be known as the Central Standard Mines Co. This will have a capitalization of $250,000, divided into shares of 10c. each.

The Chief Consolidated on May 1 paid a dividend of 5c. a share, bringing the total to $2,136,726. Operations are carried on here almost entirely by lessees. The same leasing system is being used at the Grand Central, and other Tintic mines are beginning to copy it and are going from an operating deficit on to a dividend-paying basis. The Iron Blossom and the Colorado have recently adopted leasing, and have done much better by it than by working on company account. The Eagle & Blue Bell, including the Victoria, is to undertake leasing, especially in the ground adjoining the Grand Central. A few blocks of ground, including some of the old stopes, are being leased at the Tintic Standard, and it is probable that the leasing system will be adopted on a larger scale here.

At the Apex Standard, in East Tintic, it is reported that the Chief Consolidated people have become interested by subscribing money to be used entirely in development, in exchange for stock. Four headings are being driven from the Water Lily shaft of the Chief Consolidated, in East Tintic.

Park City—Shipments for the week ended Feb. 28 amounted to 2,222 tons of ore and concentrates, compared with 2,333 tons the week preceding. Shippers were: Judge companies, 973 tons; Ontario, 719; Silver King Coalition, 530.

Alta—At the Emma 5 ft. of good ore has been opened on the Montezuma fault in a raise 80 ft. above the Bay City tunnel. This ore assays well in lead and silver, and is thought to be making out from the fissure on the limestone bedding. The strike is the favorable part of the mine and is considered important. M. M. Johnson is consulting engineer.

The Wasatch Mines is continuing development from its 5,000-ft. drain and operating tunnel. New ore has been opened at the Columbus-Rexall in several places.

The Michigan-Utah is rebuilding its tramway, which was taken out by snowslides in February. This tram will be shorter than the other—the length being about 12,000 ft. Hauling will be done from the lower terminal to Wasatch.

At present no ore is being shipped from Alta, on account of the melting snows and the poor condition of the roads.

COLORADO

Freeland Mine to Be Reopened—New Strike at War Dance

Telluride—The boiler house at the Tomboy mine was destroyed by fire recently, with a loss of about $15,000, covered by insurance. A new boiler plant is under construction. As the plant supplied heat for the mill, the later was shut down temporarily as a result of the accident.

Freeland—After a shut down of several years on account of litigation, the Freeland mine will be reopened in the near future, and development work will be resumed. The power plant is being overhauled, and repairs are being made at the dam, preparatory to resumption of operations under the management of W. L. Shaffer, of Idaho Springs.

Russell Gulch—Another rich strike has been made in the famous little War Dance mine, this time in the form of a 2-ft. vein of $40 gold ore. A test shipment was made recently to the smelter at Leadville.

Georgetown—The St. George mine, operating on Douglas Mountain, in Clear Creek County, will erect a fifty-ton mill. Construction work will begin by May 15. Theodore R. Heinrichs, manager, expects to have the plant completed by Aug. 1.

Alma — The Lincoln Consolidation company made the first shipment of lead-silver ore from its recent strike on April 1.

The Yuba Construction Co., which is erecting the dredge for the Platte River Dredging Co. on the Platte River near Fairplay, has the boat under cover and floated. The remainder of the machinery, ten carloads in all, is expected early in April. When this is installed, the boat will be placed in commission.

Western Australia's Gold Output

By Cable from Reuters to
"Engineering and Mining Journal-Press"

London, May 6—The gold output in April in Western Australia totaled 46,384 ounces.

SOUTH DAKOTA

Homestake's South Mill Building Nearly Completed—Mica Producers Busy

From Our Special Correspondent

Custer—Work will be resumed on May 1 at the Great Northern mica mine west of Custer. A compressor and crude oil engine have been ordered. A site for a grinding plant has been selected at Custer, where the mica will be ground. Motor trucks will be employed for hauling between mine and plant, a distance of nine miles.

Keystone—The American Producers Mica Co. is shipping a car a week from properties near Keystone. Most of the material is scrap, although some plate mica is recovered.

Work at the Maywood Chemical Co.'s property is continuing, and amblygonite has been shipped recently to the plant in New Jersey. Production will be increased when the weather improves.

Lead—The new South mill building of the Homestake company is nearly completed, and installation of equipment has begun. Part of the new plant will be in operation by Sept. 1. A crusher has been installed underground at the Ellison shaft, and skip loaders are being placed. Most of the machinery is in place, and the skips will be running within a few months.

ARIZONA

Humboldt Smelter to Start About June 1—Iron Cap Following North-South Vein—Grading for Stargo Mill Begun

Jerome—United Verde shovel operations are above the hot stopes. Some small deposits of good ore are being found, but little of importance is expected until the headings are advanced to the same point on the next lower shovel level.

The northwest drift from the 650 station of the Verde Central is in solid ore that assays 22 per cent copper and 5 oz. silver, in disseminated glance and carbonate. The drift is now advanced about 230 ft. and is about 1,500 ft. from the United Verde side line along the fault. New electrical equipment is being installed, and the wires of the Arizona Power Co. are being extended to the mine.

Announcement has been made that the Southwest Metals Co. expects to start operation of the Humboldt smelter about June 1, and that it is in the market for custom gold, silver, and copper ore. G. M. Colvocoresses, the manager, is reopening the Swansea mine, in northern Yuma County, and has sent Chester A. Knight to Swansea to take charge of the concentrator there.

Globe—On the 900 level of the Iron Cap, east of the Iron Cap shaft, a new vein, called the Spur, is being followed. Its trend is due north and south, at right angles to the course of the main veins of the district. F. A. Woodward says that for 150 ft. the vein assays, for 25-in. width, 11 per cent copper and and 20 oz. silver.

Morenci—Grading has been started for the new seventy-five ton cyanide mill of the Stargo Mines. Construction is expected to take four months and to cost $75,000. The ore to be treated carries silver and gold and is expected to average nearly $15 a ton at the mill. In the past about 300 cars have been shipped to smelters at Clifton and Douglas. The company has been reorganized. Ben Getzoff, of Bernardsville, N. J., is president. Mike Hannon remains manager. The offices will continue in Phoenix.

MICHIGAN

The Copper Country

Lake Rate on Export Copper Lower—Ahmeek Increases Tonnage.

By M. W. Youngs

Houghton—No definite advices have been received as to when other of the Calumet & Hecla mines and independent properties, such as Franklin, Mass, and Michigan, will reopen. Resumption by some, if not by all, of these mines, however, is expected before the close of the year.

It is expected that May will witness a considerable increase in the amount of copper shipped out of the district. The Lake rate on export copper to the coast is 40c. per 100 lb., as compared with the all-rail rate of 48c.; the rate to Detroit and Buffalo is 25c., compared with 38c., all rail. This is a decrease of 4c. per lb. from last season's rate. The New England lake-rail rate is 44c. compared with 50c., all rail.

The first copper boat out May 3 took 800,000 lb. of metal for export to France as well as a large cargo of copper for domestic customers.

Six stamps are in operation at the Calumet mill of the Calumet & Hecla, and it is probable that two more will be started soon. Nos. 9 and 10 shafts are now being reopened.

Mayflower-Old Colony is investigating a mineralized formation met in the south drift on the 1,450 level, a crosscut proceeding west toward the foot wall to ascertain the width. The showing is described as encouraging.

Seneca should be in a position to resume sinking in Gratiot No. 2 shaft within ninety days. The stripping and straightening of the shaft is now proceeding below the tenth level, and only about 300 ft. remain to be given attention. The seventh level south has practically reached the Ahmeek boundary and a drift south from the sixth level will now be driven. All openings north, toward Gratiot, continue in good milling ground.

Ahmeek has increased its tonnage somewhat, the daily average now being about 1,800.

OREGON

Grants Pass—Dr. A. M. Knapp and William G. Tait, of Medford, have acquired the Jewett gold mine five miles from Grants Pass, and are reopening it.

MINNESOTA

Outlook Much Improved for Mesabi and Vermillion Ranges

Hibbing—Prospects for a good shipping season on the Mesabi and Vermillion iron ranges are bright. Practically every operating company has started some phase of operations which indicates that a revival of the iron business is near.

On the Mesabi, after an almost complete shut down for all properties, there was a slight improvement in January, 1922, when some of the underground properties resumed work on a one-shift basis. Since then, and more especially in April, some companies have started ore operations both underground and in open pits, while others have started stripping only. The Oliver Iron Mining Co., the largest shipper on the range, has not yet received orders to forward ore, but is preparing to do so at some of its properties; and at others stripping is being done.

The Vermillion range companies withstood the depression in better manner than those on any other range in the Lake Superior district. Nearly all work was carried at full time and there were few shutdowns. Active work at nearly all mines is now in progress.

Comparing the situation with normal, it is estimated that some form of work is being done at 60 per cent of the properties giving employment to about 7,000 men, compared with 16,000 in normal times. Only about one-quarter of these properties, or 15 per cent of the total, are on ore operations, as it is still a little early in the season. Several instances have been noted where mines entered the shipping list for a short period and then ceased.

Several factors tend to retard a general resumption of activities. At present a definite price on iron ore has not been announced, and the controversies relative to the rail rate from the mines to the upper Lake docks and the Lake freight from the upper to the lower docks has not been definitely settled. A suit to compel the railroads to reduce their rate from the mines to the upper docks is in progress, with little possibility of an early decision. Indications, however, on the whole, point to a good movement of ore which is estimated at about 25,000,000 tons for the Mesabi and Vermillion ranges and about 45,000,000 tons for the Lake Superior district.

Duluth—Some drilling for iron ore has been done on the Namekon Range, northwest of Tower and west of Vermillion Lake. It is understood that two or three groups, one of them the International Iron & Steel Co., (Minneapolis interests), have been doing this work. Some seams of magnetic ore are said to have been cut. The company named is reported to have spent $180,000 and to be ready to spend more. Two engineers examined the properties concerned some time ago. The opinion is expressed that the operators stand a good chance of finding commercial ore.

THE MARKET REPORT

Daily Prices of Metals

May	Copper, N. Y., net refinery* Electrolytic	Tin		Lead		Zinc
		99 Per Cent	Straits	N. Y.	St. L.	St. L.
4	12.75	30.00	30.875	5.25	5.125@5.15	5.00
5	12.75	30.125	30.875	5.25	5.125@5.15	5.025
6	12.75	30.125	30.875	5.25	5.125@5.15	5.025@5.05
8	12.75	30.00	30.75	5.25	5.125@5.15	5.025@5.05
9	12.75	29.875	30.625	5.25	5.125@5.15	5.025@5.05
10	12.75	29.875	30.625	5.25	5.125@5.15	5.025@5.05

*These prices correspond to the following quotations for copper delivered. May 4 to 10 inc., 13c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
4	60	60½	65	148½	150⅛	24	23	27	26⅞
5	59⅞	60⅜	65	149¾	151⅛	24	23⅛	27	26⅞
6	..	...	...	....	....	...	...	...	...
8	60¼	60⅝	65	149¼	150¾	24⅜	23⅜	27⅛	27
9	60¼	60⅝	65	148¾	150¼	24½	23⅛	27¼	27⅛
10	60	60⅜	65	148⅞	150¼	24⅜	23	27⅛	27

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

May	Sterling Exchange "Checks"	Silver			May	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
4	443⅝	99⅝	69⅝	35¼	8	444	99⅝	69½	35⅛
5	444	99⅝	70⅛	35½	9	443¾	99⅝	69⅞	35⅜
6	444	99⅝	69	35	10	444⅜	99⅝	70¼	35½

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, May 10, 1922

The metal market has been generally quiet during the last week, tin and zinc being particularly stagnant. Lead is much less active than three or four weeks ago. Copper business improved somewhat, but sales did not indicate any general buying wave.

Copper

Copper has been in better demand than any of the other non-ferrous metals during the last week. This has been partly owing to the fact that copper producers generally feel that higher prices are in prospect and have been reluctant to sell. When some of them began to raise their price above the 13c. level which has ruled for the last ten days, there was a small-sized rush to contract for requirements at the even figure. Producers who have been willing to sell for 13c., delivered, during the last three days have done an excellent business; those who have gone to 13⅛c. have sold only an occasional carload or none at all. In some instances, where delivery charges have been low, consumers have been able to get copper for 12⅞c., but in no transaction have sales netted producers less than 12.75c. f.o.b. refinery, so far as we have learned. Most of the copper has been sold for June and July delivery. It would not be surprising to see the 13⅛c. level established within the next two or three days. Demand has been generally distributed.

Export demand has been in fair volume to the usual consuming countries, including England. The price was advanced from 13.25c. to 13½c.

The announcement has been made that the Granby output will hereafter be sold by the Nichols Copper Co. instead of by the American Metal Co.

Lead

The official contract price of the American Smelting & Refining Co. remains at 5.25c., New York.

Since the phenomenal demand of a few weeks ago, the market has settled down, and consumers now realize that the advance has been definitely terminated, so that they need not hurry to provide for future requirements. Lead is freely offered now at 5.25c., New York, though 5.35c. has been realized on some lots of metal for delivery within a week or two. Most of the lead sold at the 5.25c. price has been for June delivery. Demand has not been large, though well distributed. Large orders continue to be accepted at our average prices rather than at a fixed price to a greater extent than usual.

The St. Louis lead market is also quiet. Several carload orders have been placed at 5.15 to 5.175c., but consumers desiring larger quantities have been able to obtain their requirements at 5⅛c. Two or three fair-sized tonnages have sold at that level.

Lead continues to go well into consumption, and the building industry should absorb large quantities this summer. Corroders have not taken quite so much metal as usual, but this is for the reason that they are planning on carrying smaller stocks rather than because of a slackened demand for their product.

Zinc

Zinc has been exceedingly quiet during the last week. The large buying on the rise a few weeks ago seems to have left producers with their current requirements well supplied. It is encouraging to note that the price has not weakened, remaining slightly above the 5c. level. Without doubt, foreign demand has had an effect on keeping up the price; several thousand tons have likely been taken off the market by European demands. High-grade business continues good at the unchanged price of 6c. per lb., delivered.

Tin

Though prices have declined somewhat, consumers have been off the market to a large extent. Some small business by both consumers and dealers is reported, but the demand has certently had been insistent. Electrolytic has been sold in small lots at the prices realized for Straits. Tin continues to be freely offered in the Far East, where large stocks are still held, but no violent decline is anticipated, and it is likely that a low price would bring out considerable business and act as a steadier on the market.

Arrivals of tin, in long tons: May 3, Liverpool, 25; May 4, Liverpool, 25; May 5, Liverpool, 25; May 9, London, 100; Liverpool, 50.

Gold

Gold in London: May 4th, 93s. 2d.; 5th, 93s. 4d.; 8th, 93s. 3d.; 9th, 93s. 4d.; 10th, 93s. 5d.

Foreign Exchange

No marked changes have taken place in the exchange market during the week. International bankers are still looking to Genoa for guidance. On Tuesday, May 9, francs were 9.115c.; lire, [illegible]c.; marks, 0.3425c.; and Canadian dollars, 98.34c.

Silver

Good buying by China and India advanced the market, New York making a new high price for the year at 70[illegible]c. The internal dissensions in China, rather than any improved trade conditions there, are considered responsible for the rise, and although the future tendency is uncertain, the market appears steady at the present time.

Mexican Dollars—May 4th, 52⅝; 5th, 53½; 6th, 52¾; 8th, 53⅛; 9th, 53⅝; 10th, 53¾.

Other Metals

Quotations cover large wholesale lots unless otherwise specified

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17.50@18.50c. for 98@99 per cent virgin grades.

Antimony—Chinese and Japanese brands, 5.50c. W.C.C. brand, 6@6½c. Cookson's "C" grade, spot, 8.75@9c. Chinese needle antimony, lump, nominal, [illegible] per lb. Standard powdered needle antimony (200 mesh) nominal at 5¼c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 6.75@7c.

Arsenic—7c. per lb.

Bismuth—$2@$2.10 per lb.

Cadmium—Demand for cadmium has improved recently and inquiries have been received from London. The price quoted for large quantities is now $1.15@$1.20 per lb. The metal is principally used by electro-platers.

Iridium—Nominal, $150@$170 per oz.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Small tonnages, spot, nominal at 30@33c.

Palladium—$50@$55 per oz.

Platinum—Market slightly weaker at $85 per oz., but stocks are low and dealers not inclined to sell much at that level.

Quicksilver—$55 per 75-lb. flask. San Francisco wires $54.30. Steady.

The prices of **Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of May 6.

Metallic Ores

Molybdenum Ore—Increased demand for ferromolybdenum, coupled with the fact that the Colorado properties are closed down, has resulted in an active demand for molybdenum ore, and the price has advanced to 50c. per lb. of MoS_2, for 85 per cent MoS_2 concentrates.

Tungsten Ore—Chinese quoted nominally at slightly advanced price, $2.75 per unit.

The prices of **Bauxite, Chrome, Manganese, Tantalum, Uranium, Vanadium, Titanium** and **Iron Ore, Zircon** and **Zirkite** are unchanged from the prices in the issue of May 6.

Zinc and Lead Ore Markets

Joplin, Mo., May 6—Zinc blende, per ton, high, $32.70; basis 60 per cent zinc, premium, $31; Prime Western, $29; fines and slimes, $28@$27; average settling price, all grades of blende, $30.04. Calamine, 40 per cent zinc, average, $15.

Lead, high, $73.95; basis 80 per cent lead, $70@$72; average settling price, all lead ores, $70.02 per ton.

Shipments for the week: Blende, 11,515; calamine, 125; lead, 1,808 tons. Value, all ores the week, $475,700.

Purchases this week were 3,340 tons under last week, buyers feeling that present prices were no longer warranted, since the foreign market had dropped below an export level. With export hopes blasted and a resurvey of the domestic situation made, a thought has assumed shape that in all probability consumers were pretty well stocked against the existing coal supply and that a falling off in demand might occur. Sellers of zinc ore refused to accept a pessimistic view and declined to accept lower offerings, and as a consequence only 7,690 tons was sold, as against 11,030 the previous week.

Platteville, Wis., May 6 — Blende, basis 60 per cent zinc, $30 per ton. Lead ore, basis 80 per cent lead, $70.50 per ton. Shipments for the week: Blende 363; lead ore, 70 tons. Shipments for the year: Blende 5,318; lead ore, 830 tons. Shipped during the week to separating plants, 1,066 tons blende.

Non-Metallic Minerals

Feldspar—One producer reports No. 1 pottery grade has recently been in good demand at a slight recession in price, $6.40 per ton, f.o.b. Eastern mines.

Talc—20 to 200 mesh, $7@$12 per ton, f.o.b. Vermont; $8@$10, f.o.b. Georgia; 200 mesh, $18, f.o.b. California; through No. 25 Swiss silk, $25, f.o.b. California. Market fair, but producers complain of Italian and Canadian competition and high freight rates to Eastern points of consumption.

Prices are unchanged from those in the issue of May 6, on **Asbestos, Barytes. Borax, Chalk, China Clay, Emery, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica and Sulphur.**

Mineral Products

Copper Sulphate—Active demand and advancing copper prices have resulted in an advance to 5.75c. per lb. for large crystals.

The prices of **Potassium Sulphate, Sodium Nitrate, and Sodium Sulphate** are unchanged from the issue of May 6.

Ferro-Alloys

Ferromanganese—Domestic, 78 to 82 per cent, $67@$69, f.o.b. furnace; English, $65, c.i.f. Atlantic seaports. Spiegeleisen, 19 to 21 per cent, scarce at $35 per gross ton, f.o.b. furnace; 16 to 19 per cent, $34.

Ferrotitanium, Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotungsten, Ferro-uranium, and **Ferrovanadium** are unchanged from the prices published May 6.

Metal Products

Copper Sheets — New York base, 19.25c. per lb.; wire, 14.75c.

Lead Sheets, Nickel Silver, Yellow Metal, and **Zinc Sheets** are unchanged from the prices published May 6.

Refractories

Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick, and **Silica Brick** are unchanged from the prices quoted May 6.

The Iron Trade

Pittsburgh, May 9, 1922

The steel market has made gains in the last week, buyers being insistent on early deliveries. Specifications against contracts are heavy. The industry seems to have settled down to a relatively steady rate, at 36,000,000 to 38,000,000 tons of ingots a year. There is no material change in the strike situation in the Connellsville region, where production is at about one-third the rate in March. After long idleness the agricultural-implement factories are moderately active. Railroad buying is of fair proportions, and the automobile industry is operating at close to capacity.

Steel prices are firm and some independent mills have been advancing quotations. In occasional instances delivery premiums would be paid. Sheet bars have sold at $35.

Pig Iron—The merchant furnaces remain out of the market as regular sellers. There is hardly any inquiry. On a forced purchase about $24, Valley basis, would probably have to be paid for bessemer, basic or foundry.

Coke

Connellsville Coke—With limited demand and offerings the market is up 25c., at $6.25 for furnace and $6.75 for foundry. Connellsville steam coal is higher, at $3.

COMPANY REPORTS

Chile Copper Co.

The sixth annual report of the Chile Copper Co. for 1921 shows that although operations were carried on at less than half the scale maintained in 1920, the actual cost of producing copper increased only 0.1c., the cost being 10.7c. per lb. during 1920 and 10.8c. during 1921. This figure does not include depreciation and depletion. During March, 1922, the figure had been reduced to 7.8c. per lb. Development of a new anode, which will be installed throughout the tanks by the end of 1922, will in itself reduce the cost ⅜c. per lb. A combined statement of income and surplus accounts for the Chile Copper Co. and the Chile Exploration Co. for the year ended Dec. 31, 1921, follows:

Operating revenue		
Copper sold and delivered, 67,823,964 lb. @ 13.7993c.		$9,359,266
Operating cost		
Cost f.o.b. plant yards	$6,595,449	
Freight, insurance, and delivery expense	738,513	
Selling expense	90,554	
		7,424,517
Operating profit		$1,934,749
Other income		
Dividends Chile Steamship Co.	$100,000	
Interest and discount received	678,211	
Miscellaneous	68,491	
		846,702
Total income		$2,781,451
Charges against income		
Taxes and miscellaneous charges	$615,284	
Interest on bonds of Chile Copper Co.	3,150,000	
		3,765,284
Net loss carried to surplus account		$983,832
Balance of surplus account as stated Dec. 31, 1920, deficit		$349,718
Add		
Adjustment of Chilean import duties and miscellaneous adjustments		878,076
Net deficit, Dec. 31, 1920, as adjusted		$1,227,794
Net loss for year as above		983,832
		$2,211,626
Charges against surplus		
Depreciation of plant and equipment	$2,984,115	
Obsolete plant, equipment, and supplies	232,473	
Depletion of ore reserves	1,338,520	
Amortization of discount on bonds	140,000	
		4,695,108
Deficit, Dec. 31, 1921		$6,906,734
Depletion reserve		8,436,054
		$1,529,320
Less unamortized bond discount		1,435,000
Net combined surplus and depletion reserve, Dec. 31, 1921		$94,320

Ore reserves as of Dec. 31, 1921, were as follows:

Oxidized ore	327,630,000 tons, averaging 1.61 per cent copper
Mixed ore	151,000,000 tons, averaging 2.98 per cent copper
Sulphide ore	210,000,000 tons, averaging 1.84 per cent copper

During the year, 54,008,065 lb. of marketable copper was produced. Production in December, 1921, and for several months preceding, was about 2,000 tons; in January, 2,697; in February, 3,441; and in March, 4,161 tons. From the time the ore is mined to the production of finished wire bars is only twelve days, compared with ninety to one hundred days with most producers. During 1922 the dechloridizing plant will be enlarged, additional mine tracks provided, fifty additional ore cars secured, water conservation will be extended, and other improvements will bring the capacity of the plant to about 200,000,000 lb. of copper per year. Further minor additions would bring the capacity to 225,000,000 lb.

Capitalization: Outstanding, 3,800,000 shares at $25 par. Funded debt, $15,000,000 in collateral trust 7 per cent ten-year convertible gold bonds; and $35,000,000 in collateral trust 6 per cent fifteen-year convertible gold bonds.

Silver King Consolidated Mining Co. of Utah

A report of the operations of the Silver King Consolidated Mining Co. of Utah for 1921 shows assessments of $258,835.96. Production amounted to twenty-nine tons of ore, of a net value of $1,179.50. Financial statement follows:

RECEIPTS		
Cash on hand, Jan. 1, 1921	$17,563.12	
Inventory	5,404.61	
		$22,967.73
Sale of capital stock	$19,244.50	
Assessments Nos. 10, 11, and 12	258,835.96	
Ore sales	1,179.50	
Notes payable	19,900.00	
Sale of second-hand equipment	4,017.41	
Accounts receivable	6,326.34	
Miscellaneous	36.35	309,540.06
		$332,507.79
DISBURSEMENTS		
Mine account	$3,352.66	
Tunnel account	92,709.14	
Mill maintenance	1,893.65	
Expense accounts		
General, office and legal	34,032.43	
Interest	15,789.00	
Miscellaneous	787.98	
Accounts and notes paid	175,769.26	
Total disbursements	$324,335.12	
Less accounts payable taken into account and charged out Dec. 31, 1921	10,392.86	
Total cash disbursements		$313,942.26
Balance on hand, Jan. 1, 1922		
Cash	$15,455.00	
Inventory	3,110.52	18,565.52
		$332,507.78
Total number of issued and outstanding shares of capital stock on Dec. 31, 1921		[illegible]
Total number of shares remaining in Treasury on Dec. 31, 1921		[illegible]
Total number of shares authorized		1,250,000

The Spiro tunnel was driven 904 ft. during the year, making its total length 15,014 ft. on Jan. 1, 1922. The president states that "the position of the company is far better than it was at the beginning of the year and is improving daily."

Hedley Gold Mining Co.

A report of the operations of the Hedley Gold Mining Co. for 1921 shows no production, as the property was closed in November, 1920. The financial condition of the company on Dec. 31, 1921, is shown by the following balance sheet:

ASSETS		
Fixed		
Mines and mining claims	$1,359,715.78	
Buildings, machinery, and plant	[illegible]	
Stock in the Similkameen Water Works Co., Ltd.	[illegible]	
Copper Flat property	200,000.00	
		$2,222,547.63
Deferred		
Supplies	$74,965.55	
Mine development	57,948.67	
Items in suspense	10,205.34	
		143,119.56
Current		
Cash in banks	$67,145.13	
Accounts receivable	893.39	
		68,038.52
		$2,433,705.71
LIABILITIES		
Capital stock		
Authorized and issued (240,000 shares, par value $10 each)		$2,400,000.00
Current		
Accounts payable, sundry creditors		2,714.20
Reserve		
For taxes	$29,387.99	
Unearned insurance	339.74	
		29,727.73
Surplus at Dec. 31, 1921		1,263.78
		$2,433,705.71

Development work during 1921 did not increase the tonnage of reserve ore, which is estimated at 70,000 tons of [illegible] grade, without taking into account considerable lower-grade ore that could not be milled at a profit under present conditions.

Belmont Surf Inlet Mines, Ltd.

A report of the operations of the Belmont Surf Inlet Mines, Ltd., for 1921, show an operating profit of $62,758.94 according to the following account:

CREDITS			
[illegible]		$632,731.12	
DEBITS			
Mining	$454,604.15		
Milling	145,296.49		
[illegible]	22,321.45		
		622,222.09	
			$10,509.03
Other income, exchange and [illegible]			70,059.22
			$80,568.25
Less [illegible] of hospital		$15,242.29	
Less [illegible] discounts		6,024.60	
		$9,217.69	
[illegible] expenses		$8,591.62	
			17,809.31
Operating profit for the year 1921			$62,758.94
Depreciation			
Mill, buildings and machinery [illegible]			57,639.81
Net income for the year 1921			$5,119.13

Balance sheet as of Dec. 31, 1921, follows:

ASSETS		
Property		
Mines and mining claims at cost	...	$1,923,465.22
Mill, buildings and machinery after writing off $255,626.34 depreciation		307,226.57
[illegible] after writing off $5,550.21 depreciation		30,635.65
		$2,261,327.44
Investments		
[illegible]		200,000.00
Deferred accounts		9,912.19
Available assets	$124,180.69	
[illegible]	14,734.32	
[illegible]	4,948.18	
Accounts receivable	75,027.48	
[illegible]	74,915.21	
		293,805.88
		$2,765,045.51
LIABILITIES		
Capital stock		
2,500,000 shares of $1 each, fully paid		$2,500,000.00
Current liabilities		59,251.86
Reserve for income taxes up to date		48,758.90
Surplus		
Balance as at Dec. 31, 1920	$252,336.62	
Net income 1921	5,119.13	
	$257,455.75	
Less adjustments of previous year	100,421.00	
		157,034.75
		$2,765,045.51

The metal content of 134,570 tons produced was 39,825.19 oz. of gold, 24,549.5 oz. silver and 709,971 lb. of copper.

Noted Indian Gold Mine Pays Dividends for Thirty-six Years

The net revenue of the Mysore Gold Mining Co. for 1921 was £648,762 4s. 6d., the receipts from the sale of gold and silver amounting to £688,640 17s. 11d. The total profits aggregated £213,030 5s. 3d., of which £61,000 (25 per cent of value of fully paid shares) was distributed in dividends. The liquid assets as at Dec. 31, 1921, amounted to £508,003 5s. 1d. This is the thirty-sixth consecutive year in which the company has paid a dividend, the total amount thus distributed to date amounting to £9,146,519 13s. 11d.

On the termination, in May last, of the arrangement for the sale of gold to the government of India, the company was able to sell all its product in the open market. Sales have been effected in London, involving shipment to New York; and it has been possible to dispose of parcels of the metal in India on advantageous terms. The average price in British paper money has been favorable, although toward the end of the year under review there was a considerable decline in the premium.

Movements of Ores and Metals for March

Imports and exports of the more important metals and ores in March, 1922, and the revised figures for March, 1921, as compiled by the Bureau of Foreign and Domestic Commerce, are as follows:

IMPORTS

In Pounds, Unless Otherwise Stated

	March, 1921	March, 1922
Antimony matte, regulus or metal	1,776,484	2,441,872
Copper		
Ore, contents	4,029,414	1,005,357
Concentrates, contents	4,816,400	2,799,997
Matte and regulus, contents	1,020,103	169,070
Imported from		
Spain	123,648	223,280
Canada	423,480	261,892
Cuba	2,852,773	2,224,641
Chile	2,782,246	252,909
Peru	330,952	3,226
Unrefined black and blister	12,448,823	17,205,149
Refined, in bars and plates	324,060	13,737,242
Old, for remanufacture	35,062	4,097,807
Composition metal, copper chief value	450	108,129
Lead		
Ore, contents	341,211	642,376
Bullion, contents	1,867	13,034,908
Imported from		
Canada	163,269	340,267
Mexico	9,867	13,034,908
Chile	....	221,008
Other countries	169,942	81,101
Pigs, bars and old	1,993,264	....
Manganese ore, long tons	69,710	15,124
Imported from		
Brazil	30,750	76,088
British India	38,460	....
Other countries	500	828
Tungsten ore, long tons	64	.....
Pyrites, long tons	18,773	7,533
Imported from		
Spain	11,223	7,533
Tin		
Ore and oxide, long tons	1,852	566
Bars, blocks and pigs	3,028,356	15,783,259
Imported from		
United Kingdom	907,289	3,327,204
British Straits Settlements	1,689,489	10,892,979
Dutch East Indies	......	279,922
Hongkong	319,201	281,845
Australia	56,000	270,172
Other countries	56,377	731,137
Zinc		
Ore, contents	981,494	153,408
Imported from		
Canada	470,927	153,408
Blocks, pigs and old	6,162,061	......
Zinc dust	....	42,916

EXPORTS OF COPPER, LEAD AND ZINC

In Pounds

	March, 1921	March, 1922
Copper		
Ore concentrates, matte and regulus, copper content	60,970	....
Unrefined black and blister	33,613	....
Refined, in ingots and bars	36,574,236	72,393,485
Exported to		
Belgium	2,106,438	3,353,514
France	2,925,938	10,227,165
Germany	19,020,962	26,357,542
Italy	.....	3,642,817
Netherlands	1,164,846	2,746,519
Spain	554,656	1,526,812
Sweden	509,009	1,143,374
United Kingdom	7,406,780	4,713,226
Canada	1,224,040	99,213
Japan	.....	8,848,079
Other countries	1,661,567	9,735,341
Composition metal, copper chief value	3,216	273,525
Old and scrap	...	144,001
Pipes and tubes	293,826	127,537
Plates and sheets	830,544	1,438,667
Rods	......	5,130,679
Wire	984,878	1,344,995
Lead		
Pigs and bars		
From domestic ore	77,458	168,115
From foreign ore	3,138,794	11,170,618
Exported to		
France	....	2,464,953
United Kingdom	2,017,347	1,904,670
Canada	21,649	10,529
Argentina	112,000	448,000
Brazil	....	526,879
China	1,200	....
Other countries	1,064,056	5,983,702
Zinc		
Dross	7,340	635,195
Spelter		
From domestic ore	174,106	6,668,357
From foreign ore		784,000
Total zinc slabs and blocks	174,106	7,452,357
Exported to		
France	..	4,483,828
Italy	..	
United Kingdom	.	1,654,325
Canada	3,750	167,534
Mexico	136,833	5,547
Japan	..	1,030,523
Other countries	33,523	110,598
In sheets and strips	171,865	391,568
Zinc dust		269,825
Other zinc manufactures	.....	53,615

MINING STOCKS

Week Ended May 6, 1922

COPPER

Stock	Exch.	High	Low	Last	Last Div.	
Ahmeek	Boston	62	61	61	Sept. '20, Q	$0.50
Alaska-Br. Col. new	N. Y. Curb	4¼	3¼	4		
Allouez	Boston	27	25½	25	Mar. '19	1.00
Anaconda	New York	54	52⅜	52¼	Nov. '20, Q	1.00
Arcadian Consol	Boston	3¼	3	3¼		
Ariz. Com'l	Boston	9½	9	9½	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*24	*21	*24		
Bingham Mines	Boston	15¼	15	15	Sept. '19, Q	0.25
Calumet & Arizona	Boston	60¼	58	59½	Mar. '22, Q	0.50
Calumet & Hecla	Boston	275	270	270	June '20, Q	5.00
Canada Copper	N. Y. Curb	*55	*47	*50		
Centennial	Boston	11½	10⅛	10⅛	Dec. '18, SA	1.00
Cerro de Pasco	New York	37⅞	36¾	37¼	Mar. '21, Q	0.50
Chile Copper	New York	20¼	18⅞	20		
Chino	New York	29½	28⅜	28½	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	†*31	*29	*31		
Con. Arizona	N. Y. Curb	*8	*2	*8	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	1 13/16	1¾	1⅝		
Copper Range	Boston	43½	41¼	41½	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1½	1¼	1⅜		
Davis-Daly	Boston	8½	8⅜	8⅜	Mar. '20, Q	0.25
East Butte	Boston	11⅝	11	11	Dec. '19, A	0.50
First National	Boston Curb	*85	*78	*85	Feb. '19, SA	0.15
Franklin	Boston	2½	2	2½	..	
Gadsden Copper	Boston Curb	1¼	1	1 1/16		
Granby Consol	New York	27¾	25¼	27	May '19, Q	1.25
Greene-Cananea	New York	32½	31¼	31¼	Nov. '20, Q	0.50
Hancock	Boston	3¼	3	3¼		
Howe Sound	N. Y. Curb	3⅜	3⅛	3⅛	Jan. '21, Q	0.05
Inspiration Consol	New York	42	40¼	40¼	Oct. '20, Q	1.00
Iron Cap	Boston Curb	9	7½	9	Sept. '20, K	0.25
Isle Royale	Boston	24½	23¼	23½	Sept. '19, SA	0.50
Kennecott	New York	34¼	33	33¼	Dec. '20, Q	0.50
Keweenaw	Boston	3	2½	3		
Lake Copper	Boston	4½	3½	4¼		
La Salle	Boston	2	1¾	2		
Magma Copper	N. Y. Curb	30	29	29¼	Jan. '19, Q	0.50
Majestic	Boston Curb	†*12	†*9	*10		
Mason Valley	Boston	2¼	2	2¼		
Mass. Consolidated	Boston	4	3½	3	Nov. '17, Q	1.00
Miami Copper	New York	29⅝	29	29⅜	Feb. '22 Q	0.50
Michigan	Boston	3¼	2⅞	3	..	
Mohawk	Boston	59¼	56	57	Feb. '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	10	8⅜	9¼		
Nevada Consol	New York	17⅝	16½	17	Sept. '20, Q	0.25
New Cornelia	Boston	18¼	18	18¼	Feb. '22, K	0.25
North Butte	Boston	13¼	12½	12½	Oct. '18, Q	0.25
North Lake	Boston			*40		
Ohio Copper	N. Y. Curb	*10	*8	*10		
Old Dominion	Boston	25½	23½	24½	Dec. '18, Q	1.00
Osceola	Boston	35	35	35	June '20, Q	0.50
Phelps Dodge	Open Mar.		†165		Apr. '22, Q	1.00
Quincy	Boston	44	43½	43½	Mar. '20, Q	1.00
Ray Consolidated	New York	16¾	16¼	16⅜	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1¼	1⅛	1¼		
St. Mary's Min. Ld	Boston	46	45	45¼	Apr. '22, K	2.00
Seneca Copper	Boston	13⅝	13¼	13¼		
Shannon	Boston	*95	*80	*80	Nov. '17, Q	0.25
Shattuck Arizona	New York	9	8⅝	8½	Jan. '20, Q	0.25
South Lake	Boston	*90	*90	*90		
Superior & Boston	Boston	1¾	1½	1¾		
Tenn. C. & C. cfs.	New York	12⅛	11⅝	11¾	May '18, I	1.00
Tuolumne	Boston	*69	*65	*69	May '13	0.10
United Verde Ex	Boston Curb	28½	28	28	May '22, Q	0.25
Utah Consol	Boston	2½	2	2	Sept. '18	0.25
Utah Copper	New York	67¼	65	65½	Mar. '22, Q	0.50
Utah Metal & T	Boston	1½	1¼	1⅜	Dec. '17	0.30
Victoria	Boston			1		
Winona	Boston	1⅞	1⅜	1		
Wolverine	Boston	13¼	12	13¼		

NICKEL-COPPER

Stock	Exch.	High	Low	Last	Last Div.	
Internat. Nickel	New York	18⅞	17¾	18½	Mar. '19,	0.50
Internat. Nickel, pfd	New York	82½	80⅛	82½	Feb. '22, Q	1.50

LEAD

Stock	Exch.	High	Low	Last	Last Div.	
National Lead	New York	94⅝	92½	93¼	Mar. '22, Q	1.50
National Lead, pfd	New York	110¼	110	110	Mar. '22, Q	1.75
St. Joseph Lead	New York	15⅞	14⅝	15	Mar. '22, Q	0.25

QUICKSILVER

Stock	Exch.	High	Low	Last	Last Div.	
New Idria	Boston	1¼	1⅜	1¼		

ZINC

Stock	Exch.	High	Low	Last	Last Div.	
Am. Z. L. & S	New York	19⅝	18¼	18¼	May '20,	1.00
Am. Z. L. & S. pfd	New York	44	43⅛	44	Nov. '20, Q	1.50
Butte C. & Z.	New York	7⅛	6½	6½	June '18,	0.50
Butte & Superior	New York	31⅜	29¼	31¼	Sept. '20	1.25
Callahan Zn-Ld.	New York	7⅞	7½	7½	Dec. '20, Q	0.50
New Jersey Zn	N. Y. Curb	146¼	146	146	Feb. '22, Q	2.00
Yellow Pine	Los Angeles	*45	*40	*40	Sept. '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil, Colorado Springs, The Financial Press, N. Y.

GOLD

Stock	Exch.	High	Low	Last	Last Div.	
Alaska Gold	New York	⅝	½			
Alaska Juneau	New York	1½	1½	1½		
Carson Hill	New York	15¼	14¼	15¼		
Cresson Consol. G.	N. Y. Curb	2⅞	2⅝	2¾	Apr. '22, Q, X	$0.10
Dome Extension	Toronto			*85		
Dome Mines	New York	28¾	27½	27¾	Apr. '22, Q	1.00
Florence Goldfield	N. Y. Curb	*25	*22	*23		
Golden Cycle	Colo. Springs	*76	*72¼	*76	June '21, Q	0.02
Goldfield Consol	N. Y. Curb	*7	*7	*7	Dec. '19,	0.05
Hollinger Consol	Toronto	9.80	9.65	9.75	May '22,	0.05
Homestake Mining	New York	73	71⅛	72½	Apr. '22, M	0.25
Kirkland Lake	Toronto	*46	*42	*44½		
Lake Shore	Toronto	2.44	2.35	2.38	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	19.25	18.50	19.00	May '22, K	0.05
Porcupine Crown	Toronto	*29½	*26¼	*28½	July '17,	0.03
Porcupine V. N. T.	Toronto	*39	*34½	*37½		
Portland	Colo. Springs	*30	*30	*30	Oct. '20, Q	0.01
Schumacher	Toronto	*59½	*57	*58		
Silver Pick	N. Y. Curb	*20	*18	*19	....	
Teck Hughes	Toronto	*60½	*58	*59		
Tom Reed	Los Angeles	*60	*60	*60	Dec. '19,	0.02
United Eastern	N. Y. Curb	1 13/16	1½	1 11/16	Apr. '22, Q	0.15
Vindicator Consol	Colo. Springs	*10	*8	*8	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*9	*8	*8	..	
Wright Hargreaves	Toronto	3.06	2.85	2.90	Apr. '22,	0.02½
Yukon Gold	N. Y. Curb	1⅛	1	1	June '18,	0.02½

SILVER

Stock	Exch.	High	Low	Last	Last Div.	
Batopilas Mining	New York	1⅛	1	1⅛	Dec. '07, I	0.12½
Beaver Consol	Toronto	*36	*34¼	*35	May '20, K	0.03
Coniagas	Toronto	1.30	1.27	1.27	May '21, Q	0.12½
Crown Reserve	Toronto	*18	*16	*17	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	4⅛	4	4	Apr. '22, Q	0.12½
La Rose	Toronto	*35	*27½	*28¼	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*34	*28	*30½	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.15	*80	1.05	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6¼	5⅞	6⅛	Apr. '22, Q, X	0.30
Ontario Silver	New York	9⅛	8⅝	8½	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	.		*12	Jan. '12,	0.10
Temiskaming	Toronto	*36	*30	*33½	Jan. '20, K	0.04
Trethewey	Toronto	*6½	*4	*4½	Jan. '19,	0.05

GOLD AND SILVER

Stock	Exch.	High	Low	Last	Last Div.	
Boston & Montana	N. Y. Curb	*22	*19	*20		
Cash Boy	N. Y. Curb			*4		
Dolores Esperanza	N. Y. Curb	2	1½	1½		
El Salvador	N. Y. Curb	*7	*5	*7		
Jim Butler	N. Y. Curb			*8	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	*5	*5	*5	June '16,	0.05
MacNamara M. & M.	N. Y. Curb	*10	*9	*9	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1¾	1 11/16	1 11/16	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*80	*75	*76		
Tonopah Extension	N. Y. Curb	1⅝	1½	1½	Apr. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1⅞	1 11/16	1 11/16	Apr. '22, SA, X	0.07½
West End Consol	N. Y. Curb	1½	1⅜	1⅜	Dec. '19, SA	0.05

SILVER-LEAD

Stock	Exch.	High	Low	Last	Last Div.	
Caledonia	N. Y. Curb	*7	*7	*7	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*95	*95	*95	Dec. '20,	0.15
Chief Consol	Boston Curb	4½	4	4½	May '22, Q	0.05
Consol. M. & S.	Montreal	23½	22¼	23¼	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†2.00	†1.00		July '20, Q	0.10
Daly-West	Boston			2	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†3	†2½	2½	Apr. '21, K	0.05
Electric Point	Spokane	*8¼	*7½	*8¼	May '20, SA	0.03
Federal M. & S.	New York	13¼	13¼	13¼	Jan. '09,	1.50
Federal M. & S. pfd.	New York	45¼	44	44	Mar. '22, Q	1.00
Florence Silver	Spokane	*23	*20	*22	Apr. '19,	0.01½
Grand Central	Salt Lake	†*80	†*60	*75	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	6½	6¼	6⅜	Mar. '22, Q	0.15
Iron Blossom Con.	N. Y. Curb	*20	*20	*20	Apr. '22, Q	0.02½
Judge M. & S.	Salt Lake	†2.60	†2.21	2.60	Sept. '20, Q	0.12
Marsh Mines	N. Y. Curb	*22	*9	*18	June '21, I	0.02
Prince Consol	Salt Lake	*4¼	*3¼	*3½	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*5	*4	*5	Feb. '19,	0.01
Rex Consol	N. Y. Curb	*10	*9	*9		
South Hecla	Salt Lake	†*60	†*35	..	Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	24	*15	*23	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*11	*10	*11	Dec. '15	0.05
Tamarack-Custer	Spokane	2.55	2.50	2.50	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.00	1.97½	2.00	Dec. '21, Q	0.05
Utah Apex	Boston	3¼	3	3½	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	....	..	*2	Nov. '17,	0.01

VANADIUM

Stock	Exch.	High	Low	Last	Last Div.	
Vanadium Corp	New York	47½	41½	47½	Jan. '21, Q	1.00

ASBESTOS

Stock	Exch.	High	Low	Last	Last Div.	
Asbestos Corp	Montreal	60	57	57	Apr. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	75	75	75	Apr. '22, Q	1.75

SULPHUR

Stock	Exch.	High	Low	Last	Last Div.	
Freeport, Texas	New York	19½	17	18¼	Nov. '19, Q	1.00
Texas Gulf	New York	44½	43⅛	43½	Mar. '22, QX	1.00

MINING, SMELTING AND REFINING

Stock	Exch.	High	Low	Last	Last Div.	
Amer. Sm. & Ref.	New York	59¼	57½	57½	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	98	97	98½	Mar. '22, Q	1.75
Am. Sm. Sec. pf. A.	New York	92½	92½	92½	Apr. '22, Q	1.50
U. S. Sm. R. & M.	New York	41½	40	40	Jan. '21, Q	0.50
U.S. Sm.R.& M. pf.	New York	46	45½	45½	Apr. '22, Q	1.75

Current Prices of Mine Materials and Supplies

Rise and Fall of the Market

Advances—Dynamite steadies with slight advances along the Western coast. White lead continues brisk and linseed rises 5c. at the New York market. Drill rods are steady. Wire rope shows added strength over the previous two weeks. Cement is quoted 20c. higher.

Declines—Yellow pine down $1 in Chicago, douglas fir and hemlock fall $4 in Los Angeles. Lime is 15c. to 20c. lower in St. Louis and Seattle.

SHEETS—[illegible] from warehouse; also the [illegible]:

	Pittsburgh Large Mill Lots	St. Louis	Chicago	San Francisco	New York
[illegible] No. 10	$2.[illegible]	$3.47½	$3.38	$3.95	$3.38
[illegible] No. 28	3.35	4.[illegible]	4.[illegible]	[illegible].45	4.25
[illegible] No. 28	4.[illegible]	[illegible]	5.30	6.30	5.25

STEEL RAILS—[illegible] per ton f.o.b. Pittsburgh and [illegible]:

	Pittsburgh Current	One Year Ago	Birmingham	Chicago
[illegible]	$4[illegible]	$45.00		$40.00
[illegible]	4[illegible]	47.00	$40.00	40.00

TRACK SUPPLIES—[illegible] per 100 lb. f.o.b. Pittsburgh [illegible] the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
[illegible]	$2.15@2.25	$3.30	$2.55	$3.00	$4.25	$3.10
[illegible]	3.[illegible]@[illegible].5	4.[illegible]5	3.65	4.25	5.25	4.05
[illegible]	2.40	2.50	2.40	3.00	4.00	3.25

STRUCTURAL MATERIAL—[illegible] base prices f.o.b. mill Pittsburgh [illegible] per 100 lb. from warehouses at [illegible]:

	[illegible]	Birmingham [illegible]	New York	Dallas	St. Louis	Chicago	San Francisco
[illegible]	1.[illegible]	$[illegible]	$2.58	$4.00	$2.57½	$2.48	$3.10
[illegible]	1.[illegible]	[illegible].65	2.58	4.00	2.57½	2.48	3.10
[illegible] 3 to 6 in., ¼ in.	1.[illegible]	1.65	2.58	4.00	2.57	2.48	3.10
[illegible]	1.[illegible]	1.65	2.58	4.00	2.57½	2.48	3.10
[illegible]	1.[illegible]	1.65	2.58	4.00	2.57	2.48	3.10

WIRE ROPE—[illegible] bright and galvanized [illegible]:

	Eastern Territory New York and East of Missouri River
[illegible]	36%
[illegible]	32½%

	New York	Cleveland	Chicago
Drill rod [illegible]	[illegible]	55	50%

WROUGHT PIPE—[illegible] lots for carload lots on the [illegible]:

	Steel Black	Galv.	Inches	Iron Black	Galv.
BUTT WELD [illegible]	71	58	[illegible] to 1½	44½	29½
LAP WELD 2	64	51	2	39½	25½

STEEL—[illegible] discounts hold for [illegible]:

	Black New York	Black Chicago	Black St. Louis
1 to 3 in. b[illegible]	[illegible]	62	59%

CAST-IRON—[illegible] prices per net ton for carload lots:

	New York Current	New York One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
4-[illegible]	$50.80	$73.30	$38.50	$48.10	$43.70	$54.00

	New York	Cleveland	Chicago
Nuts, [illegible] sq., per 100 lb. off list	$2.50	$3.50	$4.00
[illegible] sq., per 100 lb. off list	2.50	3.50	4.00

MACHINE BOLTS	New York	Cleveland	Chicago
[illegible] up to 12 in.	40%	60-10-10%	60-10%
[illegible] bolts, with hex nuts	30%	$3.90 net	. .

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Current Price	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J. Factory
4x12x12	$0.11120	$0.1895	$0.0821	$0.095	$0.063	$0.108	
6x12x12	16670	2526	0950		.08	156	
8x12x12	20840		1295	175	12	244	$0.17890

LUMBER San Francisco—Prices of rough Douglas fir No. 1 common, in more than carload lots. To contractors $2 per M ft. additional

Lumber Prices to Contractors in Yards at San Francisco

	6-8 and 12 Ft	10-16-18 and 20 Ft	22 and 24 Ft	25 to 32 Ft.
[illegible] 3 4	$24.00	$24.00	$25.00	$30.00
[illegible]	25.00	25.00	26.00	31.00
4 4-6 [illegible] 8	25.00	26.00	27.00	32.00

LUMBER (continued)

Wholesale prices to dealers of long leaf yellow pine

	New York 20 Ft and Under	New York 22-24 Ft.	Chicago 20 Ft and Under	Chicago 22-24 Ft.
3x4 to 8x8	$38.00	$39.00	$36.00	$38.00
3x10 to 10x10	41.00	42.00	38.00	40.00
3x12 to 12x12	43.00	44.00	40.00	42.00

Other Cities	8 x8-In. x 20 Ft and Under P.	Fir	Hemlock	Spruce	12 x 12-In 20 Ft and Under P.	Fir
Boston	$50.00	$52.00	$55.00	$45.00	$54.00	$52.00
Cincinnati	39.00	50.00			40.00	64.00
Montreal		47.00	35.00	35.00	82.00	47.00
Denver		35.75	35.75	35.75		36.75
Minneapolis	40.00	39.00	38.00		47.00	39.00
Kansas City	33.00	34.00			36.00	35.00
Birmingham	21.00				26.00	

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh Mill	Chicago	San Francisco	Dallas	St Louis	Montreal
Wire	$2.40	$3.15	$3.90	$5.00	$3.25	$4.95
Cut	2.25	5.80	5.90	7.75		5.00

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted

	Current	One Month Ago	One Year Ago
New York	$2.60	$2.30	$3.20
Chicago	1.97	1.94	2.17
Cleveland	2.26	2.26	2.43

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$15.80@$16.80	$12.50	$3.68	$2.75@$3.18
San Francisco	22.00	18.00	.	1.75

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Chicago Current	Chicago One Year Ago
Raw in barrel (5 bbl. lots)	$0.95	$0.67	$0.90	$0.68

WHITE AND RED LEAD—Base price in cents per pound:

	Red Current Dry	Red Current In Oil	Red 1 Year Ago Dry	Red 1 Year Ago In Oil	White Current Dry or In Oil	White Yr. Ago Dry or In Oil
100-lb. keg	12.25	13.75	13.00	14.50	12.25	13.00
25 and 50-lb. kegs	12.50	14.00	13.25	14.75	12.50	13.25

HOSE—

Fire	50-Ft. Lengths
Underwriters' 2½-in.	49½c per ft.

Air	First Grade	Second Grade
¾-in. per ft.	$0.24	$0.19½

Steam Discounts from List

First grade 40-10% Second grade 50-5% Third grade 5-10-5%

RUBBER BELTING—The following discounts from list apply to transmission rubber and duck belting:

Competition 60-10-5% Best grade 60-5%

LEATHER BELTING—Present discounts from list in fair quantities:

Light Grade	Medium Grade	Heavy Grade
50%	40-5%	35%

RAWHIDE LACING For cut, best grade, 50-10%, 2nd grade, 60%.
For laces in sides, best, 41c. per sq. ft.; 2nd, 39c.
Semi-tanned: cut, 50%; sides, 43c. per sq.ft.

PACKING—Prices per pound:

Rubber and duck for low-pressure steam, ⅛ in.	$0.90
Rubber sheet	.45
Rubber sheet, wire insertion	.70

MANILA ROPE

Boston	$0.20	New Orleans	$0.17¼
New York	.17	Los Angeles	.16¾
Chicago	.19	Seattle	.16½

COTTON WASTE—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	7.50@10.00	12.00	12.00
Colored mixed	5.50@9.00	9.00	9.00

EXPLOSIVES—Prices per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.2950	$0.3250
Kansas City	.24	.2750
Denver	.2250	.2550
Baltimore	.2550	.27
Cincinnati	.2350	.255
New Orleans	.2725	.3075
San Francisco	.195	.23

FLOTATION REAGENTS—All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight, 500 lb.

Pine oil, steam dist., sp.gr. 0.930-0.940	gal.	$1.90
Pine oil, pure, dest. dist.	gal.	1.50
Pine tar oil, ref., sp. gr. 1.025-1.035	gal.	.46
Pine tar oil, crude, sp. gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal.	.35

NEW MACHINERY AND INVENTIONS

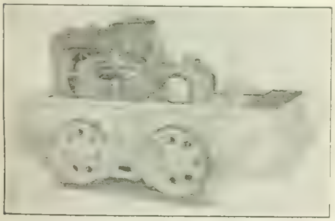
A New Gasoline Mine Locomotive

The accompanying illustration shows a type of mine locomotive which was developed to meet the demand for a compact, dependable gasoline locomotive for light haulage service. It is a substantial machine complete in every detail, and is built to stand severe service.

The motor is of the rugged tractor type with all parts thoroughly inclosed and protected, but still easily accessible. The in-take air is washed by passing through a water clarifier, which removes the dust. A simple and effective splash system of lubrication is used. The lubricating oil is introduced at one point in a central reservoir which lubricates all parts of the motor and transmission.

The clutch is placed just behind the flywheel in the usual manner, and the propeller shaft mounts at its extremity a bevel pinion which is in constant mesh with two bevel gears, causing the bevel gears to rotate in opposite directions. Forward or reverse motion is obtained by engaging either one of these bevel gears by means of a sliding gear clutch. A neutral position is also provided. The drive from the bevel gear shaft is by a spur gear reduction to the jack shaft, on the extremities of which are mounted sprockets which drive the axles through high-grade roller chains.

The power plant is mounted in a standard locomotive frame similar to that which has been used for some time on electric locomotives in mining and industrial service. Complete locomotive equipment, such as hand-operated brakes with renewable brake shoes, hand-operated sanders of rugged design, structural steel frame and locomotive type bumpers, is used. Speed changes are obtained by throttle control similar in operation to that of a steam locomotive. All control levers are conveniently grouped in the operator's compartment. Cast-iron wheels are standard equipment, but steel wheels or steel-tired wheels, as well as a cab for inclosing the operator and mechanism, can be provided if desired.



Gasoline locomotive for light hauls

The locomotive is known as Type "G" and is manufactured by the Atlas Car & Manufacturing Co., Cleveland, Ohio.

Steam shovel, equipped with caterpillar traction, in operation in Ohio lime quarry

Caterpillars Applied to Shovels

Of interest to operators of railroad-type shovels is the announcement that all sizes can now be equipped with caterpillar traction. Among the advantages of mounting a shovel in this way are the following: No time lost in moving up; an ordinary move requires about ten seconds only; no rails to lay; no jacks to release and set; no stops during operation to reset jacks; the shovel is always ready to dig; the shovel does not have to face blasting; may be moved back out of the way quickly and easily; can be turned around quickly; no track trouble when in water; in emergencies, such as slides, can be moved back quickly out of danger; shovel can always dig at most effective distance from bank—short moves easy and quick to make; no delay on account of boulders rolling in close to shovel; lighter work for pitmen; saves from two to four pitmen and sometimes more; can travel and work on approximately same character of ground as shovel on railroad trucks, and where shovel on railroad trucks requires blocking under jacks and both rails, when working on soft ground, the shovel on caterpillars requires blocking only under the caterpillars.

The mounting consists in general of two forward caterpillars, replacing the jack arm, and two rear caterpillars mounted under the rear end of the shovel.

The front caterpillars are so designed that they can swivel and adjust themselves to unevenness of the ground. Both front caterpillars are drivers.

The rear caterpillars consist of two caterpillar units mounted on the same frame. They are designed with sufficient strength to permit the crossing of holes and ditches without the delay incidental to filling in.

Steering is accomplished through the rear caterpillars. The massive steering arm is integral with the pintle of the rear caterpillar trucks. It carries a heavy gear segment which engages a pinion on a vertical shaft. It is driven by an independent center-valve, reverse-type engine, suspended underneath the car frame. This engine may be operated either from the operator's stand or from ground alongside the rear caterpillars. Steering in curves of large diameter can be accomplished by the swinging of the boom without the steering mechanism.

Propelling is accomplished through the front caterpillars. Both caterpillars may be driven together or each one independently, forward or backward. The propelling speed is about half a mile per hour. The tractive power is sufficient to enable the shovel to climb with ease 15 per cent to 20 per cent grades.

The Bucyrus Co., Milwaukee, Wis., was the first manufacturer to equip dragline excavators with caterpillars, over eleven years ago; it was the first to apply this mounting to revolving shovels; the first to mount tower excavators weighing over 200 tons on caterpillars; and it is now the first to design and build a caterpillar mounting for railroad-type shovels of all sizes.

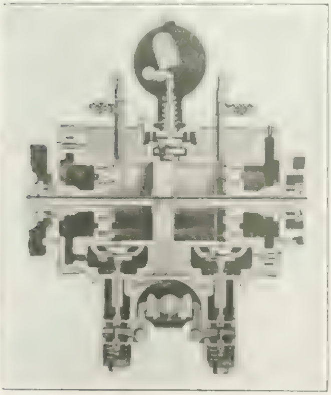
High-Carbon Iron Advantageous in Grinding Balls and Mill Liners

A grinding ball cast from an alloyed steel-base white iron containing a high percentage of combined carbon is said to possess a degree of hardness that makes it almost impossible to scratch the surface with a steel tool. Such a grinding ball should furnish excellent service in reducing ore to any degree of fineness. It is stated that these "Duroloid" grinding balls are cast in such a way that the iron crystals radiate from the cores of the balls; thus, only the ends of the crystals are ex-

[illegible] is reduced to a minimum, chipping becomes impossible. The balls are made in sizes ranging from [illegible] in. in diameter by the Los Angeles Foundry Co. of Los Angeles, Cal. "[illegible]" mill liners, made of the same metal as the grinding balls, are finished with a smooth, hard face by a special facing process which eliminates [illegible] holes and rough spots so common in the ordinary white iron liner. This gives added value in cutting down horsepower required and a maximum of ore crushed per pound of grinding medium.

Steam Economy Is Keynote of New Compressor

Builders of steam-driven air compressors have made little effort to improve the steam economy of their machines. The development of the steam-driven air compressor has not kept pace with the development of the steam engine, for today the steam consumption per unit of work of the former is much higher than that of the modern steam engine built for general service. There has been an urgent need for improvement in compressor design, and this need has been greatly increased by the widespread and ever-growing use of superheated, high-pressure steam.


Steam cylinder in which initial condensation is almost eliminated

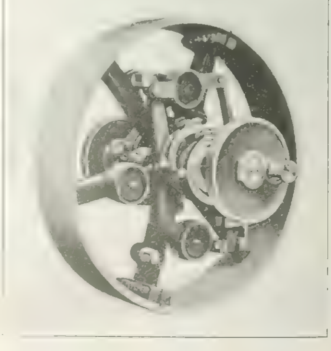
A new type, which is known as the "Dual Flow" steam-driven air compressor, is being produced by the Chicago Pneumatic Tool Co., and is said to obtain better steam economy than has heretofore been found possible.

The foremost feature of the Dual Flow compressor is the steam cylinder, which is so designed and constructed that initial condensation is almost entirely eliminated, resulting in a great saving in steam power. Initial condensation is one of the greatest preventable losses in steam engines of the old counterflow or compound type; it is caused by the cooling of the cylinder walls and head by the comparatively cool exhaust steam as it washes over them in leaving the cylinder through the same port by which it entered.

In the Dual Flow cylinder, the exhaust steam does not wash back over the cylinder walls and head, but leaves through a port in the center of the cylinder. Thus the interior surfaces of the cylinder walls and head remain at nearly the same temperature as the entering steam, and initial condensation is reduced to the absolute minimum. The exhaust port is uncovered by the piston when the latter has traveled about half its stroke. The exhaust is controlled, however, by a patented steam-tight poppet valve, which opens when the piston is near the end of its stroke and closes again (if the machine is running non-condensing) when the piston covers the port on the return stroke. When running condensing, the valve of course closes early in the return stroke.

The Dual Flow cylinder has several advantages over unaflow types. In the first place, it makes possible a material saving in steam consumption when running non-condensing. As the piston of a unaflow engine covers the exhaust port at the start of the return stroke, some provision must be made for preventing excessive compression. This usually takes the form of large clearing spaces. If there is any back pressure, there must be still greater clearance. Compression in the Dual Flow cylinder, on the other hand, does not begin until the piston has traveled half the return stroke.

Valve leakage probably causes a greater steam loss than any other single factor. Especially is this true of installations where superheated, high-pressure steam is used; in fact the faults common in most of the valves now used, such as leakage, excessive clearance and the necessity of valve lubrication, have served to defeat the advantage to be derived from the use of superheated steam. The valve problem has been solved in the construction of the Dual Flow compressor by the adoption of the Skinner steam-tight, double-seat poppet valve, which is patented, for both admission and exhaust. It is claimed that this valve will remain steam-tight indefinitely and will seat perfectly, regardless of the pressure or temperature under which the cylinder is operated. It has been known to keep steam-tight, with one grinding, with 159 lb. pressure and 150 deg. F. superheat and also with saturated steam at 100 lb. pressure. No lubrication is required.


Governor of Dual Flow compressor

The governor is mounted in the flywheel and operates by centrifugal force and inertia. The governor arm is connected to the steam valve eccentric, and by changing the throw of the latter, it changes the point of the cut-off of the steam entering the cylinder. This method is far superior to the old scheme of merely throttling the steam. Variations in speed may be made by adding or removing weights.

A Non-Corrosive, Non-Flaking Coating

Realizing the inherent chemical and mechanical deficiencies of zinc galvanizing as a protective coating, Richard Staack, after many years in research work and experiments, has invented and perfected the "Nonpareil" method of hot-dipped lead coating, which is said to provide a flexible non-corroding coating of pure metallic lead. This coating is not merely a surface covering, but it forms an alloy with the outer surface of the metallic object to which it is applied, thus making the coating an integral part of the article itself and removing all tendency of the coating to break away from the metallic object to which it has been applied.

Metallic lead, being a highly ductile metal, makes it possible for articles or metal parts which have been lead-coated by the "Nonpareil" method to be bent to any desired radius without cracking or impairing the protective qualities of the lead coating. This is a distinct advantage over the use of zinc galvanizing, on account of galvanized zinc-coating being brittle and flaking off under hammer blows or when metal is bent even to a limited degree.

Zinc galvanizing, unless kept absolutely dry, sheds its surface gradually through surface oxidation when exposed to moisture of the air, thus making its protective life temporary and inefficient. It is rapidly eaten away when exposed to acid fumes or spray. As zinc itself corrodes when exposed to acid fumes, it cannot be considered as a protection against corrosion. Pure metallic lead, on the contrary, is not brittle and is unaffected by moisture or acid fumes or spray, and is a permanent protector against corrosion and rust. Though its surface may become tarnished or even covered with deposits of iron oxide from the moisture in the air, it can be wiped off, and the coating will be found not to have been impaired, and the article itself has been efficiently protected.

The process is controlled by the Richard Staack Lead Coating Works, Inc., of North Bergen, N. J.

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Volume 113 New York, May 20, 1922 *Number* 20

Electric Activity of Sulphide Oxidation

IN OUR ISSUE of April 22, G. N. Libby wrote upon the theme that certain mineral sulphides are a possible source of commercial electrical energy, since in the process of their oxidation much energy is released. This, he showed, was particularly the case with pyrite. He showed by experiment that mineral sulphides, such as pyrite, oxidize readily as an anode in an alkaline solution, with the development of measurable electrical energy. The article had in mind not the processes in nature, but the possible use of the principles established for commercial development.

The paper by Professor Schlumberger, of Paris, the translation of which appears in this issue, bears upon the same problem from another point of view. Professor Schlumberger has actually detected electric currents around certain sulphide orebodies, especially those which are highly pyritic. His observations indicate that these currents travel down along the sulphide body a certain distance, and then the circuit is completed by the current returning upward through the wall rock. It is Professor Schlumberger's opinion that the origin of the current lies in the dissimilarity of the ground water near the surface and in depth, that near the surface being partly aërated; and that the pyrite body, which is immersed (through the humidity in the ore and in the rocks), in this dissimilar bath, acts mainly as a homogeneous conductor for the currents. He believes that the result of this electric current is to liberate oxygen and hydrogen (apparently from electrolysis of water); that the oxygen thus liberated in the lower portions of the circuit reacts with the sulphides, oxidizing them, so that the process of oxidation goes on below the zone where the air-derived oxygen is present in the waters.

Professor Schlumberger has sought to make this activity a guide to the presence and extent of the sulphide bodies which thus set up an electric current. By means of a delicate potentiometer, he measures the local differences of electrical potential in the vicinity of known or suspected orebodies, and a plotting of the observations thus made should indicate the form of an underlying orebody. Professor Schlumberger's assistant, Mr. Sherwin F. Kelly, has recently tested the instrument in a number of districts in the United States and Canada. The result, as shown to us, for the pyrite bodies of Ducktown, was very satisfactory and clear; while we understand that the gold-quartz ores of Porcupine and the sparsely disseminated native copper ores of Michigan did not prove detectable by this method. This is as should be expected under Professor Schlumberger's theory, for neither the Porcupine gold ores nor the Michigan copper ores are excellent conductors; they are not unusually high in metallic or pyrite content.

The whole subject opens up a field which may prove to be of great future interest to the miner and to the geologist. Are the electric currents measured by Professor Schlumberger due simply to the pyrite body acting as a conductor for the currents set up by the permeating unsymmetrical ground water (aërated above but not below); or is it the oxidation of the sulphides in the superficial portion of the sulphide body which develops the electric current, as indicated as possible in Dr. Libby's experiment? Most ground waters are mildly alkaline. In either case, sulphide oxidation and the alteration of ores would appear to be not simply a chemical but an electro-chemical process, in which the composition of the ground water plays an important rôle. The nature of those secondary minerals which develop near the surface as the result of atmospheric reactions should be studied further from the electro-chemical viewpoint.

It has long since been demonstrated that certain mineral sulphides in the presence of ground water act as the two poles of a battery, with the result that these are reduced to the oxidized form more rapidly than associated sulphides which do not so act; but that where one of these minerals occurs without the other, it is not attacked thus readily. We may even, perhaps, find in some cases that the deposition of secondary native metals, such as copper and silver, in the superficial zone, is sometimes the result of an electroplating process, as suggested by Dr. Libby's remarks concerning his laboratory experiment: "It may be possible to oxidize the sulphide in one cell, generating electricity; and in another cell to use this energy to electroplate the metal from the solution that resulted from the action in the first cell."

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The Russian Bandits

ORGANIZED LABOR in this country, speaking through Mr. Gompers, has refused to recognize the Soviet government of Russia, but the British labor unions are urging such action. The idea in Europe seems to be that however bad Lenine and his friends may be, it is desirable to come to terms with them in order to expedite a resumption of business with the Russian people, and it may be that the British labor unions, which play politics, may see some national advantage in recognizing the gentlemen at Moscow. To us it seems that Mr. Gompers and his friends are more sagacious; the cause of organized labor can gain nothing by association with the organized piracy that is now in the saddle formerly bestridden by the Czar and his bureaucracy. We regard the Soviet leaders as a band of pirates, who, having brought Russian government to chaos and Russian industry to ruin, desire to destroy the system of orderly living we call civilization. For any government to make a loan to Lenine and his pals is like lending money to a group of hootch bandits, or leaving a bottle of whiskey at the corner of Third and Market Streets, San Francisco. They are international outlaws.

The Central Copper Co.

WHO AND WHAT is the Central Copper Co. of Arizona, Inc.? Such a strong stock-selling campaign is being conducted by the individuals back of this enterprise that the question is repeatedly asked. Its property, for it actually has some, is at Dos Cabezas, in Cochise County, Ariz., in the southeast corner of the state. However, the New York office of one of the important well-known copper producers operating in Cochise County professed total ignorance of it when a representative recently asked for information.

Little real information is given in the company's prospectus. In this are set forth the names of officers and directors, none of which is familiar; also the facts that the capitalization is $10,000,000, the cash and liquid assets are $1,000,000; that only $100 will be accepted from any one person (though we understand one may subscribe for others); and no promotion stock.

The prospectus also indicates that the company owns 520 acres of ground and has leased an adjoining 860 acres for twenty years from April 1, 1920, together with a fifteen-mile railroad and a two-mile aërial tramway, as well as considerable operating equipment; and it states that a stockholders' committee composed of bankers, manufacturers, attorneys, teachers, mining engineers and the like has said: "The whole property appears to be a vast copper zone of enormous wealth."

Of the important matter of ore reserves the prospectus has only this to say: "It is necessary to develop a large reserve tonnage before installing proper plants for handling the ore. This guarantees a steady and economical production." How true this is and yet how inadequate! On specific assay reports it is likewise silent. Photographs of the property and of a group of satisfied stockholders, together with a recitation of their unanimously optimistic but, from our viewpoint, worthless and nonsensical verdicts, occupy the rest of the prospectus. A supplement, known as the "Copper Review," published and edited by the officers of the Central company, is equally uninformative, though it says much about copper in general and talks overmuch about the fortunes that others have made on small investments.

Where, then, is the strength of Central Copper's selling campaign? It is this: The company seems to have obtained the support of the Arizona Corporation Commission. It is reported that the audience room of the commission at Phoenix, Ariz., has even been used for a moving-picture show advertising the Central copper project—an unusual circumstance, in our judgment.

Further, much is made by the promoters of a letter from Amos F. Betts, a member of the commission, replying to an inquiry regarding the company. The inquirer is told that the commissioners believe that the success of the project is practically assured. Mr. Betts however, prefers to quote from an "exhaustive report" made on the property by Charles F. Willis, editor of the *Arizona Mining Journal*. It is noteworthy that Mr. Willis, as quoted by Mr. Betts, says nothing about ore reserves and specific values. Mr. Willis has also "written up" Central Copper in his magazine, this, too, being a "talking point" for the company.

Mining is none too brisk, though steadily improving, and many reputable engineers would doubtless be willing to examine and sample the company's property for no more than their regular fee. The public has a right to know the facts. We invite the Central Copper Co. to have such a bona-fide examination made.

Abuse of the Oil-Shale Industry

A SUBSCRIBER has sent us a copy of *The Shale Review*, a monthly magazine published in Denver, and devoted, according to its own declaration, to the oil-shale industry. Our correspondent desires to know what we think of the principal article in the issue, one written by the editor of the paper under the caption "Gold, Silver, Platinum, and Other Rare Metals Are Found in Oil-Shale Deposits." Now, if this particular article were the only one of its kind, or if *The Shale Review* were the only publication that shows its "devotion to the oil-shale industry" by originating such stuff; or if such stories were not copied innocently by reputable but uninformed daily papers and weekly periodicals, in which they are given wide circulation—except for these reasons, we would not take the trouble to discuss the article in question. If it were only absurd but innocuous nonsense there would still be no reason for further comment; but such literature is more than that: it is distinctly harmful. It will retard the development of meritorious processes, retorts, and equipment; it will obstruct the financing of legitimate enterprises. Since it will hurt the oil-shale industry, and since the exploitation of oil shale is distinctly part of the mining industry, we feel that we ought to denounce such journalism even if we are powerless to reform it. Here, for instance, are a few extracts from the article in question, quoted verbatim except for a few observations by ourselves:

"After the spent shale is precipitated from the retort [the plant is at Denver] it passes into a rod mill, an apparatus commonly used in grinding metallic ores. This mill pulverizes the shale to a floury fineness. This treatment is held to be essential in further steps in the process of obtaining metals. From the rod mill the shale goes into the decarbonization furnace, which is similar in construction to the shale retort, except that air is admitted. A high degree of heat and the presence of air completely destroys the carbon. The removal of the carbon is of the utmost importance as it is held that this substance locks the metals so they will not precipitate. After decarbonization the shale passes to an agitating or Pachuca tank. Here it is subject to a wash of hot water. After the washing process the cyanide solution is placed in the tank. This solution is the kind generally used in all cyaniding operations. The inventor has another solution of his own discovery which it is claimed is much cheaper and more effective. In the present operations it was deemed desirable not to depart from established methods in order to leave no room for criticism or claims that the solution has been salted. [A wise precaution; cyanide solutions cannot be salted!] The cyanide solution takes up any gold and silver found in the shale and is drawn off by a vacuum into a separate metallic tank. The shale is then taken from the Pachuca tank and concentrated on what is known as a Wilfley table. This concentration brings the residue [evidently means concentrate] down to about 5 per cent of the original quantity of the decarbonized shale. The concentrates so far are found to contain a considerable quantity of an unknown grayish metal heavier than gold and which does not melt except at a temperature above that of any other known metal. All tests so far made indicate that this metal is osmium or iridium, or possibly both.

"The cyanide is precipitated through zinc shavings which separates the gold and silver from the solution.

Due to the fact that the cyanide solution must be used over and over, gradually absorbing the gold and silver in successive charges in the tank, no precipitation of these metals in quantity has been completed."

We are quite ready to believe this. Further pseudo-technical stuff precedes the following ingenuous but ingenious admission:

"The story of the Beam operations, from the time the inventor first made claims for metal values in the shale, down to the present time, is a tale of adverse criticism and ridicule, not to mention downright accusation of trickery and dishonesty. [Harsh words!] Mining men, assayers, chemists, metallurgists without number long ago voted A. M. Beam a faker. According to all the rules laid down in the books and demonstrated by recognized assay methods, oil shale carried no gold, silver, or platinum worth mentioning. [Verily.] That the Beam assays were salted, or that he did not know his business has been the consensus of most expert opinion. Whether the results obtained in the treatment of some forty tons of shale at the present test has caused any change of sentiment is unknown. . . . The Beam discoveries have revolutionized the oil-shale business and brightened the future a thousand per cent."

If the oil shales of Colorado and Utah contained appreciable quantities of silver, gold, or platinum it would be unnecessary to build a plant and to treat forty tons in order to prove the fact. Any reputable custom assayer can determine in a few hours not only the existence or non-existence, but the quantity of precious metal, if there be more than a trace, in a sample of raw shale. Even if we were to concede—and we emphatically do not—that Mr. Beam has "discovered" or "invented" a miraculous process for converting precious metals from some mysterious form into that with which we are all familiar, he could do it with ten pounds as well as with forty tons, and the assayer would then be able to settle any uncertainty as to how much precious metal each ton of shale contained.

In short, we believe that if every trace of silver, gold, platinum, and any other rare metal were extracted from the entire lot of forty tons, the total value of the metals recovered would be worth less than, for example, a single ounce of Pittman-Act silver. Moreover, it is our deliberate conviction that the writer in *The Shale Review* agrees with us. At any rate he adroitly avoids making any direct assertion to the contrary.

Why, then, does he write and publish such a story? Possibly he considers the article so ably written, or so thrilling, or so subtly humorous, that it will attract paid subscribers, thereby stimulate advertising, and in consequence increase the profits of his publication. Perhaps the article is an advertisement, in disguise, for the American Continuous Retort Co., which, no doubt, is willing to promise a share in its millions of future profits to any who can be persuaded to put real money into the company at the present time. In that event the "ad" may be paid for in cash. Or perhaps the publisher expects to reap profit in a less direct way. Perhaps he believes that the wide dissemination of such stuff will stimulate oil-shale exploitation and that general activity in the industry will be reflected in prosperity for *The Shale Review*. Whatever may be the motive, the article speaks for itself; and as we have pointed out, it is typical of many articles that are being printed in all kinds of publications, not only in the West but in the East. We contend that all reputable mining engineers should take advantage of any opportunity for correcting the ideas that this sort of publicity implants in the public mind, and that engineers and others who are engaged in the oil-shale industry should take active steps to stop the publication of such articles, in order that a really remarkable industry may enjoy a legitimate and healthy growth based on real merit.

The Importance of Mica

IT IS UNFAIR to judge the importance of an industry entirely by the value of its output; the fact that a mineral is industrially indispensable should be considered. Statistics indicate that the value of mica produced in the world during 1917 and 1918, the years of record production in the United States, was about $8,000,000 per annum. Owners of mica mines, however, have the comfort of knowing that growth in the demand for their product doubtless will synchronize with the expansion of the electric industries, since intensive research thus far has failed to find a material of dielectric properties adequate to make a satisfactory substitute in sundry electrical manufactures.

The price of sheet mica varies widely with the quality of the product and, particularly, with the size of the sheets that can be cut from a block. For example, material from which can be made sheets 1½ x 2 in. is worth about 7c. per pound, whereas equally good mica that can be cut into sheets 8 x 10 in. will bring $8 per pound. Methods of mining mica deposits are unusual in many respects; that is, they differ from those used in the mining of metalliferous ores, because of the characteristic habits of the minerals and the specifications of the most desirable products.

It is interesting to note in the timely article written by Mr. J. Volney Lewis, which we publish in this issue, that despite inherent peculiarities in their operations many companies have already discovered the advantages of systematic development and efficient organization in the exploitation of their deposits. According to Mr. Lewis, India is the one mica-producing country where the methods of preparing and grading mica have been properly standardized. Producers in the United States and Canada will find it to their advantage to co-operate to accomplish the same end.

Sulphide Crystals Wanted

WE HAVE HAD several requests recently for the names of mining companies or individuals who have mineral deposits wherein perfect crystals of galena and chalcopyrite can be found. These are used in the simple forms of radio receiving apparatus, and it is said that the clearness with which messages may be received depends to a great extent upon the quality of the crystal detector. Some manufacturers of these detectors buy large quantities of ore, which they sort by hand in the hope of finding a few acceptable specimens. They tell us that this method of getting suitable material is decidedly unsatisfactory and wasteful, and that it would be much better if someone at the mine could select good crystals, packing them carefully, and shipping little or no ore which, although high-grade from the smelter's standpoint, is of no value for radio purposes. If any of our readers know where such specimens can be found, we would appreciate having them communicate with us.

Even Methuselah Died

By T. A. Rickard

ELSEWHERE in this issue a Cornish friend in London writes to us to say that three gold mines in Rhodesia are yielding rich ore at a depth of about 1200 feet, and that the St. John del Rey, the deepest mine in the world, is doing remarkably well. Whereupon he suggests that it is time "to investigate the accuracy of the statement that 'even Methuselah died' ". This phrase was the title of an editorial that appeared in the 'Engineering and Mining Journal' of May 2, 1903. In it I attacked the recklessly optimistic anticipations of the persistance of rich ore on the Rand, as expressed in proposals to sink shafts to a vertical depth of 8000 feet. The Biblical reference suggested that as all men are mortal, so also all orebodies come to an end. Our correspondent gives some particulars concerning the ancient hierarch, and suggests humorously that we do not know when he died or indeed that he did die, and that the presumption of his death "affords but slender basis for an aspersion on the continuity in depth of valuable ore". Here I may mention that Mr. Wells in his 'Outline of History' records the fact that the earliest method of reckoning was by moons and by generations of men, and that the great ages of the patriarchs as given in the Book of Genesis should be read in terms of lunar months, so that the alleged life of Methuselah is reduced to a figure that is credible. In Genesis (V. 27) his age is given as 969, which, if translated into lunar months, of 30 days, would be equivalent to 83 years. We trust that this will not be deemed an "aspersion" on the prototype of persistence!

Let us turn now to the pleasing statements concerning the fortunate mines in Rhodesia. They are yielding rich ore at depths ranging from 1100 feet to 1500 feet. This is not deep; a mine of that vertical extent is no more 'deep' than a man of 35 is old, for as men live to be 100, so mines continue to be productive down to 6000 feet. Whether the three Rhodesian mines are yielding richer ore at the bottom than they did within a hundred feet of the outcrop, I venture to doubt—and I would like to know. The St. John del Rey has attained a depth of 6426 feet, and is easily the Methuselah of its kind. In 1921 the yield averaged 56¾ shillings per ton, for 146,800 tons. During the first 42 years of its life (1850 to 1892) the mine yielded ore that averaged 54 shillings per ton, as stated in a historical account prepared by Mr. George Chalmers, the general manager, in 1913. The St. John del Rey is the pre-eminent example of ore-persistence to great depth. That is a cheerful fact; but the circumstance itself is abnormal. So also is the fact that Gladstone was able to hold the House of Commons spellbound by his oratory until he was 85 years old. It is as abnormal for a man's vitality to continue to such an age as it is for a gold mine to be productive to 6000 feet. The actuary will confirm the one statement as surely as the statistician will confirm the other. What avails it to deny either? The statement that mines do not last indefinitely is one that needs no argumentation; the records of the Stock Exchange will establish it with as much melancholy emphasis as the nearest cemetery will convey its lesson concerning the mortality of man.

This subject has interested me keenly since the day that I first saw an abandoned mine. In 1893 William P. Blake wrote an article on 'The Persistence of Ore in Lodes in Depth' in the January 7 issue of the 'Engineering and Mining Journal'. I contributed a criticism and demurred to his statement that "it can be shown that lodes can be expected to maintain their average value to any depths we are ever likely to reach in mining operations". Since then I have urged the mining profession repeatedly not to approach the appraisal of a mine without considering the possible non-persistence of the ore.

It is amusing to recall the changes of public opinion on this subject. Thirty years ago it was a common saying that mines became richer in depth, especially if they were identified with 'true fissure-veins'; whereupon I suggested seriously that the scientific way of working a mine was to sink to, say, 4000 feet and work upward systematically, instead of nibbling at the ore by means of the successive extension of the workings downward. Later, as experience served to flout the extreme phase of the fallacy, it became popular to say, particularly in prospectuses, that mines, especially gold mines, did not become poorer in depth. Next it was recognized that some of them did become poorer, but these served as a contrast to those that, it was alleged, did not weaken. Then came the sublime spoofery of the Rand promoters, who asserted that the 'banket', or gold-bearing conglomerate, of the Witwatersrand was unlike an ordinary lode, that it was more like a coal seam, and that it would persist so uniformly as to place the companies operating at Johannesburg in the category of 'investments' suitable for the trust-funds of widows and orphans. Serious and solemn scribes said that a return of 6% on the capital 'invested' in Rand mining companies sufficed, and that the shares were as gilt-edged as British Consols! What pathetic nonsense it seems today! By means of such statements the public was beguiled into buying shares on a large scale, and the insiders unloaded at fictitious values. In the course of seven years—between 1911 and 1918—the public lost $204,000,000 by the fall in the market-valuation of only three mining stocks: the Rand Mines, Crown Mines, and East Rand Proprietary. That South African fiasco will remain the classic example of a disregard of facts, of a perversion of technical knowledge, and of the complacence of the mining-engineering profession. The leading engineers of the Rand did not endorse the fallacy, but they failed to warn the public when they knew that the chairmen and directors of the companies with which they were connected were saying what was not in accord with the facts. Their failure to check the deception is a blot on the record of our profession that will endure long after the last mine on the Rand has been exhausted. In Rhodesia the same state of things existed; if three mines are doing well at a comparatively shallow depth, how many have come to an inglorious end at less than 500 feet? In these matters the mining engineer must be true to his scientific training and recall Huxley's aphorism that the tragedy of science is the killing of a beautiful theory by an ugly fact. Whether Methuselah lived to 2800 years or to 83 years is open to doubt, but that he died is certain.

DISCUSSION

Promoting Efficiency in Drilling and Blasting

Technical Comment on the Practical Use of Explosives Under Varying Conditions of Altitude and Humidity

THE EDITOR:

Sir—The March 18, 1922, issue of *Engineering and Mining Journal* contained an article by B. F. Tillson entitled "Promoting Efficiency in Drilling and Blasting," which, while offering some interesting suggestions, contains a number of statements regarding blasting supplies and methods of testing them that are wholly or in part not only faulty but misleading, and if put into practice are so dangerous that they cannot be passed by without correction.

At the outset Mr. Tillson quite properly affirms the tendency of the workman to use more explosive than is necessary, due to the lack of basic knowledge which might permit the specification of the most efficient use of explosives; yet the literature on explosives and handbooks of manufacturers abound in ingenuous attempts to solve his more specific questions.

The writings of the scientists, who by their untiring investigations have contributed greatly to the progress of the usage and manufacture of explosives, are voluminous and technical, so much so that their contents are available only to a student. However, even a student must turn to the field of experience or to the advice of those trained in the school of experience to determine what is best for actual working conditions.

Lack of space will not permit more than a passing reference to some of the deductions. A complete analysis involves the inclusion of an extended theoretical discussion, and it seems of greater importance for the moment to discuss only such parts of the article as are really misleading.

"INITIAL FORCE PROPORTIONATE TO AREA"

Mr. Tillson's experiments in Trauzl blocks with cylindrical and rectangular charges of a given weight of explosive appear to support his assumption that initial force is in proportion to the bounding area, but his application of this idea in "experiments made to determine useful work" does not support the author's deduction. The fact that sticks of dynamite slit down the middle and backed up with a half cylinder of clay in some of the experiments, as Mr. Tillson says, effected a saving of 40 to 50 per cent of explosives, would indicate one of two things—either that overcharges had been previously used or that the ground was of such a nature that explosives used of half the strength or of lighter density would have been equally efficient. The assumption that overloading had been practiced is further borne out by the fact that the semi-cylinders of clay contributed a cushioning effect and that the clay acted as a diluent. What actually happened in the Trauzl block test to make the author think initial force proportionate to area is the commonly accepted phenomenon that initial force is proportionate to diameter.

This experiment also interestingly disproves the theory advanced by some that a cap shoots downward. The action of a cap is local; it is the propagation of the detonation through the dynamite itself that causes its initial explosion to extend through such portion of the remainder of the charge or all of it, as conditions permit, depending upon the violence of the initial impulse and the sensitiveness of the dynamite. Authorities also agree that this impulse acts radially in all directions. This characteristic is further supported by the fact that the more dynamite there is immediately surrounding the cap, the greater is the amount of dynamite present to receive the initial impulse, and complete detonation is accordingly propagated further in all directions.

"THE END PLATE TEST"

Similar experiments supported by practical usage demonstrate that, particularly with insensitive explosives, the more surface there is of cap composition in contact with the dynamite, the greater the initial impulse, and herein lies an advantage that certain light-density caps have over the original high-density fulminate of mercury caps. This same characteristic offers a reason why heavy charges of fulminating compositions, such as the No. 8 strength caps, are loaded into comparatively long columns of the usual small diameter shell, instead of increasing the diameter with weight of charge, as would seem advisable if the theory could be supported that caps shoot downward; but they do not, and for this reason the author's tests showing certain No. 6 caps stronger than No. 8 by the aluminum plate end test will be discussed fully under the subject of "The End Plate Test" where the apparent discrepancies and certain idiosyncracies of the test will be explained.

"BURNING RATE OF FUSE"

Mr. Tillson's assertions as to the effect of certain physical and atmospheric conditions on the burning rate of fuse are entirely wrong, and should be corrected, lest some of his readers be misled into the "unpleasant experiences" that it is aimed to avert.

What actually happens in practice is exactly the reverse of his statements. Increase of pressure by tamping, or otherwise, does not decrease the burning speed, but, on the contrary, increases it so that the portion of the fuse covered by tamping will burn faster than in free air. This fact has been determined by several investigators, and statements to this effect appear in most publications of the explosive companies. The rate of burning of safety fuse as influenced by temperature and pressure has also been the subject of special investigation by the Bureau of Mines and reported in Technical Paper No. 6, in which it is stated that under certain conditions of tamping the rate of burning was increased 77 per cent.

High altitudes retard the burning time; therefore, miners accustomed to using fuse in the mountains must use longer lengths when operating at or near sea level. The fuse of all manufacturing plants in the United States is timed to burn at approximately forty seconds per foot, variations being held to within 10 per cent, but when this same fuse is taken up into the mountains to an altitude of 7,000 ft., as at Park City, Utah, its burning rate become sixty seconds per foot and will revert to its original speed of forty seconds when returned to a point at sea level.

The method of dipping both ends in a waterproofing compound should be employed only where fuse is to be stored underground (a practice that is not recommended), but when such is necessary the reader should be further advised to cut off at least ½ in. of one dipped end of the fuse before inserting it into the cap. Examination has shown that, exposed to a humidity of 80 per cent for twenty-four hours, impregnation of moisture will not extend over one-eighth of an inch into the fuse; therefore the waterproofing precaution suggested is not really necessary except for wet places.

DELAY ELECTRIC BLASTING CAPS

Mr. Tillson rightly asserts that delay exploders (delay electric blasting caps) in periods of five delays do not offer sufficient range of time intervals. There has been in use in the Western mining districts for several years a brand of delay electric blasting caps known as the "Ideal" which are manufactured in ten delay periods, and which have proved sufficient for practically all classes of work. "Ideals" embody several patented features constituting a flameless and waterproof device accurately timed and capped ready for use, thus obviating the inconvenience and inaccuracies incumbent upon trying to adopt delay igniters by cutting the fuse to varying lengths, then capping, crimping, and waterproofing, as suggested by Mr. Tillson.

In addition to the ten delay periods, the longest of which is less than 8 in., there is also a "no-delay" unit for use in the place of instantaneous electric blasting caps when simultaneous action is desired in the cut holes. The practice of using instantaneous and delay in the same circuit does not as a rule work satisfactorily, because they are primed differently. The primer in the "no-delay" is of necessity the same as in the delays, because the black powder in the fuse which constitutes the delay element requires a hotter and slower-acting primer than does fulminate in the instantaneous caps.

ELECTRIC CIRCUITS

Mr. Tillson should qualify his admonition about never connecting electric exploders in parallel, as such advice applies only to users of low-amperage blasting machines such as the push-down and most other portable types. It is highly desirable whenever power or lighting circuits are available, and especially for underground work, to use the parallel or multiple connection, as there is usually sufficient current to assure the ignition of every cap practically instantaneously. The expression "multiple" is synonymous with parallel and is more commonly used than the latter. Experience has shown that multiple (parallel) connections are the most satisfactory method to use when the holes are closely grouped, as is generally the condition when delay electric blasting caps are advisable. Even when the holes are widely scattered, the slight additional cost of the extra wire which is necessary for this method is offset by the added insurance of "getting" each hole, because each cap receives its proportionate amount of current and the failure of one does not affect the rest of the caps in the round, as when series connections are used.

ELECTRIC BLASTING INSTRUMENTS

Galvanometers, either of the disk type or calibrated-scale type, such as are at present supplied as blasting accessories, should be used only for determination of the continuity of circuit, or for a rough approximation of the resistance of the circuit. If quantitative results are desired, a portable ohmmeter should be used.

Blasting machines of the push-down type are practically all series-wound generators—i.e., the external circuit is in series with the field windings, the current being released to the external circuit through a switch. The first current built up in the armature is the result of the residual magnetism; then, as the current increases, the magnetism increases and therefore causes the "magnetic" brake action on the armature to increase. It is for this reason that the downward stroke should be vigorous and the pressure continued throughout the duration of the stroke.

To anyone who has had to contend with the personal equation in the operation of the push-down blasting machines, the advent of a dependable machine having an improved design in which this equation is eliminated would be welcome.

TESTING BLASTING CAPS

The occasional testing of blasting supplies to assure that they are of the desired strength and that they are being properly cared for is important. It is equally essential, however, that the test used be a criterion of the characteristics under examination. Grave doubt exists as to the end test on the metallic plate described by Mr. Tillson being a fair measure of the condition of blasting caps either of different manufacture or of the same manufacture. The *Engineering and Mining Journal* of Feb. 25, 1922, on page 322, published an article on detonators by Charles S. Hurter, which explains the limitations of this method of testing.

In the first place, the indentation depends to a certain extent on the shape of the bottom of the cap. A concave-bottom cap will give a better indentation than a cap having a convex bottom, because the air under a concave bottom cap is forced into a small mass, and, being controlled by the waves of compression, is driven into the plate. This action on a plate is analogous to that of a bullet, but when the hollow-bottom cap is pressed into a cartridge of dynamite, the air is displaced from the cap, and the bullet effect is lost.

The fine lines, or striae, radiating from the position of the cap on the plate, are merely an indication of the degree of fineness to which the copper container has been pulverized by the explosive in the cap, the degree of pulverization being influenced by the temper of the metal in the cap shell.

Secondly, all caps being approximately of the same diameter, different grades vary with respect to dimensions only in their length; therefore, the center of detonating impulse in caps of greater strength is further away from the plate, and most of the energy is dissipated in the air.

Not being a comparative test for caps of different strength, this method cannot be conceded to be advisable even for the determination of the condition of caps of the same strength.

The Bureau of Mines, in Technical Paper 125, "The Sand Test for Determining the Strength of Detonators," by Storm and Cope, describes a method of testing blasting caps that is largely used, and Bulletin 59, by Hall and Howell, describes the nail test. Another interesting article describing several simple tests was published in *The Detonator* of October, 1921.

Oakland, Cal. E. L. WATTS.

The Miner and the Forest Service

THE EDITOR:

Sir—In the *Engineering and Mining Journal-Press* of April 8, Dean Thompson of the Idaho School of Mines has taken a slam at the policy of the Forest Service in its dealings with the prospector. His particular reference is the Hamburg-American Copper Mining & Milling Co., of the Cœur d'Alene district of Idaho. Dean Thompson in the same breath condemns the Forest Service and compliments the local land office for its officials' respective actions in the same case.

Inasmuch as I am not interested in either side of the matter, but incidentally know something about the ground involved, I will say frankly that in my opinion the Forest Service did the only thing its agents could have done in protesting a part of the claims of this group. I am sure that neither the service nor any of its agents has ever charged the Hamburg-American company with bad faith or with attempting to steal timber under the guise of mineral locations. There was the best possible evidence of good faith on two of the claims where the development work had been done and where ore had been found. But there were outlying claims, commonly known as "protection" claims, on which the agents of the service could find no mineral or any work to indicate the company had made serious effort to find mineral. These were the claims protested by the Forest Service, and anyone who is faintly familiar with the Federal statutes as applied to our public land states knows that an arm of the Government itself would not do otherwise than it did without flouting the law and inviting claim owners to do likewise.

Were Dean Thompson a real friend of the Forest Service, or had he known a few facts about the ground involved in the contest, he would have criticized the mining law rather than the Government for attempting to uphold the laws Congress has made for its specific guidance. The tone of the article by Dean Thompson can scarcely be called friendly, providing he knows anything about the facts in this case, and I presume one in his responsible position would not criticize any branch of the Government, state or national, without knowing the grounds on which he does so. His article is similar to many protests which have appeared now and then in the mining press of the country, and it is a peculiar fact that not one of them, so far as I know, has criticized the law involved, and of course that is where the real trouble originates.

A discovery is required to be made on each claim before it is located, and should most certainly be made before patent issues, and the Federal courts have clearly defined the term "discovery." It would seem to follow, then, that a mere perfunctory "discovery" cut in country rock or in mantle rock, as many of them are, cannot be a discovery under the law, and a Government official acting upon such a case has no option whatever. If the result is adverse to the claimant, it is hardly logical or praiseworthy to place the blame upon an arm of the Government, and certainly if the result in the aggregate is working an injustice, the conclusion seems inescapable that the law itself should be revised.

There is enough ground for sound criticism of many Government activities these days without the loose sort illustrated by Dean Thompson. F. R. INGALSBE.

State University, Missoula, Mont.

Is Methuselah Dead?

THE EDITOR:

Sir—A well-known consulting engineer writes from Rhodesia that the Cam and Motor has struck at the tenth level the richest ore yet encountered in the mine and that the Lonely Reef is looking remarkably well in the bottom level. He also refers to the good showing in depth made by another mine, and concludes "I do hope T. A. will not be annoyed about it."

The arrival of this letter at a time when our old and deep St. John del Rey seems in vigorous prime induced the writer to examine the authority for the statement "Even Methuselah Died!" It will be remembered that on this statement was based an editorial, still well remembered, deprecating expectation of continuity in depth of payable ore.

My investigation proved more interesting than could have been foreseen. Consultation with the leading authorities revealed the extraordinary position that there is even yet no evidence of the death of Methuselah, but that after the return from the Captivity, say about 500 B. C., or 2,800 years after his birth, the Priestly Code decided that Methuselah ought to be dead, and wrote him "dead" accordingly. But I maintain that this mere presumption of death, unsupported by any evidence whatever, affords but slender basis for an aspersion on the continuity in depth of valuable ore.

Long live Cam, Motor, Lonely Reef, St. John del Rey, *and* Methuselah! WEST COUNTRY MINER.

Mining Engineers a Commodity

THE EDITOR:

Sir—The letter under this heading in your issue of April 8 reminds me of something I once heard my father say. The directors of an English company were objecting to the proposed charge of a manager for his services, one of them saying that he could get a man at half the price. "Very likely," said my father; "I have no doubt you could get a dozen men to take the job for nothing—*and pay themselves.*" G. E. C.

Denver, Col.

The Problem of Depletion

In the letter from C. B. Holmes, on "The Problem of Depletion," which was published in the *Engineering and Mining Journal-Press* of April 22, 1922, through a typographical error Mr. Holmes was made to say "the basis for depletion charges is the cost of mines, mills, and other holdings." What Mr. Holmes really said was "the basis . . . . is the cost of mines, wells, etc."

Geology and Mining of Mica

A Non-Metallic Mineral That Is Becoming of Increasing Importance—Deposits Mainly Associated With Pegmatites—Valuable Byproducts May Be Recovered—Mining Generally Shallow and of Small Magnitude—Modern Methods Being Introduced

By J. Volney Lewis[*]

IN A VERY REAL SENSE our vast electrical development is a monument to mica, the one indispensable dielectric. The history of the intensive electrification that has been in progress during the last three decades is the history of the modern mica industry. How perfectly this mineral, alone of all known substances, has fulfilled the most exacting requirements of constantly increasing voltages is perhaps fully appreciated only by those who are familiar with the technical difficulties encountered. Because of the experiences incidental to the war, many people have now gained a keener appreciation of mica as one of the fundamental materials of our intricate civilization.

Mica a Wasting Asset

The world consumes mica as fast as it is produced, and once used little is ever salvaged. Furthermore, the war demand demonstrated the inability of the mines to meet a requirement for any considerable increase in production; and, as 86 per cent of the sheet mica produced is already consumed by the essential electrical industries, reallocation can give only slight relief in the face of the increased demands that will surely come in the future. Hence it is necessary to produce continuously more and more mica or to find a satisfactory substitute. If progress is to continue along the lines that have marked the recent decades, there is no other alternative.

It would be hazardous to predict that a substitute for mica will never be produced; but it is at least significant of the difficulties of the problem that, under the stress of the war blockade, Germany, with its intensely organized research, was unable to solve it. The substitute was desperately needed, but it was not forthcoming. Also, urgent need for more mica was felt by all the leading belligerents, and any substance that could safely have supplemented the limited supply would gladly have been adopted. Hence it is practically certain that the electrical industries will demand mica in increasing quantities for many years to come. Such a demand can be met only by the development of new fields or by the introduction of scientific engineering and equipment in place of the primitive methods that still so largely prevail in all the great mica-producing regions of the world. This transformation can be brought about only through an understanding of the conditions that control the mica-mining industry and of the inherent difficulties that must be overcome. It is with the hope of emphasizing this fact and possibly contributing something by way of suggestion that I have set down these notes concerning the occurrences and associations of mica and the methods employed in its extraction.

Muscovite and Phlogopite Most Important Varieties

To the mineralogist many kinds of mica are known, but only two of these find important applications in the industries. These are muscovite, the potash or "white" mica, and phlogopite, the magnesia or "amber" mica. None of the others has yet been found in sufficient size and quantity to be commercially available.

Courtesy of U. S. Geological Survey

A mica mine near West Rumney, N. H. Mine in hillside. Manufacturing plant on right. Owned by General Electric Co.

In thin sheets both muscovite and phlogopite are transparent, and muscovite is colorless. Rarely phlogopite is also colorless, but most of it is yellow or brown and much of it has a coppery or bronzy sheen. In sheets one-sixteenth of an inch or more in thickness most muscovite also shows some shade of gray, yellow (inclining to amber), red, brown, or green. The value of mica depends on its remarkable combination of physical properties—cleavage, flexibility, elasticity, transparency in thin sheets, non-conductivity of heat and electricity, brilliancy of cleavage flakes, softness, and toughness.

Sheet mica finds its greatest use[1] in the electrical industry, where an insulated, non-inflammable material is necessary. In thin films it is used extensively in condensers for magnetos and wireless apparatus. In the form of sheets, washers, and tubes it is used in dynamos and numerous electric heating devices, sockets, spark plugs, insulators, rheostats, fuse boxes, and telephones. Flexible mica cloth and tape are also employed in electric insulation.

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[*] In the preparation of these notes many scattered papers have been consulted. The following publications have been found particularly serviceable, especially in the compilation of data concerning regions that have not come under the writer's own observation:

Hugo S. de Schmid: "Mica Its Occurrence, Exploitation, and Uses." Canada Department of Mines, 1912.

A. Faison Dixon: "The Mica Industry." *Trans.* A.I.M.E., Vol. 45, [illegible] 112.

Durand A. Hall: "Mica." *Political and Commercial Geology*, New York, 1920, pp. 380-387.

D. B. Sterrett: "Mica Deposits of the United States." U. S. Geological Survey *Mineral Resources*, 1906-1914; U. S. Geological Survey Bulletins 315, 380, 430, 530, 580.

W. T. Schaller: "Mica." U. S. Geological Survey *Mineral Resources*, 1915 and later years.

A. A. C. Dickson: "The Mica Miner's and Prospector's Guide." London, 1919, 56 pp.

J. Volney Lewis: "Mica." *The Mineral Industry*, annual volumes since 1914.

[1] Schaller: *Mineral Resources*, 1918.

Sheet mica is also used for glazing the fronts of stoves, furnace sight-holes, as heat-retarding screens in front of highly heated materials, in optical lanterns, military lanterns, and for lamp chimneys and canopies. It is also used in special spectacles, as motor goggles, in sandblasting, sight-holes for drivers' helmets, smoke helmets, compass cards, gage fronts, and in windows where heavy shocks and vibrations must be withstood, as in warships and conning towers of submarines. Mica diaphragms are used extensively in phonograph and other sound-producing devices. In India large numbers of sheets of mica are used as material on which pictures and portraits are painted, the mica being resistant to heat, dampness, and the attack of insects. Sheet mica is also used in India for inlaid work, tassels, flowers, banners, and toys.

GROUND MICA HAS MANY USES

Ground mica is used for decoration in printing wall paper and cloth, to which it gives luster and brightness; also in fancy paints, ornamental tiles, and concrete. Because of its heat-resisting qualities, it is used as packing in the journals of railway cars, in pipe and boiler coverings, and in fireproof paints and coverings. Ground mica finds an important application as a filler in rubber tires and also as a finishing pigment, as a component of some roofing materials, and is molded with shellac into electric insulators of various forms. It is used as an absorbent of nitroglycerine in the manufacture of dynamite ("mica powder"), in annealing steel, as lubricant for wooden bearings, or mixed with oil or grease as lubricant for metal bearings. Tar roofing paper is rolled with "bran mica" to prevent sticking.

In India ground mica is used for a great variety of decorative purposes—on lamps, pottery, curtains, cloth, fans, and in temples and palaces. It is also used as a heat insulating covering on pipes and roofs, and considerable quantities are consumed as medicine.

From reports made to the U. S. Geological Survey, Schaller has estimated the uses to which mica was put in the United States in 1918 as follows: Domestic uncut, all sizes: Electric insulation, 71 per cent; stove fronts, 23; phonograph disks, 2; other uses 4 (including lamp chimneys and canopies, less than 1 per cent). Imported uncut, excluding splittings: Electric, 82 per cent; stove fronts, 5; phonograph disks, 6; lamp chimneys and canopies, 4; other uses, 3. Domestic and imported, combined: Electric, 76 per cent; stoves, 17; phonographs, 3; lamp chimneys and canopies, 2; miscellaneous, 2. All sheet mica, including splittings: Electric, 86 per cent (sheet, 46; splittings, 40); stoves, 10; phonographs, 2; all other uses, 2. Ground mica: Roofing, 60 per cent; wall paper, 21; automobile tires, 8; other rubber goods, annealing, printing, 3; fancy paints, concrete facing, artificial "snow," 3; molded electric insulation, 3; lubrication, 2.

The uses of mica have been classified according to relative importance as follows: Essential: Electric insulation (sheets, washers, splittings, and built-up mica board). Less essential: Stoves, lamp chimneys and shades, electric heating devices, pipe and boiler coverings, roofing material, annealing steel, lubricant for wooden bearings. Non-essential: Phonographs, decoration, lubricant for metal bearings, filler for rubber and various other materials.

COMMERCIALLY VALUABLE MICA OCCURS MAINLY IN PEGMATITES

Muscovite, the chief commercial mica, is a normal constituent of several kinds of igneous rocks, is abundant in many gneisses and schists, and occurs in considerable amounts in some sandstones and shales, but only in pegmatite is it found in sheets large enough for its principal uses. Pegmatite is an igneous rock re-

Courtesy of U. S. Geological Survey

In mica trimming house of Ridgeway Mica Co., Ridgeway, Va.

ates in granite in mineral constituents and chemical composition, but it is commonly much coarser and more variable in texture. Thus in granite the mineral grains are generally a small fraction of an inch in diameter, whereas in some of the coarsest pegmatites the individual minerals measure several feet across. From the deposits of mica in large crystals or "books" in such masses the commercial supply is obtained.

Phlogopite is a much rarer mica than muscovite. The only important supplies come from Quebec and Ontario, where the mineral occurs in coarse pyroxene-calcite-apatite rock, commonly called "pyroxenite," which forms irregular masses and dike-like bodies. The mode of occurrence and the conditions encountered in mining are similar in many ways to those of muscovite. These notes are written primarily with a view to muscovite, but they are almost equally applicable to Canadian phlogopite, except as regards the associated minerals.

In pegmatite the chief and commonly the only constituents, besides mica, are feldspar and quartz; hence these are the principal associated minerals, and both of them are generally much more abundant than mica. In some regions, as in western North Carolina, it has been observed that the mica is clearer and freer from stains and specks where the pegmatite dikes intersect a country rock containing dark minerals, as in gneisses and schists rich in hornblende or biotite. Where the country rock is granite or some other rock with few ferromagnesian constituents, the mica is generally darker in color, and much of it is spotted or specked with films of black, red, or yellow iron oxide.

MINERALS ASSOCIATED WITH MICA MAY BE VALUABLE BYPRODUCTS

The commonly associated feldspar is orthoclase, the potash variety, but generally some soda or soda-lime feldspar (plagioclase) is also present, and in some pegmatites this is more abundant than orthoclase. The associated quartz is mainly in the form of disseminated grains or granular aggregates and, rarely, as distinct crystals. In some localities the pegmatites carry many accessory minerals. Some of these are useful, and where they occur in sufficient abundance they may be profitably recovered as a byproduct of mica mining. Occasionally one or another of these minerals is found in considerable quantity and is mined as the principal product. This applies to several gem varieties of beryl and also to zircon and the rare radium and uranium minerals—uraninite, gummite, samarskite. Samarskite in masses weighing nearly one hundred pounds has been found in a mine near Nellore, India, and several tons of it have been saved.

Of more importance because more abundant are the large bodies of nearly pure feldspar. A considerable number of small mines formerly worked for mica alone have become feldspar mines, with mica as a byproduct. In some kaolinized pegmatites similar relations exist between mica mines with byproduct kaolin, and kaolin mines with mica as a byproduct.

In all, more than forty mineral species have been found in the mica mines of North Carolina, chiefly in those of Mitchell and Yancey counties. Also, many accessory minerals have been identified in the pegmatites of India, but the only common ones are a little tourmaline and biotite and an occasional crystal of garnet or beryl. In the Canadian phlogopite mines high-grade phosphate (apatite) may be won simultaneously with the mica, and many of the mines were originally opened for their phosphate content. It is interesting to note that the mica itself was long an unwelcome byproduct of phosphate mining and was thrown upon the dump as worthless.

"BOOKS" OF MICA DIFFER IN SIZE AND OCCURRENCE

Mica crystals, often called "books" or "blocks," occur in a variety of ways in pegmatite, the most important being as follows: (*a*) Evenly disseminated through the rock, like plums in a pudding; (*b*) gathered here and there into irregular clusters or pockets; (*c*) forming lenticular aggregates dispersed through the rock; (*d*) in lenses arranged somewhat in planes, with or without connecting stringers of mica; (*e*) in the form of vein-like continuous tabular aggregates along the sides or in the midst of the dikes.

In any of the segregated modes of occurrence the mica may be found chiefly near one or both walls of the dike, or it may be concentrated chiefly along a central plane. It is sometimes observed that where the accompanying quartz is segregated into large masses, the mica deposits are richest near the quartz. Valuable mica is sometimes found imbedded also in solid quartz or feldspar and in kaolin from the alteration of the feldspar.

Crystals of mica range in size from less than an inch to several feet in diameter and length, but in most of the mines the great majority of the "books" yield sheets that are less than 6 in. across. Very rarely crystals up to 8 or 9 ft. across and 4 or 5 ft. thick are found. Perhaps the largest ever discovered was one that was taken from the Inikurti mine, in the Nellore district, India. It is said to have measured 10 ft. over the cleavage surface and 15 ft. across the leaves. Such blocks weigh many tons, but there is great waste in splitting, trimming, and cutting them into commercial shapes. Aggregates of mica weighing a ton or more, but containing no commercial sheets, are often found in mining. "The books do not make up," the miners say, when such quantities of waste mica occur.

"LEADERS" IMPORTANT IN EXPLOITING DEPOSITS

Where lenses or pockets of mica pinch out, they are often found to have small stringers or "leaders" of mica and quartz or of thin clay gouge or salvage connecting them with other lenses, both downward and along the strike. In following these the work may pass through entirely barren ground for a distance as great as the length of the productive lenses before commercial deposits are again encountered.

Besides these irregularities of occurrence within the pegmatite, the dikes themselves are extremely irregular in both size and form. They range from stringers only a few inches thick to masses measuring 100 ft. or more. Workable dikes from 5 to 25 ft. thick are very numerous. Although pegmatites as a rule have the tabular form and somewhat elongated outcrop characteristic of dikes, irregularities are common, and many masses cannot properly be called dikes. Lenticular bodies, both isolated and connected, are abundant; also stock-like and pipe-like forms with rounded or oval cross-sections, and complex branching and ramifying intrusions are not rare. As a rule the pegmatites follow the foliation of gneissic or schistose country rock, but there are many local exceptions. Prominent outcrops of massive quartz are common, and such dikes form the tops of many ridges, even under conditions where the feldspar has been kaolinized.

This is generally true in the Piedmont region of North Carolina and in India.

Pegmatite dikes are widely distributed through the metamorphic rocks of many countries, but available deposits of mica are by no means so common. There is great variation in the proportion of mica in pegmatites of different regions and not uncommonly even in neighboring dikes. Furthermore, be it ever so plentiful, the mica is worthless except for grinding unless it will yield sheets of commercial size—say two square inches and larger. Even the presence of numerous large "books" does not assure the value of a deposit. Great quantities of such mica are constantly thrown into the scrap pile for grinding or cast upon the waste dump as worthless because of defects that have originated in geological disturbances to which the deposit has been subjected.

Courtesy of U. S. Geological Survey

Block mica in pegmatite near Gilsum, N. H. Keene Mica Products Co.

Compressive strains associated with warping, folding, and faulting may wrinkle and corrugate the mica or so bend or twist the cleavage planes that smooth sheets are not obtainable. Shearing and other stresses in which they have been involved may also develop a parting in one or more directions across the cleavage, so that the sheets crack and are readily broken into triangular or "A" shapes or split into narrow ribbons. Slight movements that do not bend or crack the mica may suffice to open the cleavage and admit solutions from which iron or manganese oxides may be deposited or other minerals developed that will render much or all of the mica worthless. These factors vary so greatly from place to place that attempts to estimate the extent and value of a mica deposit are little better than pure guesswork.

INDIA AND CANADA MOST IMPORTANT PRODUCING COUNTRIES

Perhaps no large area of the earth's surface has remained entirely free from crustal movements for long periods of time; but some have undergone such movement much less than others, and in regions such as eastern North America and the peninsula of India, where relative stability has prevailed since the intrusion of the pegmatites, much of the mica remains uninjured, although locally its value has been destroyed.

Hence, although small amounts of mica of economic value have been found in many countries, India, the United States, and Canada have long produced more than 95 per cent of the world's supply. Brazil, Tanganyika Territory (formerly German East Africa), and Argentina now give promise of becoming important sources, and smaller quantities have been furnished by South Africa, Guatemala, Ceylon, Madagascar, and Australia. A few other regions seem to hold potential supplies—Nyassaland Protectorate, Norway, and parts of China and Siberia. In the United States about 70 per cent of the domestic production comes from North Carolina, 23 per cent from New Hampshire, 3 per cent from Virginia, and small irregular quantities from South Dakota, Georgia, Alabama, Idaho, and Colorado.

VALUE OF DEPOSIT DEPENDS ON PHYSICAL PROPERTIES

De Schmid has emphasized the contrast between mica deposits and the generality of veins and lodes of the metallic minerals. The prevailing discontinuity of the deposits, even where the mica is largely segregated along the sides or through the central parts of the dikes, makes it impossible to estimate reserves, even where the ground has been well opened up for stoping—a rare condition in mica mining. Furthermore, the value of a mica deposit, unlike that of the metalliferous ores, depends primarily on the physical properties rather than the quantity of mica present. This factor is so variable, not only as between different mines but from place to place in the same mine, that an accurate estimate of quantity, even if this were possible, would have little value.

With the most favorable conditions as to quantity and size of crystals, earth movements and internal strains may cause widespread damage, as pointed out in a preceding paragraph. Even in successful mines, much mica that could otherwise have been profitably extracted has been destroyed in this manner. Few mica deposits have entirely escaped such injury from causes that produce little or no effect on deposits of the metallic ores. Thus the large deposits of mica that have been developed in the well-known Lacey mine, in Loughborough, Ontario, were encountered only after several unsuccessful attempts had been made to mine the property. The last of such operations stopped when within a few feet of an almost solid mass of high-grade mica. Frequently the experience is just the reverse. A mine that has been worked profitably may without warning suddenly develop mica entirely worthless except for grinding.

MICA MINING GENERALLY SHALLOW IN DEPTH

The mining of mica is at present largely of a superficial nature, and much of it might properly be called quarrying. The pockety character of the deposits and the irregularities of the containing pegmatite prove serious obstacles to their exploitation. There are few reliable rules and indications by which the miner may be guided, and he depends largely on chance in following the mica leads. Hence the methods of mining have nearly everywhere remained simple and crude. Because of the limitation of such methods most of the world's supplies have been taken from the more accessible deposits at shallow depths, and the output of any producing district generally comes from many small mines, often worked spasmodically, rather than from a single large mining property.

The bulk of the mica from India and the United States is produced in regions that may be characterized as essentially agricultural. This is pre-eminently true of North Carolina and the producing parts of adjacent states, a field that furnishes about three-fourths of the domestic output. Farmers do most of the mining; hence at least the work is seasonal, and generally it is very irregular. Great numbers of small mines have been worked a few months at a time by many operators, with intervals of idleness or abandonment for months or years at a time. Much of the mining is done on insufficient capital, and the work is often interrupted or suspended altogether on account of ground water, the lack of pumps or of hoisting appliances, the caving of a tunnel or a shaft, or the depletion of a lens or pocket of mica and the necessity of doing dead work for a time.

Many deposits have been worked out to the depth of "one-man" mines, and new deposits with promising mica in the outcroppings are no longer easily found. To these adverse conditions must be added the almost universal practice by the small miner of "gophering" or "groundhogging," which results in a complex of irregular openings, shallow shafts, and small, crooked tunnels. Of a similar nature are the underground workings of petty leasers, or "jayhawkers," who open irregular and dangerous stopes without timbering or adequate pillars and leave the workings so clogged with waste as to make further mining or exploration almost impossible. Hence the reopening of the old mines is always a difficult and generally a dangerous undertaking. In New Hampshire the winters are also longer and more severe and the rock is harder, the softer decomposed material having been removed by glaciation.

Similar conditions and methods still persist to a great extent in all mica-producing countries. In India, where the industry is the oldest, mica was mined hundreds of years ago, and nearly a century ago 5,000 natives were employed in the Bengal mines. It has been estimated that in recent decades about 15,000 men, women, and children have been annually employed in mica mining. Little mining is done during the "rains" (July to October, inclusive), not so much because of the extra water as because many of the laborers go back to their fields during the season of cultivation. "Gophering" or burrowing methods have been carried out on an enormous scale in India, and the older mica mines have been likened to vast rabbit warrens. Despite primitive methods, however, many of the difficulties of mica mining have been largely overcome in India. Labor is plentiful and cheap, transportation offers no serious problem, and the processes of grading, preparing, and packing the mica for shipment are more highly developed in India than in any other country.

METHODS OF MINING IN INDIA SERVICEABLE FOR SHALLOW WORK

Dixon has maintained that until recently the primitive methods of India had much in their favor. They were economical, at least for the time being; little capital was required; little work was done that did not immediately produce mica; most of the workings were shallow—15 to 30 ft.; when work became expensive with increasing depth the mine could be abandoned for another equally as good, and little expensive European supervision was required. But conditions have changed. Only small amounts of mica are now to be found near the surface; there is keen competition for land; production has not been maintained, even at advancing prices; old mines must be reopened, and the richest are naturally the deepest; most of them have caved, and they cannot be opened successfully by the old methods.

As a result of primitive, superficial methods, many of the so-called mines in all mica-producing countries are mere prospects, which have been opened on small showings of mica and worked for only a few months or intermittently for a few seasons. All merchantable mica in sight has been removed from many of them, but they have been only scratched and their true value is uncertain. If they had been properly handled and worked with sufficient capital to make adequate tests doubtless many of them would now be on a producing basis.

METHODS OF MINING MICA SIMPLE

The Open Cut.—The quarry or open-cut method is everywhere the most extensively employed, because it is the simplest, the most obvious, and the cheapest. It yields quick returns, requires little system or skill, and is perhaps the most satisfactory method for large lenses or pockets of mica and for closely spaced "books" disseminated through thick masses of pegmatite. It is pre-eminently the method of the small operator, and it is likely to dominate in any region so long as superficial deposits are available that can be thus easily exploited. The open cut has been extensively employed in all the great mica-producing countries, with the result in many operations of interfering seriously with the later development of underground mining. It is not well suited to the exploitation of well-defined leads or small pockets, unless they are very closely spaced, as it involves the removal of an excessive amount of waste rock between the veins.

In common practice, the miner who has found an outcrop of mica opens a cut if it is on a steep slope, or sinks a pit if the ground is flat, and the opening is extended and enlarged as far as paying mica is found or until the work is stopped by the infiltration of water. Small openings of this sort are often made without preliminary trenching to ascertain the form, nature, and direction of the deposit.

The Open Trench.—Open trenches often result from the extension of open cuts and pits, where the mica deposits approximate the form of definite leads, whether in continuous reefs or in connected or closely spaced pockets or lenses. Several pits are often sunk at intervals along the leads, and these are joined by removing the mica-bearing rock between them. This work generally takes the form of crude and irregular underhand stoping or of quarrying, carried forward bench-fashion from one or more pits. Such trenches are sometimes opened to lengths of hundreds or even thousands of feet, and depths of 50 to 100 ft. are often attained in following down the deepest pockets. Where barren or low-grade rock is encountered some of this is generally left as pillars; otherwise, the general practice is to take out everything, a few stulls being put in for temporary protection if serious caving threatens.

In hilly and mountainous country open cuts and trenches can generally be designed for gravity drainage, but commonly this is only partly accomplished, and many workings less than 100 ft. deep have been abandoned on account of ground water. These methods have their obvious limitations, such as increasing danger from caving and falling rock with depth and the necessity of suspending work in unfavorable weather, particularly in winter. The mine is generally abandoned or underground methods are begun before the depth of 100 ft. is reached, and work is often stopped at less than half that depth on account of caving or increasing hardness of the rock.

Cross-cutting Tunnels.—In the mountainous portions of the mica district in North Carolina, and less commonly in the lower hills of Ontario and Quebec, crosscutting tunnels are driven to intercept one or more mica-bearing pegmatite bodies that outcrop on higher ground. Drifts are then opened along the dikes, and if mica deposits are encountered they are stoped out. Some mines are worked on several levels by this method without shafts, a succession of tunnels being driven at different elevations on the mountain slope. Hoisting and pumping costs are thus avoided, but the saving may be offset by the cost of long tunnels for the deeper workings. Many crosscut tunnels are poorly located and approach the mica-bearing dikes at an acute angle with their strike; some are small and crooked, and some are driven on such a steep grade that much of the advantage of depth is lost. Obviously such unskillful work may make a failure of any method.

Shafts.—Almost invariably shafts are located on the pegmatite outcrop, and this rock is followed in sinking. Hence, many shafts are inclined and some are crooked. Wherever promising mica is encountered, drifts are opened and the deposit is stoped out. The shaft is then deepened and the operation repeated as other pockets are found. Shafts are also often sunk along the drifts or at their extremities, and the workings are thus extended and multiplied as long as paying mica is found. If a shaft does not find workable mica at moderate depth, drifts are often opened along the strike of the pegmatite at vertical intervals of 50 to 100 ft. Few shafts exceed 300 ft., and most of these are in India.

CARELESS SHAFT SINKING OCCASIONALLY NOTED

Expensive bungling is sometimes observed in the shafts of mica mines. Many of them are unnecessarily crooked and irregular, both in diameter and in form of cross-section, and sometimes they are sunk at absurdly short intervals. Thus, for the mining of separate pockets of mica, shafts 50 ft. deep have been sunk within 15 ft. of each other!

The method, sometimes advocated for its economy of mica, of sinking in the country rock beside the deposit, with crosscuts and drifts at intervals to prove its extent and character, and finally stoping out from the bottom, is seldom employed in mica mining. For the small miner it involves a greater outlay of capital before the producing stage is reached. Overhead stoping is a desirable economy, but the contention that mica is wasted by sinking through the deposit has been questioned. Thus, Dixon states that the Indian miner instantly knows by the feel of his steel when his drill strikes a "book" of mica. Unless the drill is perpendicular to the cleavage it cannot be turned, and it is almost impossible to drill through a "book." This of course refers to hand drilling, which is still the prevailing method. He says, further, that blasting around a "book" does not injure it if ordinary care is used and only enough powder to loosen the rock. The Indian miners are patient and skillful in getting out the mica with little injury.

Drilling and Blasting.—Little or no drilling is required in the shallow workings of most mica-mining districts. Thus in India, the southern United States, and Brazil the rocks are softened by kaolinization of the feldspars to depths of 50 to 100 ft. or more. Such materials are handled with the pick and shovel, with an occasional blast in the harder residual masses. Mining in the hard rock is generally avoided as long as easily worked deposits can be found near the surface.

In the hard rock hand drilling is the rule. Power drills are employed only in the exceptional mine that has a certain amount of modern equipment. They are commonly operated by steam rather than compressed air, as by this method only a boiler is required for both pumping and drilling, and the expense of installing a compressor is avoided. Electric drills have occasionally been used, with hydro-electric power plants on neighboring streams, as at some localities in North Carolina. In the hard rock of the New Hampshire mines it is estimated that machine drills cut down the operating costs about 50 per cent. They give great economy everywhere in barren rock, but unless carefully watched they do serious injury to the mica in stoping.

Slow progress is made when working in the mica deposits, on account of the care that must be exercised to minimize damage to the mica. Few and shallow holes are drilled, generally only 2 to 4 ft. deep, and light shots are fired, so as merely to loosen the rock, which is then taken down with picks or with hammers and wedges. Fuse firing is the usual custom, so the different shots will explode in succession. In poor or barren ground deeper holes are used to advantage and battery firing is often employed to break down the greatest possible amount of rock.

Haulage and Hoisting.—The simplest windlass is the most common equipment for hoisting. Next to this some form of hand winch or boon derrick is widely used. Horsepower is used for hoisting at many mines, either by direct traction or by the horse-whim, and an increasing number of mines are using the steam hoist.

Many mines use small dumping cars on light tramways, but the wheelbarrow is still extensively used in the smaller workings. In India the waste is loaded into baskets by hand or with the hoe-like kodali, and the baskets are then picked up and carried, even where the distance is only a few feet. In the old primitive type of workings the waste is passed out of the mines from hand to hand by long lines of women. The great problem of haulage and hoisting in all mica mining is the removal of the waste rock, the relatively small amount of mica being picked out and freed from the adhering rock by hand cobbing.

PREPARATION OF MICA FOR MARKET[2]

Crystals or "books" of mica as they come from the mines are rough blocks, some of them hexagonal in shape, but most of them irregular, with only one or two smooth sides. After being broken free from adhering rock with hammers, the blocks are split with knives into sheets about one-sixteenth of an inch in thickness, from which the rough, imperfect edges are removed by the fingers ("thumb-trimmed") or a knife ("knife-trimmed"). The sheets are then graded according to size and quality, after which they are ready for further splitting and trimming into desired patterns.

The rough blocks of mine-run mica do not always give an indication of the quality of mica they contain, whether it is good sheet or so flawed as to be of value only as scrap for grinding. In parts of New Hampshire and in the West, particularly in South Dakota and Idaho, much of the mica is sold by the miner as mine-run mica.

After the blocks have been split into sheets about one-sixteenth of an inch in thickness, the mica is called "sheets." In trimming the sheet mica the broken and flawed parts, mostly near the border, are broken or cut

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[2] Dixon: *Trans.* A.I.M.E., Vol. 45, 1914, p. 106; Schaller, *Mineral Resources*, 1918.

[illegible] leaving an irregular piece from which a regular pattern may be cut. Thumb-trimmed mica has the loose and imperfect parts broken off by the fingers alone; knife-trimmed has additional imperfect parts cut away with a knife. Most domestic mica as marketed is rough-trimmed or poorly knife-trimmed. Most Indian and other foreign mica is sickle-trimmed, that is, closely knife trimmed, the large knife used being called a sickle. It rarely contains any mica with cracks or important flaws, whereas the domestic knife-trimmed mica still contains many imperfections, although the most prominent have been cut off. Mica from Madras, India, which has been cut with a shear into roughly square shape is called "Madras-trimmed" or "shear-trimmed." All such sheet or split mica is technically known as "uncut" or "unmanufactured," and the foreign is also called "plate" or "block."

MANY GRADES OF MICA

In India the mica is roughly sorted by the miners. That which is obviously worthless is thrown on the dump, and the rest is made into bundles of about 30-lb. each and brought to the storehouse at the end of the day. The mica is then roughly sorted according to size and given to trimmers, boys taking the small pieces and well-paid men the larger ones. The rough edges are cut off on a bevel with a sickle-like knife, all cracks and inclusions being cut away, regardless of the shape assumed. In the larger sizes each piece is carefully cleaned as much as possible. This is the sickle-trimmed mica. It is now graded according to size; that is, according to surface area, as prescribed by the London (or Indian) standard, and the sizes are graded according to quality. The common grades are designated as clear ruby, slightly stained, and black spotted. The silver-white soft mica is usually graded separately, but the smoky, brown, pale amber, and other varieties are mixed in with the ruby.

Stained and spotted mica, No. 6 (2 to 3 sq.in.), some of No. 5 (3 to 6 sq.in.), and thin sheets derived from cleaning the larger sizes are split into films or "splittings." This work is done chiefly by children, but occasionally by women. Children have the more delicate touch and are the best workers. A knife is used or the thumb-nail, which is purposely allowed to grow long. A good worker can make about 2 lb. of splittings per day, but they generally do considerably less.

The different sizes and grades are packed into boxes of 100 lb. and shipped. Little Indian mica is cut to size.

Mica splittings (also called "slittings," "skimmings," or "films," and in Canada "thin-split mica") are made into mica board, which is used extensively in electric dynamos, motors, and transformers. They are also made into flexible mica cloth and tape. Splittings are about one-thousandth of an inch in thickness, are irregular in outline, and may contain a small quantity of flaws. They are so thin that a handful of them feels like crumpled tissue paper. Some splittings accumulate in the sheeting and trimming of mine-run mica, but most of them are made by splitting up the smaller sheets, especially the stained or spotted mica, as explained.

These splittings are laid irregularly on one another, either by hand or by specially devised machines, and shellac or other binder is spread evenly and thinly over them, layer by layer. The board is finished and brought to a uniform thickness by pressure and heat. "Micanite," "micabeston," and "micabond" are some of the trade names by which mica board is known.

Most of the mine-run mica is worthless for sheet mica, on account of cracks, flaws, inclusions, wrinkles, and other imperfections. Add to this the waste from trimming and cutting the sheets, and three-fourths to nine-tenths or more of the total output finds its way into "scrap" mica, which is thrown on the dump as worthless, except where the conditions are favorable to grinding it and marketing it in that form. Scrap mica as it comes to the mill consists of irregular lumps and plates of various sizes, some of which generally contain small inclusions of rock. This material is ground either wet or dry in mills specially designed for the purpose, and the ground mica is screened into various sizes for marketing.

But little is known concerning the percentage of mica actually present in the deposits as mined. This is not remarkable in view of the fact that there is practically no relation between total mica content and value, except that any deposit of value must contain some mica.

Dixon states that mica constitutes about one-eighth of the vein material in some of the most productive mines of India, and one-half of this comes to the surface as rough mica. The proportion recovered depends on the care shown by the miners in sorting. Schaller cites an Indian mine in a pegmatite dike 40 ft. thick, which was worked by modern methods in 1900 for more than 300 ft. and which yielded 40 lb. of mine-run mica, or 10 lb. of trimmed mica, for each ton of pegmatite rock removed. The mine-run mica does not include the waste mica, perhaps equally as great or even greater in amount, which goes at once to the dump, without separation from the inclosing rock.

Courtesy of U. S. Geological Survey

A mica mine near North Plumtree, N. C.

YIELD OF SHEET MICA GENERALLY SMALL

Most mines are worked for the small percentages of sheet mica they contain; the vast amount of waste can be utilized only where a ready market and milling facilities warrant the grinding. Only large deposits of nearly pure mica favorably situated with reference to transportation can be profitably worked for ground mica alone, and few mines of this sort are in operation.

The proportion of finished sheet, ready for use, obtained from the rough blocks or "books" as they come from the mine is small, rarely being as much as 10 per cent. Schaller has calculated the following percentages from detailed reports furnished the U. S. Geological Survey on about 2,500,000 lb. of mica mined in the southern United States, chiefly in North Carolina in the years 1916-1918, inclusive, all of which was mined because of its sheet content: Uncut mica—Uncut sheet, 9 per cent (1½ x 2, 3 per cent; 2 x 2, 2 per cent; 2 x 3, 2 per cent; 3 x 3, 1 per cent; large, 1 per cent); uncut punch, 26; scrap, 65. Cut mica—Cut sheet, 3 per cent (condenser, 1.2; electric, 1.1; stove, 4; phonograph, 0.1; splittings, 0.2); cut washers, 8; scrap, 89 (from trimmings, 65; from cutting punch, 18; from cutting sheet, 6).

It thus appears that only 3 per cent of cut sheet and 8 per cent of cut washers are obtainable as finished products from the mine-run mica, the remaining 89 per cent being waste or scrap mica, suitable only for grinding. It is safe to say that a deposit falling much below this average, under conditions of mining in the United States, will be of doubtful value, and careful tests should be made before large-scale operation is undertaken. Such tests should be carried through to the finished products.

Sizes obtainable from the natural mica "books" are generally overestimated by the inexperienced. The uncut mica will seldom yield a cut sheet much larger than one-half its surface area. Furthermore, about two-thirds of the rough mine-run mica must be thrown at once into scrap, because of cracks, wrinkles, markings, discoloration, or lack of smooth, perfect cleavage.

MUCH WASTE FROM GRADING AND OPERATIONS

Brazilian mica is said to yield about 10 per cent of knife-trimmed sheet from the total mica mined, and this gives an average, if carefully trimmed, of about 50 per cent of cut sheet. Schaller estimated that only about 45 per cent of the total uncut sheet, domestic and imported, in the United States, excluding splittings, or 67 per cent if splittings are included, is finally used in the finished form, the remainder becoming scrap. Thus one-third to one-half of the marketable uncut sheet mica is lost in the refuse and trimmings that result from converting it into the cut and manufactured forms.

Culin[3] calculates the following percentages from the flow sheet of a New Hampshire mica mine: Cut mica, 13.5 per cent (stove, 6; electric, 7.5); washers, 23; tubes and splittings, 3; ground mica, 68.2; loss, 2.3 per cent.

Such estimates have little significance, however, without a knowledge of the sizes and quality of the sheets produced; for, as previously pointed out, the value of a mica deposit, in contrast with a metallic ore, depends primarily on the physical properties of the mineral rather than the quantity present.

EXACTING DEMANDS UPON MICA PRODUCT

The enormous losses of mica in every stage, from the mine to the manufactured product, are comprehensible only when it is understood that large quantities of the mineral are affected by cracks, flaws, wrinkles, inclusions, stains, and other defects, and also that exacting requirements must be met in some of the most important uses of the mineral. Thus, condenser mica must be clear and must split easily and smoothly into films as thin as one-thousandth of an inch, which must be free from cracks, holes, foreign substances, stains, spots, waves, wrinkles, rulings, or knots; and for wireless use these films must withstand a voltage of 20,000. For magneto condensers, the voltage is much lower, but the films must be free from cracks and other defects. Careful selection is essential to obtain a pound of cut condenser films from five to six pounds of domestic uncut mica.

Phonograph diaphragms also require mica of very high grade. It must be clear and free from rulings, cracks, and all imperfections and inclusions, must split well and evenly, and must be flat. Mica for lamp chimneys and canopies must be clear, split easily, and be flexible. Indian and Brazilian mica are good, but very little domestic mica can be used for these purposes. For stove fronts a nearly clear, hard, and rigid mica is best. Much of the North Carolina mica, especially the greenish variety, is well adapted for this use. For general insulation a spotted or slightly stained mica will serve, but spotted mica contains too many inclusions of iron oxide for high-voltage insulation.

The utilization of smaller plates of mica in recent years for punch forms and for splittings used in the manufacture of mica board has made it possible to work many deposits that were formerly abandoned as worthless. For this reason, also, much of the waste of former years has been rescued from old dumps. Since the demand for 1 x 1 in. mica arose, de Schmid estimates that this size constitutes about 50 per cent of the output of Canadian phlogopite mines; that 1 x 2 in. furnishes 25 per cent; and only 3 to 5 per cent is 4 x 6 in. or larger.

The quantity of marketable mica that must be produced in order that a mine may be operated at a profit is subject to variation with the local labor and market conditions and the individual features of the mine itself. Thus, it is obvious that a hard-rock mine must produce a larger percentage or a higher grade of marketable mica to be successful than one in which the rock has been softened by decomposition, although the advantage may be partly offset by the necessity of timbering. Open quarries and trenches are the cheapest methods, and hill-side mines worked through tunnels are less expensive in general than deep shafts. On the other hand, any mine that is not drained by gravity must incur the additional cost of pumping. It is obvious, also, that a mine that produces chiefly small sizes must yield a larger quantity than will be required of a mine that produces a high percentage of large sheets, both because of the lower value per pound of the smaller mica and also owing to the greater cost of handling and preparing the larger quantity.

IMPROVED METHODS REQUIRED

A Canadian phlogopite mine in which no exceptional difficulties are encountered and no great depth was reached could be profitably operated in 1910, as estimated by de Schmid, on an average production of 25 lb., of trimmed mica of 1 x 2-in. grade, per diem for each man employed in the mine. The mining of muscovite in Canada from deposits producing 1 x 3-in. mica and under as their staple output he regarded as practically out of the question, on account of high labor costs, although such sizes could be profitably mined in India and other Eastern countries where labor is cheap. Many mines in the southern United States, with their longer season for open workings and operated largely as a side line to farming, are chiefly dependent on these smaller sizes.

Some mines in every important producing region have now been equipped with modern machinery and have adopted more scientific methods of operation. Even before the end of the last century some exceptional mines in Canada and North Carolina used steam hoists and pumps and a power drill has been installed here and there in the intervening years, but most of the advance has been made within the last ten years, and particularly in Canada [illegible] still large proportion of the production comes from the few well-equipped mines. Even in India, with its vast supply of cheap labor, the limitations of the old methods were seriously felt, and modern pumps and hoists were being installed with satisfactory results before the beginning of the World War.

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[3] F. L. Culin, Jr.: "University of Arizona Bull. 16," 1917-18.

In Brazil considerable capital is said to be invested in the mica mines, and the effects of better methods were apparently seen in the sharp rise in production in response to the war demands and in the special attention given to the equally important matters of preparation, classification, and grading of the mica for the market.

Modern Methods Must Produce Future Supplies

With the rapid exhaustion of superficial deposits that may be easily exploited by "gopher" and "jayhawker" methods, it is clear that future supplies must come more and more from the mines that are properly organized and capitalized for carrying on systematic exploration and mining. The day of the small operator, who finds a pocket of mica and devotes himself exclusively to its extraction as long as there is mica in sight, is rapidly drawing to a close. The sooner the transformation is realized, the more dependable will become the supply of mica, the more trustworthy will be its preparation and classification for the market, and the more firmly established will the mica-mining industry become. The small miner must organize, capitalize, and modernize his methods or suffer the penalty of extinction.

Intelligent Direction of Operations Vital To Success

As in any other type of mining, the successful exploitation of a mica deposit depends largely upon economical and intelligent management. The methods adopted must have regard not only to the maximum immediate output at the minimum outlay, but also to future possibilities; and this demands a knowledge of the character and peculiarities of mica deposits as well as skill in practical mining methods.

The necessity for vigorous and continuous prospecting and exploration in connection with mica mining has not generally been appreciated. Only in this way can adequate reserves be assured for continuous production, without which contracts cannot safely be taken or orders promptly filled. These operations call for capital and equipment. Light, semi-portable equipment, suitable for prospecting, may also be used for mining many of the smaller deposits. The installation of costly machinery at an unproved mine is always hazardous, and this is pre-eminently true of mica mines. Reliability of output is still further assured by the operation of several mines simultaneously, so that production may continue in some while dead work is under way in others.

Prospecting methods should include crosscutting ditches and tunnels as well as trenches along the strike, so as to determine the extent and distribution of the mica and the best methods and points of attack for extracting it. In hilly and mountainous districts much hoisting and pumping expense can be saved by a greater use of tunnels instead of shafts. Overhead stoping on a filling of waste will also often reduce the expense of hoisting and haulage, cheapen production, and largely dispense with the necessity for timbering, especially if pillars of lean or barren rock are left at intervals. Where the veins are not steep, underhand stoping may be found economical; but steeply dipping deposits are the rule, and these should first be proved by shafts and crosscuts and then mined by overhand stoping.

Byproducts can be made an additional source of income in some regions. Reference has already been made to the saving of apatite (phosphate) in Quebec and Ontario, and to the kaolin, feldspar, gems, and rare-metal minerals in North Carolina. Some of these, particularly kaolin and feldspar, can doubtless be utilized to a greater extent in many American mines that are near the railroads.

It is also highly desirable to save a larger proportion of waste mica in the form of splittings for the manufacture of mica board. This would be feasible if the great amount of hand labor now required in their production could be materially reduced by mechanical devices. Some experiments have been made, with partial success, it is said, and inventors might well direct their attention to this problem, to the mutual advantage of both the mica-mining and the electrical industries.

A wider adaptation of ground mica to electrical uses is also needed. At present it is limited to insulation molded with shellac. A method might be devised, for example, for the manufacture of mica board from "bran," the coarsest and cheapest grade of ground mica, or from a combination of bran mica and splittings.

Records and Maps Should Be Kept

To the miner in any other field it goes without saying that mine maps should be constructed and kept constantly up with the progress of the work. In mica mining, where so much may depend on the size, distribution, and local characteristics of the pegmatites and the contained mica, maps of the work of former years would be invaluable to the skilled miner, who will know how to take advantage of them in further exploration and exploitation in the same region. This has been emphasized by Dixon in his description of conditions in India, which largely hold true for mica mining in general.

The reopening of old workings gives rise to difficult problems. Mine maps are practically unknown. No one knows how deep the mine was, where the bottom workings are, or why the mining was stopped—whether by reason of caving or too much water, or the poverty of the ground. Under these conditions it is difficult to determine the best location for a shaft, or even whether it is worth while to sink one. According to the old miners, every deep abandoned working was fabulously rich; and there is some reason in what they say, for only rich deposits could be worked to any depth by such methods.

Finally, an urgent word of admonition should be added concerning the preparation and grading of the product for the market. No matter how great the merit of the mines of a district may be, unless the mica is carefully prepared, graded as to size and quality, and shipments are standardized, it cannot expect to obtain permanent favor among consumers in this country or in Europe.[4] India alone among mica-producing countries has mastered the art of preparing, grading and standardizing the product, and the admonition is most needed perhaps in the mica districts of the United States and Canada.

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[4] D. A. Hall: *Political and Commercial Geology.* New York, 1920, p. 384.

Refinery Practice and Flue Losses in Smelting Cyanide Precipitate at Buckhorn, Nev.

Filter Cake, Briquetted With Litharge and Suitable Fluxes, Smelted in Small Blast Furnace and the Resulting Bullion Cupelled—Careful Tests Prove Fume Losses Small

By E. R. Richards

THE REVIVAL of gold mining and the starting of many new gold and silver properties may make the following description of operations and experimental work to determine flue losses of gold and silver of interest. The plant under consideration was a 300-ton all-slime cyanide plant at Buckhorn, Nev., using zinc-dust precipitation. Two Merrill presses were used to filter the precipitated gold and silver from the solution, these presses holding the precipitate from a month's operations.

The refinery was equipped as follows: Two Merrill presses; a small water-jacketed lead blast furnace with movable crucible and lead well; a briquet press; a reverberatory type, oil-fired cupellation furnace, the cupel of which had a working space 30 in. long by 20 in. wide by 4 in. deep; a Case, oil-fired, tilting-crucible, remelting furnace; a 6-cu.ft. Connellsville blower; two hopper-shaped, sheet-iron precipitate cars; briquet trays; slag and bullion molds; scales, furnace tools; and a small dry-grinding ball mill for grinding fluxes. The blast furnace was 24 in. in diameter at the tuyères and 6 ft. high from the tuyères to the charge floor. A generous settling chamber and flue system took care of the gases from the blast furnace and cupel furnace.

Details of the Process

On the first of each month the Merrill precipitate presses were opened and the precipitate was removed by scraping it into the sheet-iron cars. False filter cloths of unbleached muslin were used over the regular canvases. These were dried and burned, and the ashes added to the precipitate. This practice cut down the cost of filter cloths and kept the presses working better than with only the regular canvases. The precipitate was weighed and carefully sampled, the moisture content was determined, and the material was then assayed for gold and silver. Normally, the precipitate was 60 to 70 per cent metal. Flue dust from the previous month's clean-up and melt was added to the precipitate, and the whole was mixed by hand with about twice its weight of litharge, 15 per cent soda ash, and 5 to 6 per cent borax glass, and pressed into briquets about 4 in. in diameter by 2 in. thick. The precipitate was not dried before mixing with the fluxes, nor were the briquets dried prior to smelting, other than the usual standing over night before the blast furnace was started.

The morning after the briquets were finished, the blast furnace was started with a wood fire, under 18 to 24 in. of coke. If the crucible had been repaired, it was thoroughly dried out before the melt. After the coke was glowing throughout, 300 to 400 lb. of pig lead was put into the furnace to fill the lead well and bottom of the crucible. Regular charging was then started, the charge consisting of 36 briquets, 15 to 20 per cent by weight of coke, and 40 to 50 lb. of lead blast-furnace slag. With this slag was fed any foul slag from previous melts, furnace barrings and cleanings from the crucible and lead well, and old cupel bottoms. Shortly after the regular charging was started, the blast was gradually raised to normal and slag started from the furnace. Slag was drawn from the furnace continuously by a trap built around the tap hole with brick and clay.

The slag from each melt was kept by itself until its assay value had been determined and its final disposition decided upon. The lead bullion was dipped from the lead well into small molds by hand and allowed to cool. The first 300 or 400 lb. of lead was saved to charge the furnace for the next melt. In blowing down the furnace, no precautions were necessary other than to charge some extra coke over the last briquet charge, and to lower the blast toward the end of the run. The furnace crucible was removed from under the shaft and cleaned immediately after the melt was finished. The blast furnace run usually took from sixteen to twenty hours.

Cupellation the Next Step

After the blast furnace had been running about six hours, the cupel furnace was started and maintained at a low heat until the cupel was a dull red. The pigs of lead bullion were then charged until the receptacle was filled, and the heat was raised until the lead started to cupel. The resulting litharge was tapped from the front of the cupel by tipping it slightly forward. More base bullion was added to keep up the level of metal in the cupel until all the bullion had been added, cupellation being continued until all the lead was oxidized and the remaining bullion remained quiet. Toward the end of the process, the cupel was tipped back nearly level and the front of the cupel cut down with a chisel bar to permit the litharge to flow out. When finished, the bullion was poured into molds and allowed to cool. The bullion was then remelted in the crucible furnace with a little nitre and sand, and cast into final bars for shipping. The average fineness of these bars was 0.890 to 0.950, the bars being clean and bright and free from slag. The litharge from the cupellation was ground dry and used for flux in the next melt.

The following tests were made to ascertain the flue losses of gold and silver during the melting of the precipitate and the cupelling of the base bullion resulting from the blast furnace run:

Blast Furnace Operation During Test

The furnace was started at 8 a.m. Feb. 3 and blown out at 12:30 a.m. Feb. 4th, a total time of sixteen and one-half hours. The blast pressure was maintained near 1½ in. of mercury. The top of the furnace was cool and at no time showed flame on top of the charge. From four to five charges of firm, hard briquets per hour was the average rate of feeding during the run.

The fume escaping from the stack was dark brown to black at all times and fairly abundant.

Referring to the accompanying drawings, Fig. 1 shows a detail of the sampling filter, which was made by pouring ordinary commercial asbestos, suspended in water, into the crucible. Fig. 2 shows the general arrangement of the apparatus. Samples for analyses were taken by passing one cubic foot of gas through this apparatus. The tube from the Gooch crucible extended into the stack about 4 in. and was far enough above the base of the stack to insure that no eddy currents would affect the results. Care was taken to get all the fume from this tube, as well as that caught on the asbestos. The gas after passing through the filter was colorless. The fume collected was black and fine grained, there being no individual particles visible. To obtain the velocity of the gas in the stack, the velocity head of the gas was measured by means of a pitot tube and an Ellison differential gage, which were home made. Both gage and tube worked well, and readings checked closely. Nine samples were taken, and the following recorded data are typical:

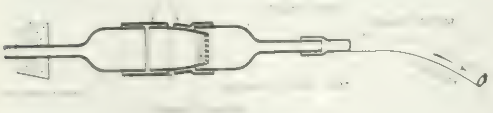

Fig. 1. Detail of sample filter

No. 1. Blast furnace running. Started 6:45; finished 7:15 p.m.; 1 cu.ft. gas drawn. Draft, 0.05 in. of water. Fume sample showed trace of gold, 0.52 mg. silver, per cu.ft. of gas.

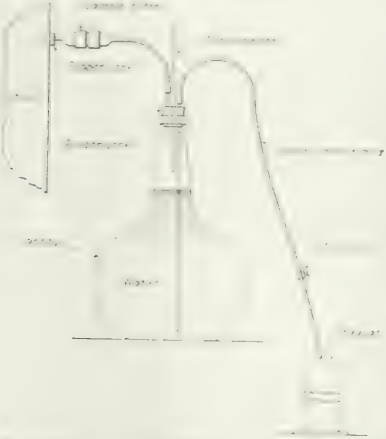

Fig. 2. General arrangement of sampling apparatus

No. 2. Blast furnace running. Started 7:20; finished 7:40 p.m. Draft, 0.05 in. of water. Fume sample showed trace of gold, 0.58 mg. silver, per cu.ft. of gas.

No. 5. Blast furnace running. Started 8:55; finished 9:30 p.m. Draft, 0.03 in. of water. No gold, 0.38 mg. silver, per cu.ft. of gas.

No. 9. Blast furnace running. Started 11:55 p.m.; finished 12:40 a.m. Draft, 0.04 in. of water.

Weight of crucible before test, 23.440 grams.

Weight of crucible after test, 23.656 grams.

Weight of fume collected, 0.216 grams—i. e., 216 mg. of fume per cu.ft. of gas. No gold; 0.22 mg. silver, per cu.ft. of gas. A cubic foot of gas was considered at a temperature of 0 deg. C., as the thermometer stood at about that point throughout the tests.

Cupel run: Six samples were taken with the cupel only running. The average of the six tests was as follows: Time, twenty-five minutes. Draft, 0.04 to 0.03 in. of water. Fume assayed no gold, trace of silver. Fume cupel very white and fine grained, and seemed to be mostly zinc oxide. Fume was tested for lead, and showed only a trace.

METHOD OF MAKING CALCULATIONS

The velocity of the flue gas was calculated from the formula $V = 21.304 \sqrt{\frac{H \times T}{P}}$ where

V is the velocity

H is the differential gage reading in inches of water

T is the absolute temperature of the gas in deg. C.

and P is the barometer reading in inches of mercury. Taking the average of the above readings for the blast-furnace run, the following is obtained:

$$\begin{aligned} V &= 21.304 \sqrt{\frac{0.05 \times 573}{28.5}} \\ &= 21.304 \times \sqrt{1.006} \\ &= 21.304 \times 1.00 = 21.3 \text{ ft. per sec.} \end{aligned}$$

The stack diameter was 30 in., having an area of cross-section of 4.90 sq.ft. Volume per minute, 21.3 × 4.90 × 60 = 6,262 cu.ft. Volume per hour, 6,262 × 60 = 373,720 cu.ft. Total gas emanating from the stack, 16½ × 373,720 = 6,166,380 cu.ft. No allowance was made for friction in the stack. Volume of gas calculated to 0 deg. C. and 760 mm. barometer. Average assay of fume as follows: Trace of gold, 0.32 mg. of silver, per cu.ft. of gas. The total silver loss was 1,973.3 grams, or 61.4 oz. This was 0.43 per cent of the total silver in the melt. The gold loss could not be calculated, as the gold from the combined samples could not be weighed. It is likely that the gold loss would not exceed half an ounce. The lead lost in fume during the melt was slight. The total lead loss during the melt was 6 per cent, which included the slag losses. The blast-furnace slag from the melt assayed 0.42 oz. gold and 11.46 oz. silver. The value was $14.45 per ton. In the dust chambers was collected 118 lb. of flue dust, which assayed 65.5 oz. gold and 440 oz. of silver per ton, and had a total value of $95.18. About 50 per cent of this dust was caught in the first flue chamber and 76.7 per cent in the first three chambers.

The temperature of the flue gases was estimated, as the only thermometer available read to 200 deg. and the temperature was somewhat above this; it was taken at 250 deg. Only one-twentieth of the error in temperature appears in the final calculations, and any error in estimating temperature is on the side of safety.

The losses due to fume during cupellation were slight, as no gold and only traces of silver showed in the samples of fume while the cupel alone was running.

The formula for calculating velocity was furnished by R. L. Stevens, one time experimental chemist for the United States Smelting Co., of Salt Lake City. The Gooch crucible, in the manner shown, was used by Mr. Stevens also.

SUMMARY OF THE PROCESS

The refinery process described worked smoothly. Two men were required for six shifts each to complete the melt, from cleaning the presses to finishing the bars.

Two extra shifts were required each month to clean up after the melt. The cost per ton for refining, including all labor, power, and supplies except zinc dust, was 1.6c. per ton of ore treated, over a period of eighteen months. This figure includes the cost of canvas for the precipitate presses.

The process is not one that is in general use, but it has several advantages over the direct melting of precipitate with fluxes in crucibles. There is no dust loss in charging, or through boiling of crucibles; no drying of precipitates; and no broken crucibles, with consequent spill of metal. Also, the precipitate is quickly converted into base bullion, thus reducing the chance for theft. The process is especially applicable where the volume of precipitate is great, as a large amount could be handled almost as cheaply as a small quantity. The method also finds a special application where arsenic, antimony, copper, or other similar metal is present that would injure the final bullion, for such metals are effectively removed by cupelling. The only losses are slag losses and fume losses, the former of which is under direct control, and the latter of which is small. The principle disadvantage of the process is the cost of installation, but this method is well worth consideration where a reasonable life of the mining enterprise is assured.

When Preservative Treatment of Wood Is an Economy

Although any set of timbers may be made more resistant to decay by preservative treatment, such treatment may not always be economical, even though the timbers are to be exposed to the most severe fungus attack, according to the Forest Products Laboratory, U. S. Forest Service, Madison, Wis. If the timbers are to be in service for a short time only, durability is unimportant, and any kind of preservative treatment would obviously be a waste of money. If, on the other hand, the wood is naturally of low durability and is to be used in a permanent location, it is easy for preservative treatment to show great savings. Between these two extremes there are a number of instances in which it is a more difficult problem to determine whether or not preservative treatment will pay.

If a timber user knows the average life that treated and untreated timbers are giving, and the cost of each in place, he can easily compute, with the use of the following table, the relative annual costs of maintaining the two. A mine operator may have found, for example, that untreated timbers are giving an average life of two years and that their cost in place is $6 per set. Assuming an interest rate of 7 per cent, the table shows that timbers which need replacement every two years cost annually $0.553 on every dollar of their cost in place. For the $6 set, then, the annual maintenance cost would be six times $0.553, or $3.32. Treated timbers, the user may find, give an average life of fourteen years and cost $7.50 per set in place. The annual charge on timbers with a fourteen-year life is found in the table to be $0.116 on each dollar of their cost in place. The annual cost of maintaining the $7.50 treated set, therefore, would be 7.5 times $0.116, or $0.87. Preservative treatment, then, would save this user annually $2.45 per set.

If a timber user knows the cost of treated and untreated timber and the average life of the untreated timber only, he can estimate how long treated timber would have to last to be as cheap as untreated timber. In the case discussed above, the untreated timber cost $6 in place; the treated, $7.50; and the untreated timber was lasting two years. The annual charge on the untreated set was found to be $3.32, and as the annual charge on the $7.50 treated set is to equal this, we may set up the equation, $7.5 \times y = \$3.32$; then y (the annual charge on one dollar expenditure) $= \$3.32 \div 7.5$, or $0.443. Referring again to the table and looking along the 7 per cent interest rate row, we find that an annual charge of $0.443 on the dollar falls between the two-year and three-year columns and evidently at a point equivalent to about a two and three-quarter year life. It can readily be seen from this that if treatment adds only three-quarters of a year to the life of the timbers, it would pay for itself, and the user could be sure from the experience of others that it would add much more than this and would therefore be profitable.

If untreated timber is giving long life, treatment might not result in great savings. However, often it might be possible to substitute for such timber a treated lower-grade material that would give as long or longer life, with an annual maintenance charge which would compare favorably with that of the better-grade untreated timber.

Several advantages arising out of the use of treated timber should not be overlooked, although they may not seem so important as cutting down maintenance costs. As decaying timbers are highly inflammable, preservative treatment, by keeping the wood sound, reduces the fire hazard. Then, a well-preserved timber maintains high strength over a long period of time, whereas a decaying timber rapidly loses its strength. Preservation, by lengthening the life of timber and by permitting the use of low-grade material, also helps conserve a timber user's resources and the nation's timber supply.

ANNUAL CHARGES ON EACH DOLLAR OF COST OF TIMBERS IN PLACE

Interest Rate Per cent	Life in years before replacement																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	16	18	20	22	24	26	28	30
4	1.04	0.530	0.362	0.275	0.225	0.191	0.166	0.148	0.132	0.123	0.114	0.106	0.100	0.094	0.086	0.079	0.073	0.069	0.065	0.062	0.060	0.058
5	1.05	0.538	0.367	0.282	0.231	0.197	0.173	0.155	0.140	0.129	0.120	0.112	0.106	0.101	0.092	0.085	0.080	0.076	0.072	0.069	0.067	0.065
6	1.06	0.545	0.374	0.289	0.237	0.203	0.179	0.161	0.148	0.135	0.126	0.119	0.112	0.107	0.098	0.092	0.087	0.083	0.079	0.076	0.074	0.070
7	1.07	0.553	0.381	0.295	0.243	0.209	0.185	0.167	0.153	0.142	0.133	0.128	0.121	0.116	0.109	0.103	0.097	0.092	0.088	0.086	0.083	0.081
8	1.08	0.561	0.388	0.302	0.250	0.216	0.192	0.174	0.160	0.149	0.140	0.133	0.127	0.121	0.113	0.107	0.102	0.098	0.095	0.093	0.090	0.089
9	1.09	0.568	0.395	0.309	0.257	0.223	0.199	0.181	0.167	0.156	0.147	0.140	0.134	0.128	0.120	0.114	0.110	0.106	0.103	0.101	0.099	0.097
10	1.10	0.576	0.402	0.315	0.263	0.227	0.205	0.187	0.173	0.162	0.153	0.146	0.140	0.135	0.128	0.121	0.117	0.114	0.110	0.109	0.106	0.106

Based on the formula, $A = \frac{P(1+r)^n r}{(1+r)^n - 1}$, in which A = annual charge
P = amount of initial investment
n = number of years in the recurring period (the average life of the timber
r = the rate of interest expressed decimally

The Marketing of Arsenic

Insecticide and Chemical Manufacturers Consume Large Amounts—Three American Mining Companies Account for Domestic Production—Industry Dependent Upon Agricultural Demand

By F. Y. Robertson
Vice-President U. S. Smelting, Refining & Mining Company

ARSENIC is an element which is generally classed among the non-metals, though it has some of the characteristics of a metal. Its appearance and luster are metallic, and it forms, with several metals, compounds which, though brittle, correspond to true alloys such as hard lead, a compound of arsenic and lead, and several varieties of speculum metal. The addition of arsenic to most metals makes an alloy which is brittle.

Arsenic is found in the uncombined condition in various localities, but more generally in combination with other metals and sulphur in the form of more or less complex sulphides. The number of arsenic minerals—that is, the minerals of which arsenic forms either a major or minor constituent—is large, 130 or more, or approximately 12 per cent of the 1,100 known minerals, and they are of general occurrence.

Arsenic Commonly Associated With Antimony and Silver

Native arsenic occurs usually in metalliferous veins in association with ores of antimony, silver and other metals. Arsenic is a constituent of the miners' arsenical iron, arsenical pyrites or mispickel, arsenical nickel, realgar, orpiment, and other minerals. The principal producing countries of white arsenic and arsenic compounds are Germany, France, Portugal, Spain, England, Turkey, Mexico, Canada, Japan, and the United States.

The ordinary commercial or white arsenic is produced, in the United States, largely as a byproduct recovered from flue dust and fume at smelters in the Western states. Sulphurous gases and fumes containing arsenic from the furnaces are precipitated by being drawn through baghouses or by the electrical precipitation of particles from the fume and gas by the Cottrell treater. After the arsenic fumes and dust are precipitated, they are refined in special furnaces or reverberatories, the result being a high-grade, fine white commercial arsenic product analyzing 99 per cent or better of As_2O_3. This product is pulverized, and barreled or otherwise prepared for the market.

Arsenical Chemicals Important

A number of arsenic salts and oxides are used medicinally, among them the bromide, iodide, trisulphide, trioxide, sodium arsenate, and potassium arsenate. Realgar, the disulphide, both natural and artificial, is used as a paint pigment in calico printing, dyeing, tanning and, as it burns with an intense white light, in pyrotechnics. Orpiment, the trisulphide, called also king's yellow, is used as a paint pigment and as a reducing agent in chemical work. The trioxide is used in paints; for preserving hides, both by taxidermists and the leather industry; as an antiseptic; in killing animal pests; and in the preparation of volumetic solutions. Sodium arsenate is used in dyeing with turkey-red oil and in printing fabrics; sodium arsenite in making soaps for use on skins and hides. Potassium arsenite is used as a reducer for silver in the manufacture of mirrors.

Elemental or metallic arsenic is used as an alloy in the hardening of metals. Its alloys with copper are white, dense, malleable, and fusible. The use of arsenic as a flux in brass is advocated by brass founders, as it is the one element which approaches nearest the action of a flux, because it promotes the union of metals that would be difficult to mix. Arsenic has been used in the manufacture of steel, and tests show a slight superiority in favor of the steel containing arsenic. It has also been successfully applied to patent fly-killing devices.

Insecticides Main Source of Consumption

White arsenic (As_2O_3) is used principally in the manufacture of insecticides, weed-killers, glass, and cattle and sheep dips. The largest consumption of white arsenic is by the insecticide manufacturers in the production of lead arsenate, calcium arsenate, paris green, london purple, and cattle and sheep dips. Lead arsenates are used in spraying solutions at different seasons of the year by horticulturists and vegetable and fruit growers throughout the United States. Most of the insecticide manufacturers are in states east of the Mississippi, supplying the demands of the Eastern and Southern states, but there are other manufacturers in Colorado, Utah, and on the Western coast, meeting the demands of their various localities. The chief marketing points are New York, Chicago, San Francisco, and Houston, Tex.

Arsenic Largely Used for Agricultural Purposes

A considerable tonnage of white arsenic is used in the manufacture of weed killers, which are used principally by the various railroads throughout the country, it being found a cheap and effective method of keeping the roadbeds and rights-of-way free from grass and weeds which otherwise would have to be removed by hand.

The annual consumption of white arsenic in the United States varies considerably. In 1920 it was estimated at approximately 15,000 tons, though in 1921 probably not over 9,000 tons was used. Prior to 1914, by far the larger proportion of arsenic was imported; in fact, from 1901 to 1910, inclusive, the United States produced only an average of approximately 975 tons per annum, though the average imports per annum for the same period of time were approximately 4,235 tons. The annual consumption in the United States has varied from a minimum of about 3,400 tons in 1904 to a maximum of approximately 15,000 tons in 1920.

The demand for white arsenic is heaviest from November to March, owing to the large amount used in the manufacture of insecticides, lead arsenates and other chemicals, the consumption of which is greatest in the spring and early summer months for spraying orchards, plants, vegetables, and trees.

Through Government research, calcium arsenate has been found effective, when properly applied, against the boll weevil, and as the encroachment of the boll weevil has encompassed the entire cotton-producing section of the United States at this time, the demand for and use of calcium arsenate will be greatly increased. The basic purpose of the poisoning is to merely keep the weevils sufficiently reduced in number so that their feeding will not increase the fruit shed which would be experienced in their absence; that is to say, the weevils are allowed to develop undisturbed until they approach the point of actually reducing the crop, and are then held in check by poisoning just long enough to let the plant set and develop beyond weevil injury all bolls that it will be able to mature.

If calcium arsenate is properly made it will not injure the cotton plants, nor is it nearly so dangerous as paris green, as it does not possess the caustic characteristics of the latter. When properly applied from five to seven pounds of calcium arsenate are required to an acre for each application, the number of applications usually varying from three to five, with an interval of from four to seven days between applications, depending upon the extent of the infestation and atmospheric conditions. Owing to the cost of the material and applying, the Government states that it seems inadvisable to attempt poisoning of land which is not capable of making at least one-half bale of cotton per acre in the absence of weevil injury. The gain secured by poisoning ranges as high as 1,000 lb. of seed cotton per acre, and on fairly fertile soil, subject to a serious degree of weevil injury, average gains of from 300 to 500 lb. of seed cotton per acre are entirely possible.

DIFFICULT TO ESTIMATE CONSUMING DEMAND

There seems to be no method of determining an average amount of arsenic used in the manufacture of calcium arsenate, owing to seasonal demands varying in accordance with agricultural conditions; that is to say, with low prices for cotton, comparatively little boll-weevil poisoning would be undertaken by the planters, whereas with good prices for cotton, and the consequent necessity of saving the crop, there would be a demand for a large amount of calcium arsenate. The quantity of calcium arsenate used per acre will vary from 15 to 25 lb., according to the number of applications required; and, if the use of calcium arsenate became at all general throughout the cotton-producing area, it would afford a market for practically all of the arsenic produced in the United States.

The principal difficulty at the present time is in securing an effective method of application. Calcium arsenate is used in exceedingly fine powdered form, and is applied either by machines treating five rows of cotton at a time, or by means of a hand gun, usually carried by a man on horseback, treating one row at a time.

The amount of white arsenic used at present is estimated as follows:

	Tons
By the glass manufacturers	2,500 to 3,000
Sheep and cattle dips, approximately	1,500
For dyes, pharmaceutical and other purposes, approximately	500
In the manufacture of lead and calcium arsenates, insecticides, and weed killers, approximately	5,000 to 9,000

Prime white arsenic, to meet commercial requirements, must be white in color and contain not less than 99 per cent As_2O_3. It has about the fineness of flour and must not be lumpy. Standard grades of prime white arsenic are produced in the United States by the United States Smelting, Refining & Mining Co., the American Smelting & Refining Co., and the Anaconda Copper Mining Co. The arsenic produced by these companies is standard grade, meeting the above-specified requirements, whereas much of the imported arsenic will not carry as high a percentage of As_2O_3 or be of the proper color and fineness.

AGRICULTURAL BUREAU AIDING CONSUMPTION

White arsenic is usually barreled and sold in carloads to insecticide manufacturers, the barrels containing about 450 lb. each. For jobbing purposes, arsenic is put up in casks of various sizes of from 100 lb. up, and for the retail trade it is put up in packages of from one pound to ten pounds. A great many of the states, through state entomologists and county farm bureaus, purchase white arsenic, arsenate of lead, and other insecticides in large quantities at wholesale prices, giving the benefit of these prices to the local farmers.

The production of arsenic in the United States has grown to such an extent that unless the consumption, due to increased demand for insecticides for the destruction of boll weevil, gypsy moth, and other pests, is materially increased, the country will have a surplus production for export.

The domestic consumption of arsenic is increasing yearly, as the farmer and horticulturist recognizes more fully the value of the use of arsenical insecticides to protect their growing crops.

Prices of white arsenic from 1901 to 1915 are given by the U. S. Geological Survey as follows:

Period	Average Price Per Pound. Cents
1901-1905	2.837
1906-1910	3.153
1910-1915	2.740

From 1915 to 1921, inclusive, prices based upon actual sales ranged as follows:

	Cents
1915	2½ to 3¾
1916	3½ to 8
1917	8¼ to 15
1918	9
1919	8 to 10½
1920	9⅛ to 14½
1921	7 to 12

Similarities Between Igneous Rocks of Brazil and Those of South Africa

Striking similarities in geological age and in composition exist between the old granites and gneisses with intrusive younger granites, the pre-Cretaceous intrusive sheets of diabase, the lava flows of the Serra Geral and the Drakensberg, the pipes and dikes of kimberlite, and the intrusive and effusive alkali rocks (nephelinesyenites and phonolites, according to a report that has been issued by the U. S. Geological Survey. The alkali rocks are found on both sides of the Atlantic Ocean near the coast; they form denuded volcanic centers, and if the west coast of Africa and the east coast of South America be considered in juxtaposition the location of these older volcanoes would be very similar to that of the young volcanoes of alkali rocks (Kenia) near the young fracture system, bordering the rift valleys in East Africa. Long dikes of nephelinesyenites prove the existence of similar fractures in the central part of South Africa.

Electrical Phenomena Produced by Metalliferous Deposits

By C. and M. Schlumberger

Translated from Comptes Rendus, of [illegible] 13, 1922, by J. E. Spurr

IN AN EARLIER communication,[1] one of the authors has demonstrated that pyritic deposits spontaneously produce differences of electrical potential in the inclosing rocks. We have studied this phenomenon in numerous different types of European and American deposits and proved that it is more general than at first appeared.

The presence of pyrite is indeed not indispensable. We have found differences of potential in many cases where this mineral was not present, notably in deposits of galena, of arsenopyrite, of copper sulphides, of gray copper, of smaltite, of pyrolusite, of anthracite, of anthracite schists, and in water courses and gas courses. The assembling of these demonstrations and of our experiments in the laboratory led us to the following conclusion:

Every mineral body which possesses electrical conductivity continuously for a sufficient vertical distance, and which is incased in the earth in such fashion that some of its parts are above the ground-water level, produces, in the surrounding wet rocks, electrical currents which are detectable.

In order that a deposit shall produce this electrical phenomenon, we see, first, that it must consist of a mineral which possesses conductivity, as is the case with most of the sulphides (except blende), with the sulpharsenides and sulphantimonides, manganese oxides, and certain anthracites. The carbonates, silicates, hematite, and limonite being non-conductors are, therefore, excluded.

Again, it is necessary that the mineralization should be strictly continuous, which can only be effected by microscopic filaments uniting the different crystals. This property is very variable in different types of ores. Thus the sulphides of copper are generally much more continuous than is galena. The anthracite schists often possess a fine mass-conductivity due to fine carbonaceous needles which are contiguous, although the total content of carbon may be only a few per cent.

The differences of potential are usually measured at the surface of the ground, above the deposit. Their maximum value depends, within wide limits, upon the nature of the metalliferous mass. As a rule it does not exceed a few hundredths of a volt with the difficultly oxidizable ores, and it may reach a volt in the anthracite schists. The extent of the field affected by the phenomenon varies, naturally, with the dimensions of the deposit. While a small vein gives differences of potential observable, at the earth's surface, only for a distance of ten to twenty meters from its outcrop, this action may extend to 200 or 300 meters from the great pyritic masses and even reach several kilometers in the case of the thick beds of anthracite schists.

The theoretical explanation of these phenomena appears to be as follows: The whole of the mineral mass, assumed to be practically homogeneous throughout its whole vertical extent, is immersed in an electrolyte which is formed by the water standing in the inclosing rocks. In the portion near the surface, the water is rich in surface-derived oxygen. It is nearly barren of oxygen below the ground-water level, as is shown by the analyses of the gases dissolved in the water of springs of deep origin. This dissimilarity in the electrolyte surrounding the ore produces an electric current, which tends to re-establish the symmetry. Indeed, our observations show that the direction of the current is such that it flows downward in the deposit and returns upward through the rock.

In depth, the currents leave the ore. They enter it near the surface. The electrolytic action on the walls of the deposit, then, consists in the formation of oxygen in the deep region, where the water does not contain any, and hydrogen in the upper portion, where the rock is considerably aërated. This nascent hydrogen leaves the circuit, combining with the dissolved oxygen to form water.

Summing up, we have an immense voltaic pile or battery, whose activity consists, in effect, in diffusing the oxygen of the atmosphere toward the interior of the terrestrial crust. Thanks to the electrolytic action, the oxygen sinks along the walls of the deposit, and for every molecule which thus appears in depth there corresponds, above, another which disappears by combination with hydrogen.

As to the order of magnitude, it seems that a total current of a tenth of an ampere, properly distributed in the rock, may be sufficient to produce the differences of potential that are observed over a deposit of notable dimensions. This tenth of an ampere only carries down less than one gram of oxygen every twenty-four hours, which is relatively a very small quantity.

In order that the battery shall continue to function and not polarize itself, it is necessary that the original dissymmetry be maintained; that is, that the oxygen, liberated in the deep portions, is eliminated at the same rate that it forms. It may be diffused slowly through the wall rocks, or be combined at once, by oxidizing the ore immediately in contact. It is, therefore, seen that oxidizable minerals themselves perform the function of depolarization for the battery, and that they are particularly apt to produce intense phenomena, as is effectively demonstrated for the anthracites and the metallic sulphides. The manganese deposits, where pyrolusite at the surface is succeeded by manganese carbonate in depth, represent a different case. The pyrolusite, being a metallic conductor, while the carbonate is not, the oxygen is deposited in the zone of contact of the two minerals, and oxidizes the carbonate, which is gradually transformed into dioxide.

According to our tests, it seems that difference of temperature between the deep and shallow portions does not figure importantly. On the other hand, pressure, which is considerable in depth, must play a rôle in facilitating the development of the oxygen and its combination.

Laboratory experiments allow the essential features of these phenomena to be reproduced in miniature. Simply put a fragment of ore, surrounded by clayey sand, in a glass vessel, and carefully drive off the free oxgyen by prolonged boiling; then let the action of the air take place slowly. The oxygen dissolves little by little in the water of the upper portion of the sand, the dissymmetry of the electrolyte is thus established, as in the natural rock, and the electrolytic battery begins to function. The differences of potential that are observed between the different parts of the sand are of the order of magnitude of those observed in the natural deposits, and the direction of the electric current is the same.

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[1] C. Schlumberger, Comptes Rendus, t. 170, 1920, p. 519.

USEFUL OPERATING IDEAS

Damming Water in the Star Crosscut

Fractures in Ground Passed Through in Three Places Were Filled With Concrete—Flow and Pumping Time Decreased

THE Star crosscut that is being run from the 2,000 level of the Hecla mine, in the Cœur d'Alene district, Idaho, will be more than 8,000 ft. in length, the longest tunnel in the world at a corresponding depth. Its purpose is to provide an outlet for the Star mine, which was purchased jointly by the Hecla Mining Co. and the Bunker Hill & Sullivan Mining & Concentrating Co. These two companies entered into an agreement to purchase the Star just about a year ago, and announced their purpose to develop and operate the mine through a crosscut tunnel from the 2,000 level of the Hecla. The 2,000 level of the Hecla is not half the actual depth that will be attained by the crosscut, for it will pass under the high divide separating Canyon Creek and the South Fork of the Cœur d'Alene River, the summit of which is 6,100 ft. above sea level. The 2,000 level is also only 1,800 ft. above sea level, thus making the maximum depth attained by the crosscut 4,300 ft.

The possibility of meeting water courses that would greatly increase the amount of water to be handled by the present Hecla pumping plant was given careful consideration by the management of the Hecla and Bunker Hill companies before this plan of development was decided upon. The pumping capacity of the Hecla is about 1,000 gal. per minute, which is in excess of the requirements of the mine. With this latitude to take care of additional water, and with means at hand for quickly increasing the pumping capacity if found necessary, the management of the Star felt safe in proceeding with the enterprise.

Nevertheless, the possibility of striking an excessive flow of water continued to be a problem that received attention after the crosscut was started. Fractures in the formation were passed through which released the water and soon made a substantial addition to the amount to be lifted by the pumps. It was here that the following experiment was tried which proved so successful that it has removed all fear of trouble with water and has reduced the cost of pumping far below the figure estimated under ordinary conditions:

In the roof of the tunnel and the walls, back several feet from the water course, holes pointed at an angle of 45 deg. or less were drilled to a depth of 18 ft., passing through the fractures forming the water course. Small charges of powder were then exploded in the bottom to "spring" the holes and breaking more or less of the rock into gravel. Gas pipe, incased in hose or other material to make it water-tight, was driven into the holes as far as necessary to make them secure.

With these pipes firmly in position, a pump especially built in the Hecla machine shop was put into operation. This pump is capable of exerting a pressure of 3,000 lb. per sq.in., and was used to discharge thinly mixed concrete, mostly cement, into the holes. As the cavities filled, the concrete would necessarily spread through the cracks and crevices in the rocks to the other holes and run out through the open pipes. As soon as the concrete started to run, the pipes were closed securely with a capping or otherwise. After all the pipes had indicated the circulation of the concrete and had been closed, the pumping continued through the single pipe attached to the pump until it was impossible to force any more concrete in, when the last pipe was closed.

The crosscut has now been advanced a little more than 3,000 ft., and in three places this damming with concrete has been applied. The result is shown in the time the pumps are operated. These pumps, of course, handle all the water from the Hecla mine as well as from the Star crosscut. Before the concrete was applied it was necessary to operate the pumps about twelve hours out of the twenty-four. Now the work is done in about eight hours, a reduction of about one-third. The broken rock or gravel produced by "springing" the holes forms a bedding that holds the concrete until it sets and prevents it from oozing under the high pressure through the fractures and seams in the rock into the tunnel. The flow has been effectually reduced 75 or 80 per cent.

Handling Safety Fuse

The following points on the handling and use of safety fuse are given by the California Cap Co. in its house bulletin, by way of reminding the old employee and informing the new:

Fuse should always be long enough to extend at least to the collar of the hole. It should never be less than 2½ ft. long, even for pops, back holes and shaking holes. It seems hardly necessary to say that, in addition to this, fuse should be enough longer to allow time for the blaster to ignite all of his fuses and then to "take cover."

It is the practice of some shot-firers, however, to try to economize by using short fuse, sometimes only a foot or less in length, which they light, ram into the bore hole, then while the fuse is sputtering, perhaps throw in a little tamping and run for safety. This custom is called "using short fuse." It is extremely dangerous, and cannot be too strongly condemned. Furthermore, the futility of trying in this way to save a few cents a day on fuse must be apparent to anyone who stops to consider that, even setting aside the added danger to life or limb of the shot-firer himself, and the possible grief and suffering brought upon his family, any saving effected is far more than offset by waste of powder.

Before uncoiling, see that the fuse is flexible and not chilled. Handle it gently. Do not straighten by striking it on a bench or on the floor. Such treatment may not only shake the powder out of the end, but may crack the covering sufficiently to cause side-spitting and loss of waterproof qualities. Do not kink or otherwise break or and do not hang it over a nail or peg less than 4 in. in diameter. A simple expedient is to cut a small nail keg in half, fasten it to the wall, and hang the cut fuse over the keg.

It is recommended that fuse be cut straight across, because this is preferable to having too much slant. Any slant greater than 20 deg. may, when pressed into the cap, cause the lip to double over sufficiently to make the fuse spit against the side of the shell instead of into the cap composition, the result of this being a misfire.

Cut the fuse with a sharp knife, and keep the blade clean with a little gasoline, but be careful that the gasoline does not come in contact with the fuse. Remove tar or gummy matter whenever it accumulates on the knife; otherwise it will smear over the powder at the end of the fuse and, sealing it, prevent the fire spitting into the cap.

To eliminate any chance of moisture having gathered, or powder having been knocked out of the ends, cut off at least half an inch, preferably one inch, from both ends of every coil before inserting in cap. Remember that fuse, if left lying around or handled much after cutting, may become damp, and also have enough of the powder knocked out of the end to keep the fire from reaching the cap. Therefore, insert the freshly cut end of the fuse into the blasting cap promptly after cutting.

If the fuse is found to be a little too large to enter the cap readily, squeeze it gently until it is small enough to fit, but do not let the powder roll out. Be sure that the fuse gets in all the way until the end is in contact with the cap composition, then be careful not to draw it away before crimping. It should always be remembered that an unfilled space in the cap barrel, after the cap has been inserted and crimped, is inviting trouble.

Prepare primers on the surface whenever possible, and take underground only enough for each day's needs. Use all of old before making up new lots.

To insure unvarying burning speeds and proper rotation of shots, it is suggested that the cartridge containing the blasting cap should be placed under the same relative load of powder and tamping (if tamping is used) in all of the holes of a given round. The reason for this recommendation is that the speed of burning fuse is materially influenced by outside pressures, so that if in a round containing a number of holes varying lengths of fuse are buried under uneven loads of explosives and tamping, the rotation of holes as originally planned will be seriously interfered with.

The practical reason for the above recommendation, which is based on long and careful underground investigation, is that safety fuse, which gives excellent results in stope work so far as rotation of holes is concerned, may fail to give desired results in development work. In most cases it is found that the reason for irregular burning is that the shot-firers concerned are not familiar with the fact that external pressure on safety fuse influences its burning time. More often than not when difficulty of this nature is reported, it develops that the trouble is due to lack of knowledge rather than to any fault inherent in the safety fuse itself, and convincing proof of this can almost invariably be given by practical demonstration.

When tamping, care should be taken not to strike the fuse a sharp blow, as injury to the jacket of the fuse may result, causing a misfire. In no case should anything but a wooden bar be used for tamping.

Water tamping is not effective in a round, because the first shot usually throws or draws the water out of all the other holes. When the better class of fuse is soft and pliable, the part that projects from the collar of the hole may be coiled and placed in the hole to avoid being cut off by flying fragments of rock.

Note that we say, the fuse may be "*coiled* and placed in the hole." Do not fold, loop or bend it when placing in the collar, because such treatment has been known to "short circuit" the fuse: it either cracks at the bend, or the hot burning portion, igniting the part it overlaps, starts the latter section burning and results in the untimely detonation of the hole.

The "spitting" or igniting of a piece of fuse requires some knack. The flame of a match will not do it unless the red-hot head touches the fuse powder. It is common practice either to slit back the end of the fuse in order to expose more of the powder, or to make a diagonal cut in the side of the fuse about one inch from the end, touching the slitted portion with one of the customary means of ignition, such as red-hot wire or iron, notched fuse, carbide lamp, candle, or lead spitter. The notched fuse method, which is one requiring some practice, is to cut slits about two inches apart in an extra piece of fuse eight or twelve inches long, light one end and use the red-hot sparks which spit from it to ignite the other fuses in the holes. As the sparks die from one section and start afresh out of the next slit, bend the burnt section back or pull it off and proceed to light a few more fuses with the fresh sparks from the next section, and continue in this fashion over the entire round.

The California Industrial Accident Commission Mine and Tunnel Safety Rules prescribe that one man shall not attempt to light more than fifteen fuses except in tunnel operations where the number of holes to be lighted is limited to ten. If there is a large number of holes in the round, assistance should be obtained.

Belting Hints

Hints as to belting are given in the catalog of the Flexible Steel Lacing Co. Every belt ply, it states, should have at least 2 in. of pulley diameter to secure full capacity and reasonably long life. A single leather belt may be considered as the equivalent of a four-ply fabric belt, and a double leather belt equal to a six-ply fabric belt.

It is good general practice to favor width over thickness in a belt.

It is better to use a light double leather belt a trifle narrower than a single belt on flanged or stepped pulleys. A double is less likely to climb, step or flange, will run truer, and shifting will not get it out of shape so easily.

Single leather belts should not be over 8 in. wide.

Except over pulleys under 6 or 8 in. in diameter, use double belts for heavy work. For pulleys under these sizes, extra heavy single or light double may be more economical.

If good results are not secured by keeping belts at proper tension and using a good dressing, it may be concluded that the belt is not heavy or wide enough.

Pulleys should always be wider than the belts.

Pulleys also should always be as large as conditions will permit. More power is obtained and the life of the belt is prolonged.

Operate belts with slack side on top. This gives greater power by increasing the arc of contact.

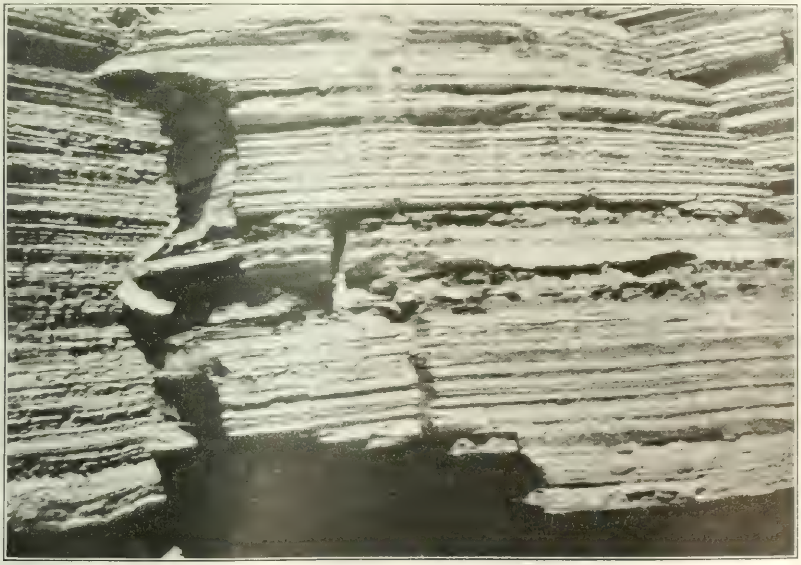
THE PETROLEUM INDUSTRY

Sampling of Oil Shale

On Account of the Low Per-Ton Value of the Material, Accuracy Is Important—
The Author Gives the Results of Work Done in Colorado—
Precautions That Should Be Taken

BY CHARLES C. STARR

AS COMPARED to the sampling of metalliferous veins, the sampling of oil shale to an equal degree of accuracy is comparatively simple. However, as oil shale is a material of low per-ton value, and since the margin between profit and loss will be low, the oil content of the workable strata on a property must be obtained as accurately as possible. The most accurate way to accomplish this is, of course, by sampling workings made in the course of underground development, which, however, should be preceded by diamond-drill and surface sampling, so that the approximate value of the property may be determined before purchase and extensive development are undertaken.



Outcrop of oil shale about four feet thick in Colorado

Drilling entails considerable expense, and each hole furnishes only a single sample, although an accurate one, of each stratum passed through. It should therefore be supplemented by thorough and careful surface sampling of all strata of possible commercial value. Such sampling should be done at various points on the outcrops, and should be accompanied by a careful study of the strata to determine their uniformity, or lack of uniformity, in thickness, oil content, and other characteristics.

Many factors influence the reliability of a single sample as a criterion of the oil content of a particular stratum as a whole. Some of these apply to surface sampling only, but others to drill-hole sampling even more than to surface sampling. These factors may be grouped roughly into two divisions: those depending on the accuracy of the sampling *per se*, and applying mostly to the surface sampling, and those depending on the regularity and uniformity of the stratum sampled, and applying even more importantly to drill sampling than to surface sampling.

Fig. 1. Comparison of richness of strata at different points on the same ledge of shale

In this connection it is pertinent to describe the sampling methods that have been followed in taking the samples referred to in the following discussion. The first move should be to inspect the strata to be sampled and select a point which appears to be average in thickness and richness, which shows the least alteration from weathering, and has not been burned. (In some places fire has eaten into the richer shale beds for a considerable distance along the outcrop.) The surface is then cleaned with a heavy pick, or hammer and chisel, for a width of about 6 in. and to a depth varying from ½ in. to 12 in., according to the depth of alteration in the shale. However, it is sometimes not practicable to clean to the full depth of the weathering.

After the cleaning is completed, a continuous groove about ½ in. deep and 3 in. wide is cut across the stratum in the bottom of the cleaned channel. The chips are caught on a canvas, sacked, and shipped to the laboratory; the thickness is then measured, and the physical character of the bed noted.

Outcrops of oil shale are affected by weathering to various degrees, depending on the amount of organic matter present, the physical structure, the time and conditions of exposure, and the climate. The massive shales show the shallowest weathering, amounting in some occurrences to scarcely more than a thin film, whereas weathering of the "paper" shale often extends to a depth of several feet.

The so-called paper appearance of some shale is probably due largely to differences in the material of alternating thin beds which have eroded unequally, leaving the more resistant parts exposed so as to resemble the pages of a book.

The question which has caused the most doubt as to the real value of surface sampling of oil shale is how closely surface, or near-surface, samples will agree with the true value of the shale at a distance from the outcrop. In other words, does the effect of weathering extend deep enough to affect the oil content of a sample taken as described above, and, if so, how much? Table 1 gives an indication of what may be expected, but the samples are too limited in number to be conclusive.

TABLE I—VARIATIONS IN SURFACE AND UNDERGROUND SAMPLES

Sample	Surface Gallon-Factor	Under-Ground Gallon-Factor	Depth of Under Ground Sample, Feet	Increase of Content Under Ground, Per Cent	Notes
8	18	30	6	66	Surface cleaned poorly
9	16	20	8	25	Surface cleaned poorly
10	17	18.5	8	9	Surface cleaned poorly
11	[illegible]	41	40	8	Surface cleaned fairly
12	26.5	26	40	2	Surface cleaned fairly
13	49	49	1,000	0	Surface cleaned thoroughly
14	56.6	57.5	8	1.6	Surface not cleaned hard, fresh

As, for various reasons, it is not advisable to publish the actual data, the figures given are percentages of the oil content of the richest sample taken; they are directly proportional to the actual number of gallons per ton from the various samples. The figure representing the relative value of a sample is hereafter called the "factor" or the "gallon-factor."

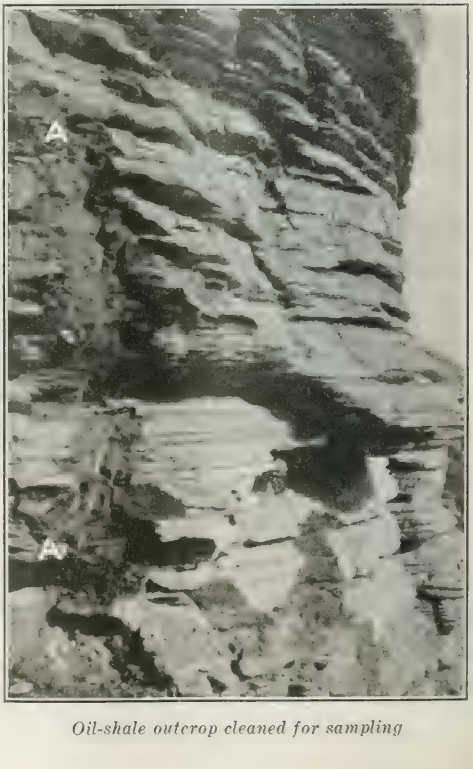
Samples Nos. 8 and 9 represent a comparatively soft, low-grade shale in which weathering was much deeper than the cleaning of the surface. No. 10 is harder, and the weathering has not penetrated so deeply. Nos. 11 and 12 are taken over adjoining strata; the outcrops of both showed thin flexible leaves—the so-called paper shale—which structure persisted strongly beyond the limits of cleaning with a heavy pick.

The upper stratum, No. 11, appeared to be somewhat more decomposed at the limit of cleaning than did No. 12. Samples were taken on the same strata in a raise 40 ft. underground in hard, massive shale of conchoidal fracture, showing not the slightest appearance of laminations or papery structure.

FRESH SHALE IS GENERALLY RICHER

Though it is possible that in unusual occurrences an outcrop may show a greater oil content than the fresh shale, it is probable that the greater outcrop value given in No. 12 is due to inaccurate sampling or retorting. No. 13 represents the composite of three sets of surface samples of fresh appearing shale, as compared to a composite drill-hole sample taken over the same thickness. No. 14 represents the composite of ten samples in hard, apparently unaltered shale.

The figures indicate the probable truth of the following inferences in regard to surface samples: (1) A sample of a lean soft shale that shows weathering may



Oil-shale outcrop cleaned for sampling

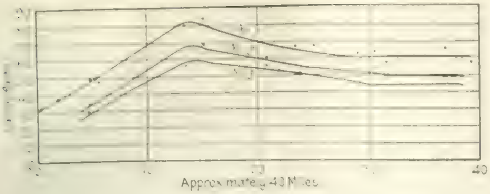


Fig. 2. Graph showing variations in richness

be considerably too low; (2) a sample of a good-grade "paper" shale taken where the laminated condition is still pronounced will be not more, and probably less, than 10 per cent low; (3) a sample of hard, massive, good shale that is apparently fresh and unweathered is approximately correct.

The ledge, or zone of rich strata, which is variously known as the "paper shale," the "rich ledge," or the "mahogany ledge," is the thickest, richest, and most uniform in the region centering around Grand Valley and De Beque, in western Colorado, where the work described herein was performed. The variation in oil content of individual strata across this ledge is rather large; individual strata, also, vary more from place to place than does the ledge as a whole.

"MAHOGANY LEDGE" EASILY IDENTIFIED

A few of the strata usually can be identified at different points by their color, texture, and other characteristics, but the presence of a thin bed of sandstone a few feet above the richest part of the ledge forms a very convenient "marker" from which the distance of the various strata may be measured. This sandstone averages about 8 in. in width and may contain a little oil. It is persistent over hundreds of miles of outcrop, but weathers easily and in some occurrences is covered by debris. Fig. 1 indicates graphically the variation of the strata across the ledge at two points, about fifteen miles apart, that are fairly typical.

TABLE 2—VARIATIONS IN OIL CONTENT AND WIDTH OF A THICK LEDGE OVER A DISTANCE OF 40 MILES

Series	1		2		3	
Sample	Width Factor	Gallon-Factor	Width Factor	Gallon-Factor	Width Factor	Gallon-Factor
1A	1.23	31				
1B	1.15	39				
2A	1.17	49	2.50	33	3.33	29
2B	1.17	49				
2C	1.17	47				
3A	1.20	80			3.38	56
3B	1.23	86	2.48	70	3.77	63
4A	1.35	60	2.50	55		
4B	1.40	67	2.40	58	3.52	53
4C	1.20	67	2.48	55	3.43	51
5A	1.23	60	2.30	49	3.43	46
5B	1.28	62	2.41	54		
5C	1.18	57	2.19	50		
6A	1.20	66	2.40	49	3.20	46
6B	1.15	57				

Each graph represents twenty-one samples. The series starts with the same stratum at the top, but it is difficult to keep the correlation of the separate strata for more than fifteen or twenty feet. These graphs, though considerably different in detail, and of markedly different average value, have a strong similarity.

The uniformity of the oil-shale strata over large areas has frequently been noted, and justly so, but there are often radical changes in a distance of ten miles, and occasionally in a much shorter distance. The variation of this ledge in oil content and width is indicated in Table 2, in which the figures given are based on carefully taken samples and oil determinations, and measured widths. The thicknesses given are not the true ones, but are proportional. This table shows samples taken at somewhat irregular intervals over a distance of approximately forty miles; all are from the same ledge and over as nearly as possible the same strata of that ledge for each series of thicknesses (1), (2), and (3).

Table 3 shows samples over a distance of approximately eight miles on a ledge that has not been certainly correlated with that of Table 2, as several hundred miles intervenes.

TABLE 3 (SUPPLEMENTING TABLE 2)

Sample	Width Factor	Gallon Factor
7A	3.18	34
7B	3.00	33
7C	3.30	31
7D	3.00	32

The figures of Tables 2 and 3 show a wide variation in the oil content of the ledge over approximately the same thicknesses at different points: a variation much wider and more regular (see Fig. 2, which is platted from Table 2) than could possibly be laid to erratic sampling.

Samples 2A, 2B, and 2C show a comparative uniformity of oil content over a "strike" distance of about two miles. Samples 3A, 3B, and others of this series not listed show, in an extreme distance of about eight miles, a variation of 5 per cent from the average of these samples. Samples of series 4, 5, and 6 show variations of 3 to 8 per cent from their respective averages.

UPPER BEDS ALONG MORE ERRATIC STRIKE

Beds lying from 300 to 500 ft. above the "mahogany ledge" are much more erratic—probably more so than any other part of the shale beds. This is true of their oil content, thickness, and internal structure. Several striking instances of radical changes along the strike are: (a) Two samples are taken across exactly the same stratum 30 ft. apart along the strike; the first was 2.6 ft. wide, gallon-factor 58, of dark-brown massive shale with satin-like threads and full of specks of bituminous matter. The second was 2.0 ft. wide, gallon-factor 25, of dark-brown shale, showing no satin threads. Of the total width only 0.4 ft. contained bituminous matter.

(b) Two sets of samples taken over erratic beds aggregating about 12 ft. in width, at points 60 ft. apart, gave average gallon-factors 12 and 22.

Fig. 3 shows these samples in detail and also indicates the changes in the physical character of the strata.

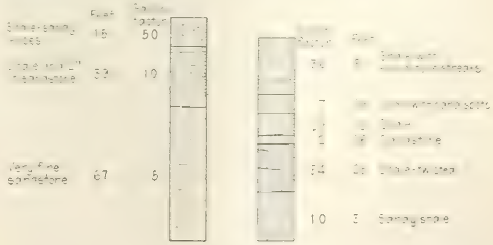


Fig. 3. Characteristics of erratic beds of shale

A more usual, though still somewhat extreme, variation in the upper beds is shown graphically in Fig. 4. It is evident that in some strata there is a wide variation both in width and oil content, and that under such conditions a stratum must be sampled in a number of places before its average value can be accurately found.

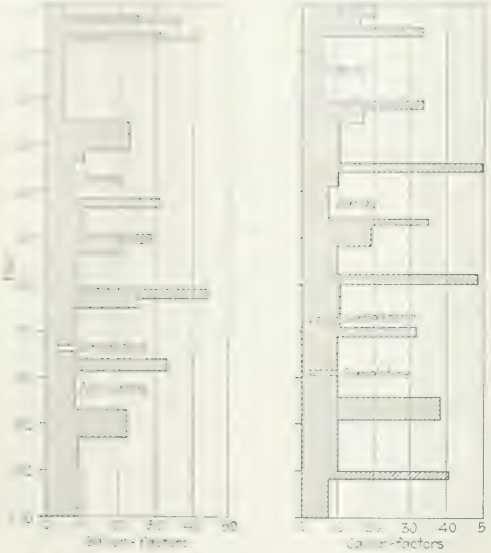


Fig. 4. Comparison of the same ledge at points one-quarter mile apart

These graphs start at the same stratum and continue downward for 110 ft. The points at which the samples were taken are about a quarter of a mile apart. No attempt was made to correlate the strata except the stratum at the top.

Fig. 5 is a sketch drawn in the field of the most involved structure that has come to my attention. It is difficult to say how many strata are represented—probably at least five in the thickness sketched, which is about seven feet. It is evident that few if any of the irregularities were caused by bending or fracturing; rather were they caused by varying conditions during deposition, probably currents, eddys, floods, and other disturbances.

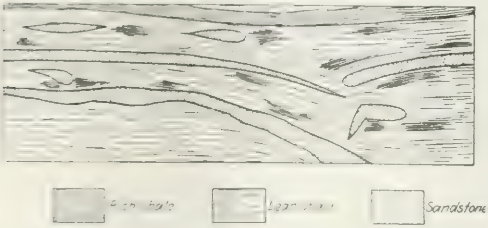


Fig. 5. Sketch showing irregularities in strata

One or two instances have been observed where a shale stratum has radically changed its color and probably its oil content within five feet along the strike; in several instances low-grade shales have changed to sandstones within fifty feet, faint diagonal lines from top to bottom of the bed marking a decided change in the character of the material. The internal structure of the richer beds of the upper shales often shows waves, whorls, and knots in the bedding, apparently due to irregular deposition in part, and in a measure to internal pressure, causing slight flowage. It is noteworthy that it is only the richer strata that show contortion.

A few strata in the middle and upper parts of the formation are notable by reason of the presence of many cavities ranging from an inch or two to six or more feet in diameter. These holes are roughly spherical but slightly flattened in the direction of the bedding planes, and are partly filled with limonite, gypsum, calcite, and a fine mud or dust, sometimes in the form of crusts and sponges and sometimes loose. Not infrequently they contain a small amount of solid hydrocarbons similar to gilsonite, in pieces up to two or three inches in diameter.

These cavities are typical in only a few strata, generally rather low in oil, but in some parts of the shale areas, and especially in the vicinity of the Colorado Naval Reserve, they attain their maximum development in and near the richest part of the "mahogany ledge." In several instances such cavities three or four feet in diameter have been found a short distance underground, generally half full of extremely fine iron-stained material and with a slight coating of lime. In the rich shales the strata are somewhat warped in the immediate vicinity of the cavities as though by pressure. Fig. 6*A* is a typical section through a cavity in the rich shales. Evidence indicates that these cavities were formed by the collection and expansion of gases from organic matter in the stratum after it was buried to a considerable depth, but before it had entirely consolidated.

Other peculiarities are the penetration of shale by sandstone pockets and dike-like prongs, as indicated in *B* and *C*, Fig. 6.

In the type represented by *B* there is generally no sign of bending or strain in the shale; in the other type the shale is bent and compressed at the edges of the sandstone intrusion, indicating that the underlying sandstone has been forced up through the shale before it was consolidated.

Only five samples are available which were so taken as to form an accurate basis for the calculation of the probable combined error of sampling and oil determination. These calculations are shown in Table 4, in which the gallon-factors of the original samples and of the duplicate samples are given. The original sample was taken from a cleaned surface of the shale and the duplicate was taken some weeks later from the same groove by the same person. The oil determinations are all by the same chemist.

TABLE 4. COMPARISON OF SAMPLES TAKEN FROM ONE CHANNEL

Sample	Width, Feet	Original Sample: Gallon-Factor	Duplicate Sample: Gallon-Factor	Mean, Gallon-Factor	Variation From Mean, Per Cent
15	2.0	49	49	49	0
16	2.3	57	64	60.5	6
17	1.6	66	66	66	0
18	2.0	87	86	86.5	1
19	2.0	73	57	65	12
Numerical average....		66.3	64.3	65.3	1.5
Composite assay		66			

The reason for the wide variation between the original and duplicate of Sample 19 is not evident; the average variation—1.5 per cent—from the mean is, however, small. The inference follows that the average of a number of samples is probably nearly correct, but that a single sample may, though probably will not, vary considerably from the truth. Obviously, local conditions will govern.

The samples in the first column of tables 2 and 3 are composites, their derivation corresponding to that of the "numerical average" in Table 4, and therefore, according to the law of averages, should compare more closely than if they were single samples. On the other hand, even the samples having the same designating numeral were taken from one quarter of a mile to three miles apart and are for that reason not strictly comparable. Thus, Sample 1A was taken perhaps a mile from 1B, but much closer to it than either of them was to 2A, 2B, and 2C. Table 5 shows these samples, giving the gallon-factor, the mean, and the percentage variation from the mean, of those which are in some degree comparable.

TABLE 5

Sample	Gallon-Factor	Mean Gallon Factor	Variation From Mean, Per Cent
1A	31	35.0	11.4
1B	39		11.4
2A	49	48.3	1.5
2B	49		1.5
2C	47		2.7
3A	80	83	3.6
3B	86		3.6
4A	60	64.7	6.9
4B	67		3.6
4C	67		3.6
5A	60	59.7	0.5
5B	62		3.9
5C	57		4.5
6A	66	61.5	7.3
6B	57		7.3
7A	34	32.5	4.6
7B	33		1.5
7C	31		4.6
7D	32		1.5
Average			4.5

The average error of sampling and determining the oil is shown to be 4.5 per cent, on the assumption that the ledge is of exactly the same oil content at the points at which the samples of each series were taken. However, this is not true, as the ledge does vary from place to place, even in short distances. It seems entirely reasonable to assume that *at least* half of this variation is due to the change in the value of the shale, making the probable error of the sample 2.25 per cent. The inference to be drawn from the accompanying tables is that carefully and properly taken samples of oil shale average within approximately 2 per cent of the true value of the shale if it be hard and fresh; in partly weathered or "paper" shale the error will presumably be greater.

CORE-DRILL SAMPLING IMPORTANT

Although we may assume that careful surface sampling of the richer strata is approximately correct, core-drill sampling should not be neglected, as it is advisable, not only to check the surface work, but to sample those areas far removed from the outcrop. A single drill hole is valuable, but on account of the local irregularities in the shale a number of holes drilled at different points are desirable. In the upper and more erratic beds a multiplicity of holes is more important than in the "mahogany ledge." Here the results should be fairly dependable. If the drill should happen to penetrate one of the cavities, the fact would be noted by the driller, and appropriate allowance would be made.

IRREGULARITIES NOT OF GREAT IMPORTANCE

In the foregoing, considerable stress has been laid on the irregularities and variations in the shale; perhaps they have been unduly emphasized. The upper beds are variable and erratic, but the examples given show extreme cases, and the usual variation is not nearly so great.

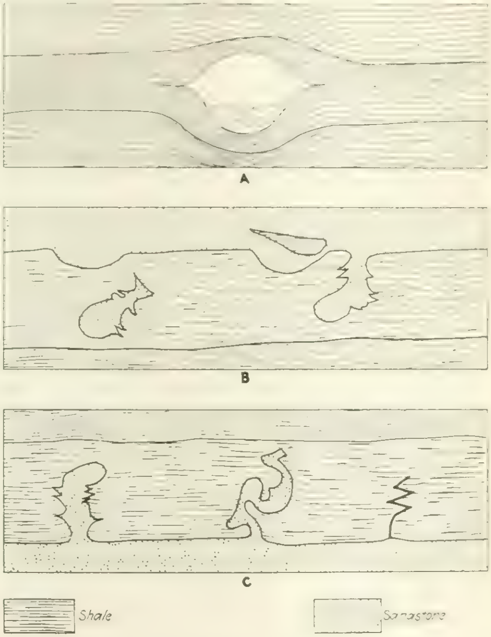


Fig. 6. Peculiarities of shale formation

The "mahogany ledge" and the beds immediately above and for some distance below are, within restricted areas, quite regular, and over areas of many square miles often show only slight and gradual changes.

SUMMARY

The following inferences are reasonable, but it should be remembered that they are based on limited and often imperfectly applicable data:

Strata of good or medium grade, if the weathered outcrop is cleaned off, leaving fresh appearing shale, may be sampled on the surface accurately.

The main or "mahogany ledge" is composed of strata varying widely in value. As a whole it is comparatively uniform in limited areas, but shows considerable variation in large areas.

The upper strata of rich shale are quite variable in thickness, structure, and oil content.

Sampling must be done in numerous places on a stratum or ledge to obtain its true average value.

The average error of a *properly* taken surface sample probably is not over 2¼ per cent.

BY THE WAY

A Prop for Darwinism

An engineer who has seen the light is Louis Wolheim, now starring in "The Hairy Ape." Louis makes a fine [illegible] in his make-up. He is also a good mechanical engineer, a graduate of Cornell, and was once employed in Mexico. Finally, Lionel Barrymore discovered him, [illegible] say, or he discovered Lionel. The result is the [illegible]. From monkey-wrench to monkey.

To Be Shipped in Sections

In the early days of the Australian gold rush, the manager of a mine was often appointed as a result of the personal recommendation of an influential director. Usually he was a relative, with small intelligence and no acquaintance with mining. On one occasion a "new-chum" manager of this brand arrived fresh from the Old Country. The superintendent took an early opportunity to emphasize the need for further development in the mine. "We need a winze here," he said, indicating a point on the plan. "Certainly," replied the new importation. "I'll cable to England for one right away."

Great Platinum Mine Salted

We paid our respects to the Iridium, Gold & Platinum Co. or the Iridio-Platinum & Gold Co., Inc., in our issue of Nov. 12 last, and now the district attorney has followed suit and detectives have pinched the outfit. This company, whose office was at 50 Union Square, has been busily mining the public, particularly the Russian portion of it. Its property near Yonkers, just without the city, was said to yield platinum and gold in quantities. All the skeptic had to do was to throw a shovelful of gravel into a crusher, and soon a few nuggets of gold or platinum rolled out. What more convincing! But this bonanza was salted. A public, however, that understands salting only when applied to almonds, peanuts, and fish cannot be expected to detect such frauds. Yet there are those who object to blue-sky legislation in any form.

From Mine to Movie

Once upon a time Douglas Fairbanks attended the Colorado School of Mines. "Who's Who" says so. Is this another case of a mining engineer gone wrong? Doug has ignored our letter asking for the sad details, so one can only guess. But here's a suggestion for a scenario: Doug at the bottom of the Pink Jacket shaft at Calumet with a party of beautiful visitors. The miners have gone off shift. The shaft caves, entrapping the party and destroying all means of communication, and no one knows of it above. Wildly our hero rushes to the shaft, now choked with fallen ground. Tackling the muck with his bare hands, and regardless of personal peril, he burrows a path for himself upward. Finally he emerges fifty feet higher. Almost a mile vertically above him stretches the shaft, the timbering wrecked in places. One hope remains—the hoisting rope hangs clear. Grasping this he climbs and climbs. Jack and the beanstalk had nothing on him and the rope. An hour later—it won't seem so long on the screen—he reaches the collar, wakes up the hoistman and watchman and gets other help. Thus the visitors are eventually rescued. (All rights to this are waived.)

A New Use for the Seismograph

"Seismograms are used by geologists to determine the intensity of a volcano, and also the location," reads an extract from a Government examination paper. "Volcanoes are classified according to quiet, intermediate, and explosive, and the seismogram is very helpful in determining which of these three the volcano belongs to. They are helpful in determining the location of volcanoes because it will warn people to not buy land which is apt to be explosive." At the National Museum at Washington it was suggested that the seismogram could be attached to the deed for land purchased.

Another applicant defined metamorphism thus: "'Meta' means change, and 'morph' means rock, metamorphism means change of rock. . . . The kinds of metamorphic rocks are granite, slate, schist, oolerite, and deolerite.

A Result of the Roofing Campaign

By Felix Edgar Wormser

"That's a sad case," the keeper informed me
As I saw, peering into the cell,
What was once, I am sure, a sane being,
But now was all gone to—smithereens.
"You see," said the keeper quite calmly,
"He was planning on buildin' a house
"For his wife, but was still undecided
"On the roof that would shelter his spouse.
"He had almost selected copper
"Because it was rich looking—swell;
"But the d. f. had been reading the pages
"And readin' the ads. as well.
"He read notices advisin' slate shingles,
"And others insistin' on tin
"And asbestos, rubberoid, wood and zinc,
"Until the poor chap was all in.
"There was iron and tile to consider;
"Aluminum and others—you know.
"The confusion was great—he went under;
"And that (his voice shook) made him so.
"Just listen to what he is sayin'."
His mutterings though low were quite plain
As he stalked up and down on the padding
Oblivious to his uncomfortable terrain.
I heard—"I have it. I'll roof it with linen,
"Or would Lena prefer talc with glue?"
He paused, and I quickly departed.
Now don't let it happen to you.

A Case for a Specialist

"Feelin' some pert this mornin', m'son," said Cap'n Dick, "but I will say this 'ere flu do knock tha stulls h'out from h'under a chap. Lucky for me tha doctor nawed w'ot 'ee wuz doin', for h'in no time a-tall 'ee 'ad me patched h'up an' h'as good h'as I wuz before. But there be doctors an' doctors, m'son. I min' one time w'en Sam Tresidder went to see one o' they young doctors 'oo'd jus' come to taown. 'W'ot are tha symptoms,' sez tha doctor. 'Aw,' sez Sammy, 'tedn't nothin' like that a-tall.' 'Wot I meant to say is, w'ere is tha pain,' sez tha doctor. 'Aw, my dear saul,' sez Sammy, 'my throat's so soore I can't clunky, I got a turrible pain cross my cheens, my nuddick feels like h'it wuz scat with a gert stick, an' I don't feel fitty a-tall.' ''Ere, you,' sez tha doctor, 'take this medicine, come back tomorrow an' bring a h'interpreter with thee—if thee's h'alive by that time.'"

SOCIETIES, ADDRESSES, AND REPORTS

Research Fellowships at the University of Washington

The College of Mines of the University of Washington offers five fellowships for research in mining, metallurgy, and ceramics in co-operative work with the U. S. Bureau of Mines. The fellowships are open to graduates of universities and technical schools who are properly qualified to undertake research investigations. The value of each fellowship is $780 per year of twelve months, beginning July 1. Fellowship holders are required to register as graduate students and to become candidates for the degree of Master of Science in mining engineering, or metallurgy, or ceramics, unless an equivalent degree has been earned.

The purpose of these fellowships is to undertake the solution of various problems being studied by the Bureau of Mines that are of especial importance to the State of Washington, the Pacific Northwest, and Alaska. The investigations consist principally of laboratory work directed largely by the Bureau's technologists. For the year 1922-1923 the following subjects have been selected for investigation: Beneficiation of coal, especially coal washing; electrometallurgy, electrothermic, and electrolytic treatment of various mineral resources; ceramics, survey, and testing of the ceramic resources of the Northwest.

Applicants should send a copy of their collegiate records from the registrar's office of the college where they have been, or will be, graduated. They should also state in detail their professional experience, if any, and give the names and addresses of at least three persons who are familiar with the character, training, and ability of the applicant. Applications are due not later than June 10, and should be addressed to the Dean, College of Mines, Seattle, Wash.

Philadelphia Section, A. I. M. E.

The Philadelphia Section of the A. I. M. E. met at the Engineers' Club on the evening of May 5. Ralph Arnold spoke on "The Future Petroleum Supply of the World"; C. R. Kemp gave a short talk on radio; and motion pictures illustrating the principles of radio communication were shown.

Engineers Discuss Tie Tamping

The regular monthly meeting of the Engineers Club of Northern Minnesota was held at Eveleth, Minn., on April 29. W. H. Armstrong, of the Ingersoll-Rand Co., gave a talk on "Tie Tamping."

American Electrochemical Society Meeting

The forty-first general meeting of the American Electrochemical Society was held at Baltimore, Md., on April 27, 28 and 29. April 27 was devoted to a symposium on electric cast iron. Papers presented on April 28 included "Experiments With Alternating Currents in Direct-Current Electrolysis," by W. B. Jones; "Conductivity of Copper-Refining Electrolytes," by E. F. Kern and M. Y. Chang; "Electrolytic Zinc and Hydrogen Overvoltage," by U. C. Tainton, and "A Plea for Rational Interpretation of Hydrogen-Ion Movements," by W. C. Moore. On April 29 the papers included "A New Method for Determining the Radium Content of Carnotite Ores and Other Products of Low Activity," by Victor F. Hess; "Electromagnetic Motions in Electric Furnaces," by Carl Hering; "Acidity of Nickel-Depositing Solutions," by M. R. Thompson; "The Throwing Power and Current Efficiency of Zinc-Plating Solutions," by W. G. Wood and T. Fuwa.

The new officers of the American Electrochemical Society are: President, C. G. Schluederberg; past president, Acheson Smith; vice-presidents, H. C. Parmelee, A. H. Hooker, and W. S. Landis; managers, A. T. Hinckley, W. M. Corse, and William Blum; treasurer, F. A. Lidbury; and secretary, Colin G. Fink.

The officers of the Electrothermic Division are: Chairman, Bradley Stoughton; vice-chairman, John A. Mathews; secretary-treasurer, Colin G. Fink; the directors being George K. Elliot, J. H. Parker, W. J. Priestley, and Dorsey A. Lyon.

Colorado Engineering Societies Hold Joint Meeting

The Colorado branches of eight of the leading national and state scientific societies met in Boulder on May 5, in connection with the second annual Engineers' Day of the University of Colorado. Among the societies represented were: the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers, the American Institute of Architects, the Colorado Scientific Society, and the Teknik Club of Denver. Among the speakers were Dr. Willis R. Whitney, director of the research laboratory of the General Electric Co., and L. T. Robinson, engineer for the company.

SOCIETY MEETINGS ANNOUNCED

The twenty-first general meeting of the **American Iron and Steel Institute** will be held at the Hotel Commodore, New York City, on May 26.

It has been found necessary to postpone for a week the meeting of the **Association of Engineers Alumni**, of Liege, Belgium. The amended program is as follows: Sunday, June 18, opening of the Technical Exposition. Monday, Tuesday and Wednesday, June 19 to 21, meetings of the congress. Thursday, Friday and Saturday, June 22 to 24, technical excursions and visiting plants.

The annual autumn meeting of the **Institute of Metals** will be held at Swansea, Wales, on Sept. 20-22. A ballot for the election of members and students desirous of participating in this and other meetings of the institute will take place on July 13. Membership particulars can be obtained from the Secretary of the Institute of Metals, 38, Victoria St., S. W. 1., London, England.

MEN YOU SHOULD KNOW ABOUT

H. W. Turner is examining the Wilshire gold mine, in Inyo County, Cal.

George O. Argall, of Leadville, Col., is examining mines in northern Ontario.

W. A. Clark, president of the United Verde Copper Co., is to sail for Europe about May 30.

Edwin J. Collins has returned to Duluth from a three week examination trip in Montana.

Alfred James, who has been spending the last few weeks in Mexico, sailed today for London.

A. Chichester Macartney, who returned recently from Australia, is in San Francisco, Cal.

A. H. Jones, of Salt Lake City, is in Tonopah inspecting the Hudson mine, in which he is interested.

D. H. Bradney, Jr., returned to San Francisco from Nogales, Ariz., and left on May 1 for Parral, Mexico.

James A. Barr has just returned from inspecting mining claims near Wickenburg, Ariz. He also visited the mine and mills at Miami.

MEN YOU SHOULD KNOW ABOUT

(Continued)

A. C. Spencer is making [illegible] [illegible] in the caves of [illegible] [illegible] [illegible].

J. W. Purcell, director of the Mazapil Copper Co., has returned to Saltillo from London.

E. M. Spieker and J. D. Eby are soon to make an examination of the Wasatch Plateau coal fields.

T. A. Rickard delivered an address before the New Mexico School of Mines, at Socorro, on May 17.

W. C. Mansfield is examining sections of the Miocene formations of the coastal plain of Virginia.

C. E. **Siebenthal** is gathering information for the U. S. Geological Survey in the Joplin zinc district.

C. Colcock Jones left Los Angeles on May 1 for an extended visit in Mexico City and other parts of the republic.

S. F. **Shaw** is inspecting the Catasillas-Nazareno-Alicante properties at Conception del Oro, Zacatecas, Mexico.

The degree of L. L. D. was conferred upon **E. P. Mathewson** by McGill University in Montreal, Canada, on May 12.

G. R. Mansfield has been placed in charge of the section of the Geological Survey devoted to non-metalliferous deposits.

G. H. Shepherd has resumed the position of cyanide chemist and assayer for the Nugget Gold Mines, of Salmo, B. C., Canada.

W. T. Lee is continuing a study for the U. S. Geological Survey of the stratigraphy of the oil sands in southern Wyoming.

C. V. Jenkins has succeeded **William A. Paine**, of Boston, as director of Granby Consolidated Mining, Smelting & Power Co.

E. O. Ulrich and **R. D. Mesler** are in central Tennessee, studying Paleozoic stratigraphic problems of the Appalachian valley.

G. F. Loughlin, of the U. S. Geological Survey, is at Leadville completing details connected with the Leadville monograph.

A. F. Melcher will make a study of the porosity of oil sands in the Burbank field of Oklahoma, for the U. S. Geological Survey.

J. R. Woodul, assistant general manager of the American Smelting & Refining Co.'s smelting plants in Mexico, is now in Monterey.

Edgar Rickard sailed from New York on May 17 for Russia in his capacity as director general of the American Relief Association.

Thomas J. Jones, consulting engineer for the Russo Asiatic Consolidated Corporation, was recently in New York en route to San Francisco.

C. R. **Hosmer**, of Montreal, has been elected vice-president of the Consolidated Mining & Smelting Co., of Trail, B. C., to succeeded **George Sumner.**

J. S. Brown has been appointed Emmons Fellow at Columbia University for the ensuing year. He expects to prepare a dissertation on the graphite deposits of Alabama.

D. F. Hewett is looking into reported discoveries of oil near Fallon, Nev. While in the state he will make a study of the application of aluminum salts to certain soils.

C. Le Roy Olson, mill superintendent for the Kansas City-Nevada Consolidated Mines Co., which mill is successfully treating Broken Hills ore, was in Reno, Nev., recently.

H. C. George, petroleum engineer at the San Francisco Station of the U. S. Bureau of Mines, acompanied **H. Foster Bain** to Alaska to inspect the oil fields of that territory.

Wilbur Van Evera, general superintendent of the Hillcrest and Gordon mining companies, has returned to his duties at Crosby, Minn., following a trip to the eastern ore markets.

Percy E. Hopkins, of the Ontario Department of Mines, will examine the gold areas east of Kirkland Lake during the coming months, and will afterward investigate the Schreiber gold area.

J. T. Pardee, of the U. S. Geological Survey, will make a study of the Pleistocene and Tertiary deposits of the Columbia plateau of eastern Washington and the neighboring parts of Idaho.

Burton Bunch, who has been secretary of the Silver City, N. M., Chamber of Commerce since June, 1920, has resigned to become Western representative of the American Mining Congress. He will move to Salt Lake City.

T. M. Bains, assistant professor of metallurgy at the Missouri School of Mines and Metallurgy, at Rolla, Mo., has accepted a position as geologist with the Moctezuma Copper Co., Pilares de Macodari, Sonora, Mexico.

J. V. N. Dorr, president of the Dorr Co. in New York, will visit the principal European countries on a two months' business trip. He will make his headquarters at the offices of the Dorr Company at 16 South St., London, E. C., and will return to New York in July.

The name of **James M. Hyde**, so well known in connection with flotation litigation in recent years, was accidentally spelled "Heide" in several places in the news story announcing the agreement reached by Minerals Separation with the Butte & Superior and other mining companies which was published in the *Journal-Press* of May 6.

R. B. Ladoo, mineral technologist of the U. S. Bureau of Mines, has spent some weeks visiting feldspar mines and quarries in the Western states. Mr. Ladoo has been gathering data intended to make available to all producers information as to improved methods of quarrying and preparing feldspar for market, with special regard to economy of production and elimination of waste.

J. E. Lanning is leaving Warren, Ariz., having completed his work there as chief engineer for **H. Kenyon Burch**, consulting engineer of the concentrating department of the Phelps Dodge Corporation. Mr. Lanning is making a general tour of the copper camps of the Southwest before taking up new work. His temporary address is at 1315 Constance St., Los Angeles, Cal.

Dr. R. B. Moore, chief chemist of the U. S. Bureau of Mines, sailed on May 6 for Europe on an official visit to study the situations surrounding radium, rare metal, and rare gas developments. In addition he will make observations as to the potash and dye industries. Dr. Moore also carries credentials from the Chemical Warfare Service and will look into certain matters of chemical development in which that service is much interested. His itinerary includes London, Paris, Berlin, Prague, Vienna, and Lieden. He has accepted an invitation to deliver several lectures while in Prague.

N. M. Fenneman, professor of geology and geography of the University of Cincinnati, has been chosen as chairman of the division of geology and geography of the National Research Council. **R. T. Chamberlin**, professor of geology at the University of Chicago, was selected as vice-chairman of the division. **H. P. Little** continues as executive secretary. The newly elected executive committee consists of the chairman and vice-chairman; **Isaiah Bowman**, director of the American Geographical Society, New York; **Arthur L. Day**, director of the geophysical laboratory, Washington, D. C.; **R. A. F. Penrose, Jr.**, consulting geologist, Philadelphia; **E. B. Mathews**, professor of mineralogy and petrography, John Hopkins University; **David White, chief geologist of** the U. S. Geological Survey, and **D. W. Johnson**, professor of physiography, Columbia University. New members at large of the division are **Charles P. Berkey**, Columbia University; **E. W. Berry**, Johns Hopkins University; **R. O. Daly**, Harvard University, and **R. de C. Ward**, Harvard University. **Alfred C. Lane** and **W. H. Twenhofel** were designated as representatives of the Geological Society of America.

Mining and metallurgical engineers recently in San Francisco included: **V. S. Garbarini**, of Jackson, Cal.; **G. H. Garrey**, of Philadelphia, Pa.; **J. W. Neill** of Pasadena, Cal.; **Robert Linton**, of New York; and **W. J. Sharwood**, of Lead, S. D.

Mining and metallurgical engineers visiting New York City last week included: **K. H. Shilling**, of Berkeley, Cal.; **A. B. Shutts**, of Wilkes-Barre, Pa.; **F. E. Vaughan**, of San Francisco, Cal; **W. J. Reynolds**, of London, England; **C. E. Hart**, of Miami, Ariz.; **H. H. Hoppock**, of Joplin, Mo.; **David B. Rushmore**, of Schenectady, N. Y.; **Gerhard Henny**, of Amsterdam, Holland; **J. L. Schueler**, of Peoria, Ill.; **N. S. Greensfelder**, of Wilmington, Del.; and **N. H. Partridge**, of Los Angeles, Cal.

New Books

The Metre vs. the Foot

Metric System for Engineers. By Charles B. Clapham. E. P. Dutton & Co., New York. $6.

This book fills a long-felt want. It is, primarily, educative. No attempt is made to stimulate propaganda in favor of the compulsory adoption of the metric system, although a serious effort has been made by the author to present all the facts to the engineer in such a way that he is able, without further research, to form a logical conclusion as to the merits of the rival systems in use. One of the most interesting features of the book is a survey of the controversy that has arisen in this connection, in which the author demonstrates the complexity of the system of weights and measures in vogue in the United States and in the British Empire. To emphasize this, one need only be reminded of the awkward factors involved in a statement of length: 12, 3, 5½, 40, 8, 6, 66, and 80! Could fruitless labor be carried to such an extreme by any other conceivable method?

The idea of using the decimal basis for a system of weights and measures, we are told, originated with James Watt in 1783; a similar scheme, applied to money, was adopted in the United States in 1786. In both of the principal English-speaking countries the metric system is permitted by law, and various proposals have been made to insure its compulsory use. The author deals at length with the oft-expressed argument that this would entail a prohibitive expense; but he explains that "During the Great War many instances occurred of drastic changes being introduced . . . and being successfully carried through"—changes that, "had they been proposed in normal times, would have been denounced as quite unworkable and liable to result in the most awful consequences . . . It would appear," concludes Mr. Clapham, "that much of the opposition to the enforced use of the metric system is engendered (perhaps unconsciously) by mere conservative objection to change, supported by a false impression of the extent to which such change would operate. If such opposition be allowed to decide in any controversy, obviously all improvement and development is arrested."

The treatise under review, however, is essentially a textbook on the subject. The basic principle of the metric system is discussed, and the features of the various units are considered. Special attention is paid to measuring-tools, with particular reference to engineering work. Tables of the commoner engineering constants are supplemented by others for conversion to and from the units of the Anglo-American system; and examples are quoted showing the alterations needed in numerical constants when the metric system is substituted for the one now in use. Loose charts are provided to facilitate the conversion of the commoner compound measures; these may be mounted on cards.

The book will serve a distinctly useful purpose as a real attempt to disseminate accurate and reliable information, in a form that is in many respects novel, on the scope and characteristic features of the metric system of weights and measures. A. W. A.

Technical Papers

Resources of Tennessee—"The Administrative Report of the State Geologist for 1920," published as Bulletin No. 25 of the Tennessee Geological Survey, covers water-power development, the work of the soldier settlement board, education in natural resources and their development, chemical, geological and forestry work, and the status of publications. Brief notes are given on certain minerals studied during the period covered by the report. It includes also a discussion of oil and gas possibilities in Benton County, and a note on the occurrence of bentonite in Bedford County. The last seventeen pages describe the oil and gas areas throughout the state. Oil has been found in six counties, but has been marketed from Scott County only.

Mesabi Range Orebodies—The relations of the iron oxides to one another, and to the gangue minerals to a minor extent, are given consideration in a paper, "Paragenesis of the Martite Orebodies and Magnetites of the Mesabi Range," by John W. Gruner, which appeared in Vol. 17, No. 1, of *Economic Geology*, January-February, 1922, and is published in reprint form. The paper will be of interest to those concerned in the economic problems of the Mesabi Range. The fact that magnetite is the protore over the rich blue ore, over most, if not all, of the range, indicates that large magnetite bodies of low-grade are not confined to the east end of the Mesabi, but are present in other parts of it, though not accessible, on account of the glacial drift cover and oxidation of some of the magnetite in an erratic manner.

Mine Fire Fighting—The summary of a report of a fire which started on Aug. 17, 1920, in the No. 3 Sunnyside mine of the Utah Fuel Co., Carbon County, Utah, is given in Serial No. 2,325, *Reports of Investigations*, U. S. Bureau of Mines; "Fighting a Mine Fire With Its Own Gases," by C. A. Allen and A. C. Watts. The paper emphasizes the fact that depleted mine air is most effective in fighting a fire, especially in a pitching vein where the air can be easily controlled. A diagram, showing the organization of the forces used in the fire-fighting work, is given. The paper may be had on application to the Bureau at Washington, D. C.

Recent Patents

Elmore Process of Treating Lead and Zinc Ore—Canadian patent No. 217,900. F. E. Elmore, Boxmoor, Herts, England. Lead-zinc ore or concentrate is treated with sulphuric or other acid which converts the lead sulphide into a soluble compound without attacking the zinc. According to Claim 8, the process may consist "in heating one part of the ore with sulphuric acid adapted to evolve sulphur dioxide from the ore, and another part with sulphuric acid adapted to evolve sulphuretted hydrogen. . . . passing the gases evolved from the first part into the heated mixture of the second part and acid, dissolving the lead sulphate formed in each case with a solvent thereof which does not dissolve zinc sulphide, and separating the solutions from the undissolved matter."

Patent No. 217,901 covers the treatment of argentiferous lead-zinc sulphides by heating to a dull red, thereby leaving the zinc sulphide undecomposed, and extracting the lead by suitable solvents. Or the heated ore may be subjected to the acid brine process, and the argentiferous zinc sulphide thus obtained leached by an alkaline-earth chloride and hydrochloric acid, which extracts the silver, leaving the zinc sulphide undissolved. Claim 14 covers heating the ore with salt in the presence of air, thereby volatilizing the lead as chloride. The silver is extracted from the remaining zinc sulphide by means of a strong solution of magnesium chloride containing hydrochloric acid, not greatly in excess of that required to convert into chloride the quantity of lead present.

Treatment of Arsenic Ores—No. 1,406,597. E. W. Westcott, Niagara Falls, N. Y., assignor to Kalmus, Comstock, & Westcott, Inc., Boston, Mass. In treating arsenide ores and speiss, the powdered material is mixed with arseniferous hydrochloric acid from a later operation, the extracted ore chlorinated to furnish arsenious chloride and fixed chlorides, the arsenious chloride so produced hydrolyzed with water, and the hydrochloric-acid solution thereby produced returned for the first step. Patent No. 1,406,595 covers the treatment of arsenical cobalt or nickel ores containing iron by pulverizing and bringing them in contact with a current of chlorine, at a temperature not exceeding 600 deg. C., and removing the vapors of chlorides of arsenic and iron so produced. Patent No. 1,406,596 covers the apparatus for chloridizing arsenical ores with chlorine gas.

Sand-Washing Tank—No. 1,406,291. E. Shaw, El Paso, Tex., assignor to The Allen Cone Co., El Paso. A vessel for washing and settling sand, with means for removing the settled material through a discharge pipe under pressure from a jet nozzle.

THE MINING NEWS

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Leading Events

DEBATE ON THE TARIFF BILL in the Senate is marked by prolonged arguments over trivial clauses, with little headway being made. A storm of some intensity has been created by the placing of a duty on cyanide.

The strike situation at the coal mines is practically unchanged, without evidence of either side being disposed to yield.

Merger of the Lackawanna and Bethlehem Steel companies has been announced, these being the two largest independents.

Further details of the settlement of the flotation litigation between Minerals Separation and the Butte & Superior and other mining companies have come out and are given in this issue.

The control of the diamond industry of the world is discussed in this issue by W. A. Doman, our London correspondent.

Bethlehem Steel Co. Acquires Lackawanna Steel

Negotiations for Separate Merger of Six Other Independent Companies Still in Progress

Completion of negotiations for the merger of the Lackawanna Steel Co. with the Bethlehem Steel Co. was announced on May 11. Coming as it did when both of these companies were being spoken of in connection with the much-talked-of "seven-company merger" of independent steel companies, the news was a complete surprise. The terms of the merger have been agreed upon.

Elimination of these two companies in this fashion as probable entrants into the proposed merger with other independents leaves six companies whose consolidation is considered probable. These are the Brier Hill Steel, Inland Steel, Midvale Steel & Ordnance, Republic Iron & Steel companies, the Steel & Tube Co. of America, and the Youngstown Sheet & Tube Co. Meetings are being held by the representatives of these companies at the office of Kuhn, Loeb & Co., New York, at which terms are being discussed.

Mother Lode Coalition To Double Tonnage Milled

The Kennecott Copper Co. has made a new contract with the Mother Lode Coalition Mines Co. for five years, under which Kennecott will mill 12,000 tons of Mother Lode ore monthly, as compared with 6,000 tons under the old contract. Additional mill facilities to take care of this contract will be completed by Kennecott this fall.

The Mother Lode Coalition is now producing 2,000,000 lb. of copper a month at a cost of 6.7c. per lb. delivered.

Wage Decrease for Metallurgical Industry in France

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, May 12—A message from Lille states that the metallurgical industry in the Department of the Nord shows no improvement. The reduction of wages in Belgium facilitates competition from that quarter. French industrialists have therefore proposed a wage reduction of 25 centimes an hour, beginning June 6, and it is considered likely that the reduction will be accepted.

Call Freight Rates on Coal in Colorado Excessive

Charge Made by Operators Before Examiner of Interstate Commerce Commission

That freight rates on coal in Colorado are unduly excessive and discriminatory as compared with the Wyoming rates, and should be reduced at once, was the principal contention of the Colorado and New Mexico Coal Operators' Association at the public rate hearing before an examiner of the Interstate Commerce Commission which began in Denver on May 10, and adjourned the following Saturday.

At the hearings, which were held jointly with the Colorado Public Utilities Commission, testimony in support of the readjustment of intrastate rates was considered as well. The hearings were conducted by the Interstate Commerce Commission in connection with a general investigation of alleged discriminatory rates and possible changes throughout the Western states. It was stated that these investigations had no bearing upon the long-expected announcement of the commission regarding a general reduction of rates.

The Diamond Position

World's Supply Now Practically Controlled in London by Diamond Syndicate-Anglo American Corporation Pool

By W. A. Doman

London, May 5—I notice that a statement has been cabled to your side to the effect that there is today a complete "corner" in the world's rough diamonds, and that it is impossible for a single stone of that kind to be purchased direct anywhere in the world outside of two blocks of buildings, one on each side of Holborn Viaduct, in London. The statement is substantially correct, but not absolutely. It will doubtless be remembered in America that when the slump came in the diamond trade, the large South African producers and the London Diamond Syndicate made an agreement for what may be termed "mutual protection." Diamonds are a luxury, and many millions of pounds are invested in the trade. In the event of any weakness being exhibited, it is questionable if the strong position in which it now stands the world over could ever be restored.

Taking everything into consideration, it was decided at the conference of the producers and Syndicate (1) that the sale of diamonds must be controlled, which means that each producer limits his sale to a fixed proportion of the total, and avoids forcing diamonds on the market which cannot be absorbed; and (2) that the sale of diamonds must be carried out through one channel and organization. It may be said that a monopoly of the trade in rough diamonds has been in the hands of the London Diamond Syndicate for many years, but this selling "pool" did not embrace—nor does it now embrace—all the diamonds produced in the world, as suggested. A great step forward has, nevertheless, been taken, and relatively few stones are found that do not get into the hands of the "pool."

The question at the moment seems to be that of the Congo stones. The supply from the Congo at one time was bought by the largest diamond firm outside the Syndicate. Subsequently the Belgian authorities decided that the stones should be disposed of in Belgium for the benefit of the country's finances. At no time has the output of the Congo stones been large, and in normal years it had little or no influence on the sales of the Diamond Syndicate. It is only since the great slump that these stones—say 250,000 carats per annum—have proved a factor in the rough diamond market. As they are cheaply mined, they can, of course, be sold lower than Syndicate goods and still yield an excellent profit.

When there is no business passing worthy of the name, as has been the conditions for about two years, the disposal of these Congo diamonds at a relatively cheap rate is a disturbing influence, though no notice would have been taken of them had not the war caused a cessation of business. An arrangement has now been entered into by which the Congo company sells the bulk of its production or its best stones to the Anglo-American Corporation (in which the Morgan group is interested).

Negotiations are still in progress, and there is every probability that the whole of the output will in due course come under the control of the "pool." The Anglo-American Corporation has developed into a powerful institution, for it not only controls the main production of the Southwest Africa Protectorate (formerly German Southwest Africa), which is allotted 21 per cent of the value of diamonds sold, but also it controls the stones from British Guiana and from Brazil, with perhaps one insignificant exception. Virtually, therefore, all stones found in bulk gravitate to London, and by the working agreement subsisting between the Diamond Syndicate and the Anglo-American Corporation, what is almost a complete monopoly has been established. That there should be only one selling organization is greatly to the benefit of the diamond-mining industry.

Santa Fe Cuts Ore Rates in Silver City District

The Santa Fe R.R. has announced a reduction in ore rates from the Silver City, N. M., area, including Hurley, Santa Rita, Fierro, and Hanover, to El Paso, effective May 22, amounting to 47½c. a ton. The new rate is to be $1.15, against the present rate of $1.62½ a ton. At the same time a reduction of 2½c. a ton will be made in the rates from Santa Rita, Hanover, and Fierro to Hurley, the new rate being 10c., against 12½c. These reductions were announced through the Corporation Commission recently.

Granby's New Stock Taken

The Granby Consolidated Mining, Smelting & Power Co., of British Columbia, has announced that stockholders have subscribed to 30,000 shares of the new stock at $25 per share. The proceeds will be used to build a new dam, which will make it possible to use hydro-electric power for the entire year. It is estimated that the new development will save over $150,000 a year.

Freeport Sulphur Co. Resumes Work at Bryan Mound

The Freeport Sulphur Co., whose mine is at Bryan Mound, Brazoria County, Tex., has posted notices that mining operations will be resumed. The two steaming units on the south side of the mound will be placed in condition for immediate operation.

Mining operations at this property were stopped in April, 1921. Active work on the railroad to the Hoskins Mound sulphur deposit, recently leased from the Texas Company, has been started. The road will be completed by July 4, it is believed, and it is planned to have the steaming plant installed and mining under way in one year.

Bunker Hill & Sullivan Co. Takes Big Creek Mine

Through an agreement entered into between the Big Creek Mining Co. and the Bunker Hill & Sullivan Mining & Concentrating Co., of the Cœur d'Alene district, Idaho, the latter has taken over the operation and further development of the Big Creek mine. The Bunker Hill agrees to advance funds for the payment of all debts owed by the Big Creek company, aggregating about $100,000. The Bunker Hill takes over the entire control of all operations and development of the mine for five years, which, of course, includes the shipment of all ores from the mine to the Bunker Hill smelter, paying a royalty to the Big Creek company on all shipments, which will be applied to repaying of the cash advanced.

The Big Creek mine is a producer of high grade lead-silver ore, and it is expected that with the ample financial resources of the Bunker Hill back of it, together with its highly efficient operating staff, the property will be placed upon a profit-earning basis. In explaining the circumstances which made the temporary transfer of the property desirable, G. Scott Anderson, president and manager of Big Creek, said that the company had long been hampered by not having the necessary capital to develop the orebodies and that "the unexpected industrial conditions brought about by the war, with the high prices of material and supplies, the excessive cost of labor and its inefficiency, together with our determination to continue extensive development, has brought about a serious condition of indebtedness."

Penalties Waived in Settlement of Flotation Litigation

Six Mining Companies Involved Take Out Licenses—Royalties Range from 4c. to 12c. Per Ton

Terms of the settlement of the flotation litigation between Minerals Separation and the Butte & Superior and other Jackling properties, as well as the Miami Copper Co., include no claim for punitive damages, nor will such penalties be paid. The total amount that Mineral Separation will receive is placed at $4,800,000 of which $4,000,000 will be paid by the Jackling companies, including Butte & Superior, Utah Copper, Nevada Consolidated, Ray, and Chino, and $800,000 by the Miami Copper Co. Just what share of the $4,000,000 each of the Jackling companies will pay has not been divulged.

The damages include payment in full on the royalty scale for the total tonnages treated by flotation since the process was introduced. All of the companies have taken out licenses for the duration of the life of the two basic patents, one of which expires in 1923 and the other in 1927. Other patents owned by Minerals Separation run beyond 1927.

Royalties paid by the companies under their licenses range from 4c. to 12c. per ton, the minimum rate being obtainable only where 30,000 tons of ore is treated daily. Butte & Superior has taken out separate licenses for the treatment of zinc ore and copper ore respectively.

Two companies remain against whom suits were brought, but which were not included in the settlement.

United Verde May Resume

The United Verde Copper Co., of Jerome, Ariz., is considering resuming production in a small way. The plan at present is to start one reverberatory and one water-jacket furnace. The company is one of the few important operators now remaining shut down.

German Metal Firms To Take Austrian Magnesite

By Cable from Reuters to
"Engineering and Mining Journal-Press"

Berlin, May 12—According to the newspapers, a group of German metal firms have concluded an agreement with the Styrian Magnesite Industry Co., of Vienna, whereby the company's output of caustic magnesite is secured to Germany.

Secretary de la Huerta Coming

Secretary of Finance Adolfo de la Huerta expected to leave Mexico City on May 20 to attend the conference with international bankers in New York. The outcome will materially affect the mining and oil situation. The secretary in a conversation with the representative of the *Engineering and Mining Journal-Press* expressed optimism as to the outcome of the conference.

News from Washington

By PAUL WOOTON

Special Correspondent

Tariff Discussions of Trivial Nature Mark Senate Debate

Opposition Disclaims Intent to Delay Consideration of Measure—Removal of Cyanide from Free List Causes Storm; Alleged Such Course Would Aid German Producers

PROGRESS on the tariff continues to be painfully slow. With the Senate meeting an hour earlier and being held in session until late at night, more ground is being covered than during the first two weeks of the bill's consideration, but unless more speed is developed, the debate on the measure promises to be interminable. Senator Smoot, of Utah, believes that an organized filibuster is being conducted against the bill. "Days and even weeks," said Senator Smoot, in the course of debate, "have been spent upon rates, more than half of which do not contemplate a higher duty than 15 per cent ad valorem."

Five hours and forty minutes were consumed in the discussion of the five-line alcohol paragraph before the committee amendment was voted on. This is typical of the procedure on numerous other items which are by no means storm centers in the bill. "Senators on the other side," said Senator McCumber, who is in charge of the bill, "disclaim any purpose whatever to delay the consideration of this bill. They speak earnestly of their desire to facilitate its progress. They remind me of the poem of Kipling's bear, as they look at us and speak to us like a man in the attitude of prayer, professing their innocence of any intention to filibuster."

That the Republicans are not a unit in their support of the bill is becoming increasingly evident. Senator Borah boldly stated on the floor of the Senate that the facts at hand are insufficient upon which to base an intelligent tariff bill at this time. "I would vote unhesitatingly," he said, "to postpone consideration of the bill and to take care of the situation by a simple addition to the emergency tariff law. I do not know where we can get facts as to the cost of production abroad. I do not see how it is possible to secure them. The facts available today will be swept away utterly tomorrow, so that there are no facts upon which we can base an intelligent opinion. I do not believe it is possible to make a tariff law of permanent worth under such conditions."

The action of the finance committee in taking cyanide off the free list where it is in the bill passed by the House, has created a real storm. The Nevada Senators have attacked the item at every opportunity. In one of his latest utterances on the subject, Senator Pittman argued that the situation is such that the only protection that can be given the consumers of cyanide in this country is the continuance of cyanide on the free list. In that way, the American company manufacturing cyanide in Canada will be encouraged to continue its competition against the German and the English monopolies. He charges that the English and the German cyanide interests have entered into an agreement, whereby the British concern does not sell in the United States or in Mexico, and the German concern stays out of South America. He also points out that there is no hope from the Bucher process of making cyanide, stating that the Government proved the process to be unsuccessful during the war.

Senator Pittman continued his attack on the Roessler & Hasslacher Chemical Co. He referred to letters in the possession of the Alien Property Custodian purporting to show that the German interests today lack only eighty shares of possessing control. More than that, he expressed the opinion that some of the sales of stock made just prior to our entry into the war were fictitious. "The company was conceived in fraud by the Germans a long time ago," declared Senator Pittman on the floor of the Senate. "The whole business is underlaid with fraud. It is a trust not only in the United States but throughout the world—a combine between the British trust and the German trust."

"Cyanide is a product," continued Senator Pittman, "which is used by the farmers, by the prospectors, and by the miners. It is used by the people in the mining industry, who cannot pass the duty on to the consumer, because there is a fixed price for their product. Cyanide is not used by the great steel corporations, but manganese, which they do use, and which is the product of an industry which was developed during the war, goes on the free list.

"The game which this German company is playing is clear. If it can secure a tariff on this commodity, it will sell this product for less than the Cyanamid Company, of Canada, can sell it. It will continue to sell at lower and lower prices until the Canadian company is run out of business. Then it will bring the price up again. This duty is desired for the purpose of assisting in the crushing of the Cyanamid Company, which has come into competition with the Germans."

A. S. & R. Co. Loses Half-Million Suit to Government

Fails to Recover $512,515 on Account of Sale of Copper to Ordnance Department at 23½ Cents

The American Smelting & Refining Co. has lost its case against the Government for recovery of $512,515 on account of sale of copper to the Ordnance Department during the war. The company had a contract with the Government for delivery of copper at 23½c. a pound, made in March, 1918. Before deliveries were completed thereon the Government raised the price of copper to 26c. on June 1, 1918. The smelting company sought to obtain 26c. a pound for copper deliveries after this price advance. The Court of Claims ruled against its contention and the smelting company took the case to the Supreme Court. In a decision announced by the court by Justice Holmes, the decision of the Court of Claims was affirmed, although the court said there was doubt as to whether the company could sue the Government for damages arising out of the contract. Whether a claim for damages could be urged was not before the court.

Assessment Work Decision Made by Acting Secretary Finney

E. C. Finney, Acting Secretary of the Interior, has rendered a decision, in response to a request from Senator Bursum, of New Mexico, to the effect that assessment work upon mining claims located between Jan. 1 and July 1, 1921, must be performed prior to July 1, 1922. The decision follows:

" . . . The statutes (42 Stat., 186.) provide that the period within which work shall be performed 'shall commence at 12 o'clock meridian on the first day of July succeeding the date of location of such claims.' A further proviso is to the effect that in all such valid existing claims the annual period ending Dec. 31, 1921, shall continue to 12 o'clock noon, July 1, 1922. The latter proviso was designed, of course, to take care of existing claims and to give an extension of six months within which work might be performed thereon. One of the reasons for the latter proviso was to avoid having the year within which assessment work must be performed end at different times for different classes of claims. As to the first provision of law, it seems clear that it was intended to permanently change the time within which annual assessment work upon mining claims must be performed, so as to have the year begin and end with the first of July, instead of the first of January as heretofore. The requirement in the statute is that the year within which assessment work is required to be performed begins on the first day of July succeeding the date of location. Therefore, if a claim were located, say, in June, 1921, the year within which work was required to be done began on the next first of July, or July 1, 1921, and to avoid relocation must have been performed during the year beginning July 1, 1921, and ending July 1, 1922."

Mining Companies May Finance Salt River Project

In reporting a bill for fifty-year power leases on the Salt River reclamation project in Arizona, Representative Hayden, of Arizona, said it was probable that the Inspiration Consolidated Copper Co. and the Miami Copper Co. would finance development of the project if the legislation is passed. At present ten-year leases only are authorized.

Strike Situation Unchanged at Coal Mines

Federal intervention in the strike seems further away than it did a week ago. For a time stocks were being consumed so rapidly that it seemed inevitable that public inconvenience was about to result, with the necessary consequence of pressure for Government intervention. The demand for coal, however, has increased to the point where it is evident that most requirements are being met by current deliveries.

When the freight-rate decision is put into effect, it will be much easier to figure on wage rates. Thus far in the strike this factor alone has made for many uncertainties. With rates at the existing level, Illinois enjoys no small amount of tariff protection as against the East.

At the end of the sixth week of the strike it has practically faded out in so far as public interest is concerned.

News by Mining Districts

London Letter

Reorganized Champion Reef's Development Gives Poor Results—Waihi Profits Little from Record Footage

By W. A. Doman

London, May 2.—As the Champion Reef Gold Mines of India is a reconstruction of the Champion Reef Gold Mining Co. of India, the first report of the working is for three months only—the period ended Dec. 31 last. During that period relatively little development work was done. Work was mainly on the East Reef, which yielded only poor results. Operations on the 19, 21, 23, and 24 levels on this reef opened up unprofitable ore. The only point in the mine where encouragement was derived was at No. 46 level, where No. 3a winze has been sunk to a depth of 47 ft. The width of the reef is 2 ft., and the value improved, as sinking continued, from 7 dwt. to 2 oz. 14 dwt. These poor results naturally affected the ore reserves.

At Sept. 30 the tonnage was 232,477; the extraction was 39,470, leaving of the original reserves 193,007 tons, and the estimated tonnage at Dec. 31 was 221,946, so that the new ore brought into sight was 28,939 tons. The average grade of the ore milled was rather better than during the whole calendar year, being 8 dwt. 3¼ grains, in comparison with 7 dwt. 21 grains. The whole extraction from battery, tube mill, and cyanide was 96.87 per cent, or 0.13 per cent lower than the average of the year. In the cyanide works all-sliming was in use throughout the period.

A good deal of exploration work is being done in the upper levels of the mine, the intention being to remove all stoping ground above No. 8 level in the north part of the mine, with a view to abandoning Rowe's and Ribblesdale's shafts. Considerable attention is being paid to ventilation at depth, and this seems to be one reason why attention is being concentrated at present on the upper levels. Rock bursts have been frequent, the average for the three months being 5.8 per day.

Although the development footage at the Waihi during 1921 was 10,222 ft., the largest since 1916, the ore reserves did not benefit. It should be mentioned, however, that 5,436 ft. was in connection with the extraction of suspense ore. Last year the total ore developed was 74,965 tons. The reserves are stated in two parts—general account and suspense account. The suspense which is not immediately available is 254,737 tons, of a value of 38.8s. per ton, and the general account, in which a decrease of 96,705 tons has taken place, is 427,123 tons, assaying 31.37s., gold being taken at 84s. per oz. and silver at 2s.

Though there were no sensational developments in the mine last year, some encouraging disclosures were made on the Martha lode, which is the principal orebody. The width in places runs up to 66 ft., and the value throughout varies considerably. For instance, on the 12th level the first 38 ft. in the crosscut assayed 7s. 4d., the next 8 ft., 28s. 3d., and the last 20 ft., 8s. 2d. On the No. 9 level the Regina lode is 44 ft. wide, but apparently only 12 ft. are payable, showing an average of 36s. 9d. A new but small reef, called the Jellicoe reef, has been met with on Nos. 5 and 6 levels. As reefs occur in the Waihi, it is narrow, from 9 in. to 5 ft. along 242 ft., though values are high, ranging from 38s. 3d. to 381s.

RHODESIA

Mineral Output in South Increasing

By Reuters Agency

The British South Africa Co. announces the following mineral output from Southern Rhodesia during March. The number of producers is 156. Comparative figures are given for the preceding month and also for the corresponding month last year:

	March, 1922	February, 1922	March, 1921
Gold, oz........	54,643	51,422	31,995
Silver, oz.	14,376	14,404	10,083
Coal, tons.....	39,741	36,521	33,084
Chrome ore, tons	nil	nil	11,767
Copper, tons...	273	284	248
Asbestos, tons..	437	380	1,990
Arsenic, tons...	85	46	21
Mica, tons.....	1	1	8
Diamonds, carats	nil	10	21

Johannesburg Letter

African Vanadium & Lead Mines in Liquidation—May Vary Percent of Native Labor in Gold Mines According to Grade of Property

By John Watson

Johannesburg, April 4.—The African Vanadium & Lead Mines, Ltd., which was floated a few years ago, to work deposits in the Zeerust district, is now in liquidation. The mining rights, also the machinery and plant, were offered for sale by auction on March 29.

The personnel of the Industrial Commission for the Transvaal was announced by the Premier, General Smuts, in the House of Assembly at Cape Town on March 28, as follows: Sir William Solomon, chairman; Sir Robert Kotze, Sir Carruthers Beattie, and William Brace. The three first named are well-known South Africans, and Mr. Brace is Labor Adviser to the British Ministry of Labor, and was for many years a miners' leader and Member of Parliament in the coal field of South Wales. The terms of reference include:

"The effect and extent of the *status quo* agreement on the gold mines and the necessity for its continuance, variation or abolition, and the desirability or otherwise of establishing another system for regulating the ratio of Europeans to natives on the gold mines.

"The methods to be adopted by the industry to effect economies, to promote efficiency, and secure the maximum field for employment of Europeans.

"The possibility of classifying gold mines into two or more grades which may employ different ratios or practice different systems of wages and overhead charges, and the establishment of machinery for effecting and controlling such classification.

"The recent strike in the coal industry, the Victoria Falls Power Co., and to make recommendations as to the points at issue."

The gold output of southern Rhodesia for February was announced last week and shows a total output of [illegible] of the value of [illegible] a decrease of £119 [illegible] January. [illegible] 88,144 oz. and [illegible] 81,771 oz.

The Frank shaft of the [illegible] in the [illegible] Coal [illegible] on March 29. Another shaft [illegible] obtained. Results will [illegible] a month, during which time the mill will crush ore from the surface dumps. The profits should not be materially affected.

In moving the second reading of the Indemnity Bill, on March 31, the Premier gave the figures of arms captured by the Union forces in the recent Witwatersrand revolution: one machine gun; 1,150 rifles; 231 shot-guns; 745 revolvers, and about 61,000 rounds of ammunition. The Government casualties (police, active citizen force and burghers) were approximately 50 killed; 237 wounded. European casualties, including both revolutionaries and peaceful citizens, were: Killed and died of wounds, 138; wounded, 287. Colored people (natives and Indians): Killed, 31; wounded, 67.

BULGARIA AND SERBIA

Mill for Plakonitza Copper Mine; Smelting Practice To Be Changed —Bor Mine Shut Down

From Our Special Correspondent

At the Plakonitza copper mine, in northwest Bulgaria, which has been operating an 100-ton smelter for the last ten years on 6-per cent copper ore at Elisena, it is planned to change from blast furnace to reverberatory and to build a concentrator to treat the lower-grade ore. These changes are the result of post-war troubles.

Up to the beginning of the 1918 "peace," an outside coke supply had always been easily obtained. After the war it was for a long time impossible to get coke from England or the United States and Germany was prevented from supplying it.

The Berlin to Bagdad railroad which reached its highest state of efficiency during the war, so that the *Balkan Zug* was operated from Constantinople to Berlin in fifty-six hours, at the close of the war was changed into a Constantinople-to-Paris system, with the "Oriente Express" nowhere making over half the speed of the German express. In 1920-21 the schedule allowed twenty-four hours from Constantinople to Sofia, and twenty-four from Sofia to Belgrade. North of Belgrade the former trunk line to Budapest, Vienna, and Berlin was disorganized into a [illegible] rate branch line service over which it was impossible to get freight. On the diverted route it required another twenty-four hours to travel from Belgrade to Trieste, or seventy-two [illegible] from Constantinople to Trieste, against the former fifty-six hours from [illegible]tinople clear to Berlin.

After using up the abundant supply of [illegible]an coke left at the mine at the time of the Armistice, the Plakonitza smelter had to close down.

Coking coal outcrops in Bulgaria in a rather inaccessible locality, over a belt forty miles long, in moderately narrow veins at steep angles from the horizontal. Crude ovens were built and about fifteen tons of coke per day was produced from this source.

Later, as Serbia found it impossible to pay French-English-American prices compared with the German, the boycott was lifted to some extent, and traffic became somewhat better organized north of Belgrade.

During the war the smelter was operated to capacity on the highest grade ore the mine could produce without regard to maintaining ore reserves. In other words, the mine was "gutted" to supply the crying need for copper. Although satisfactory reserves of smelting ore have since been developed, and coke can at present be obtained from all former sources of supply, the attention of the management was so forceably called to the advisability of concentrator and reverberatory that the improvements mentioned will be made.

The mine is an old Roman *antigua*, which was opened up in 1908. Some rich ore was shipped before the smelter was built. Between this mine and the Bor mine, across the line in Serbia, there is an interesting belt of old *antiguas* where a large copper-silver production could probably be developed today.

Most of the mines of Bulgaria have not been worked since the Romans fled the country at the time of the Gothic invasions in the fifth century. This area is particularly interesting from the fact that the Saxons came in and did considerable mining in the sixteenth century, until trouble with the Turks caused them to leave the country. Many of the present villages are built on old slag dumps as the most convenient level site in a mountainous country.

The Bor mine, in eastern Serbia, which has operated a 300-ton smelter on 6 per cent copper ore for the last ten years and has been a profitable undertaking, has recently been closed down because of adverse legislation. The government economists reasoned as follows: Copper production has always been exported; manufactured copper articles are imported; this is a mistake. Their method of righting the mistake was to put a prohibitive export tax on copper. Coming at a time when the copper mining business was not particularly prosperous anywhere, this proved to be the last straw which broke the camel's back, and the mine closed down. The threat of the government to take over the mine has availed nothing, and both parties are at loggerheads.

The measure of adverse legislation in Serbia which first comes to the attention of the American visitor is the $10 fee charge to "Americans only" every time they want to cross the Serbian line, either in or out, whereas the citizen of Germany or any other country in the world goes in and out for about $2—this in spite of the announcement made a little over a year ago that an "open season" on Americans would no longer be enforced in foreign countries after the present administration came into power at Washington.

AUSTRALIA

Queensland

"Diviners" Predictions as to Silver-Lead Mining Near Brisbane Fail—State Arsenic Mine Resumes

From Our Special Correspondent

Brisbane, April 16.—The reduced prices of silver and lead have detrimentally affected silver-lead mining in the suburbs of Brisbane, where there was such a spurt in this direction a year or so ago. One mine only remains operative. Last year the company now named Finney's Hill United, continuously stoping the rich carbonates on the original holding, produced 234 tons of hand-picked ore, containing from 40 to 46 per cent of lead and 60 oz. of silver per ton. The probable ore remaining in the rich shoot in this mine is estimated to amount to 22,500 tons, having contents not exceeding 15 per cent of lead and 24 oz. of silver per ton. The workings have reached a depth of nearly 200 ft. None of the predictions of the "diviners" on whose advice several shafts have been sunk have been verified.

Attributable to the unsatisfactory state of the world's markets, there was a big decline in Queensland's mineral production last year, and at present there are no signs of improvement. Coal held its own better than any other branch of the mining industry, and there was only a small falling off in the production of gems. In the official returns for the year, just published, cobalt makes its appearance for the first time, 500 tons having been shipped to England from the rich mine opened up in the Cloncurry district. It is uncertain whether the whole of this has been sold, and the price realized has not been disclosed. The owners, however, are erecting a costly crushing and concentrating plant, which is expected to be ready soon. The mine, in which the workings have reached a depth of 112 ft., is reported to be developing well, and much ore has been stacked on the surface ready for treatment.

The State arsenic mine, at which production has been suspended since August last owing to supply having exceeded the demand, has again been put in operation. This mine and its treatment works were initiated mainly to encourage the destruction of prickly pear, which has become a devastating pest in Queensland, and for this purpose arsenic is supplied to the public at £10 per ton. It has been sold for other purposes at prices ranging from £23 to £50 per ton; the cost of production and transporting it to a market has been £49:7:10. While the government has been selling the product at the prices mentioned, the London ruling quotations have been about £60 per ton.

NORWAY

Sulitjelma Company Took Loss in 1921

Kristiania—The operations of the Sulitjelma copper mining company during 1921 showed a loss of 116,000 kroner. It is rumored that the directors may propose writing down assets by 5,240,000 kroner.

BURMA

Burma Corporation Cuts High Grade

Bawdwin.—The Burma Corporation cut high-grade ore on April 27 in its seventh level crosscut after passing through low-grade ore. Twelve feet of ore was cut running 40 oz. silver, 40 per cent lead, and 18 per cent zinc, this not being the full section of the orebody.

MEXICO

A. S. & R. to Begin Development of Coal Lands in Coahuila

Mexico City—Aside from an attempt to get a more favorable railway rate for metals from the roads controlled by the federal government, apparently the representatives of the American Smelting & Refining Co., who recently spent some time in Mexico City, had their eye on the coal business.

The Department of Commerce and Labor has stated officially that, within the next ninety days, the A. S. & R. Co. will begin development of its Coahuila coal properties on a large scale. Not only are the fields to be developed to their capacity, but a model city for workmen will be laid out at Rosita, one of the principal centers.

There are three well-developed coal basins in the State of Coahuila—the Fuente, with an area of about 12,350 acres and parallel to a similar deposit which is being worked in the vicinities of Eagle Pass and Laredo; the Sabinas basin, covering about 400,000 acres; and the Esperanza basin, which contains about the same amount. The total production is something under 1,000,000 tons a year, which falls far short of filling the local demand, so that consumers in Mexico are obliged to rely on imports of American and British coal, principally the latter.

It is understood that favorable reductions in haulage rates for metals and coal were granted the American Smelting & Refining Co., conditioned on the above large expenditures and improvements for the betterment of the conditions of the working classes.

According to the Department of Finance, mining conditions in Mexico, and with reference to silver in particular, are improving. This statement does not appear to be based particularly on the recent sharp advance in the price of silver, as those financially heavy in the game pay little attention to the rise and fall of the metal, but are working and planning along broader lines for the future. Improvement in local conditions—that is, safety, railway-rate reductions (promised)—and a gradual return to normalcy in wages and general working status may safely be assumed as the basis for a part of the optimism expressed. The other portion is inherited.

There appears to be an impression that under the presidential decree of March 6, this year, dealing with back mining taxes, taxes in arrears are forgiven, which is not the fact. A careful perusal of the decree shows that payment of back taxes is made "easy" and that even in cases of forfeited titles, these may be recovered, provided no new denouncements have been accepted.

Durango

Los Reyes Property Redenounced—Many Settle Back Taxes

By Alberto Terrones Benítez

Santiago Papasquiaro District.—W. B. Hosmer has just returned from the Tahuehueto mines, not far from Topia, where he prospected for a few weeks. Homer C. Coen has denounced the properties formerly owned by the old Tahuehueto company. These are old mines or *antiguas* famous for their bonanzas many years ago. Large quantities of low-grade ores were reported when the old company shut down. All the mines are caved.

The Candelaria (Pirindongo) mine, at Metatitos, not far from Tahuehueto, has been worked by *gambuzinos* under Víctor Gamboa. They have been shipping ore to Tepehuanes.

Tamazula District.—The Topia camp remains idle. A few American engineers have been examining mines recently, but so far there is no indication that activity will be resumed soon.

The old Los Reyes mines have been lost by the Cía. Minera de Mina Grande y Anexas for failure to pay its mining taxes. The mines, which cover an area of 110 pertenencias, have been redenounced by Gen. Jesus Agustín Castro, and patent will be issued to him within the next four months. The mines are said to contain a large tonnage of milling ore.

Durango District.—The decree remitting all penalties for failure to pay taxes on mining claims is still in force, and many people have settled with the Federal Government. This decree will be in force until June 30, 1922.

Two geologists of the National Geological Institute of Mexico City have arrived in Durango City for the purpose of making a geological survey of the country surrounding the Iron Mountain (Cerro de Mercado), in connection with studies that have been undertaken to determine the nature and depth of the deposits. Leopoldo Salazar Salinas, chief geologist of the institute, will superintend the work.

Senate Puts Duty on Arsenic

Duties on arsenic as recommended by the Senate Finance Committee were adopted in the tariff bill by the Senate, but notice was given by Senator Jones, of New Mexico, that he would later seek to have these products placed on the free list.

CANADA

British Columbia

Standard Silver-Lead Meeting Adjourned

Silverton—The annual meeting of the Standard Silver-Lead Mining Co., held at the head office of the company in Spokane early in May, was adjourned to May 22 after re-election of directors. It is known that the main thing to be considered at the adjourned meeting is the policy to be pursued by the company with regard to the acquisition of at least one and possibly two properties, with a view to their development and operation.

Sandon—Snowslides have been unusually numerous in the Slocan this spring, with some damage to mining property. An outstanding instance was the partial destruction of the Queen Bess tramway and some damage to the compressor of the Rambler-Cariboo mines.

Trail—Ore shipments received at the Consolidated smelter May 1 to 7 inclusive totaled 7,944 tons. Shippers were: Florence (lead), Princess Creek, B. C., 32; Molly Hughes (lead), New Denver, B. C., 15; Paradise (lead), Lake Windermere, B. C., 48; Silversmith (lead), Sandon, B. C., 76; Black Rock (zinc), Northport, Wash., 43; Standard (zinc), Silverton, B. C., 127; and company mines, 7,603.

Stewart—The Premier Gold Mining Co.'s tramway was shut down for three days recently while repairs were being made to the driving gear. During the first four months in the year the tramway conveyed approximately 25,000 tons of ore and concentrate from the mine to Stewart. During 1919 only 488 tons of ore was shipped from the mine and only 799 in 1920, despite the fact that about fifty horses and two five-ton tractors were employed.

Usk—The Kitsalas Mountain Copper Co. has made financial arrangements for the continuation of the development of its property, and two shifts have been started on the driving of the tunnel that was begun last fall.

IDAHO

Cœur d'Alene Mine Profits in 1921—Lookout Mountain Begins Shipping

By Alfred J. Dunn

Wallace—In conformity with the Idaho law, statements have been filed by productive mines of the Cœur d'Alene district covering details of operation and net profits for 1921. The showing is lean compared with that of previous years, owing to the total suspension of several large producers and to the low price of lead, together with high mining costs. The Federal Mining & Smelting Co. (Morning mine) reports a net profit of $299,651, compared with $568,072 in 1920; Sierra Nevada, $90,527, compared with $99,765 in 1920; Caledonia, $94,799, compared with $223,371 in 1920; Hecla, $655,530, compared with $1,093,602 in 1920; Bunker Hill & Sullivan, $676.263.

compared with $2,593,089 in 1920. The Callahan and the Hunter were closed down throughout the year, and the Hercules and Tamarack were active only the first three months. In 1920 the Callahan reported profits of $268,746; Hunter, $115,8[illegible]; Hercules, $1,147,706; Tamarack, $169,371.

The Lookout Mountain Mining Co. is now shipping, the ore being hauled to the Bunker Hill smelter, a distance of eight miles. Practically all the stock is owned by Kellogg people, who through the slow process of small assessments have developed a rich body of lead-silver ore. Unusual interest attaches to the property, on account of the fact that it is situated in the heart of the Pine Creek section, where zinc predominates, though Lookout Mountain shows no evidence of that metal. The oreshoot has been developed for a length of about 300 ft. and at about the same depth from the surface. The ore is in the form of lead carbonate, sulphide and sulphate, this being the first time sulphate has been found in this district in commercial quantity. A cable tramway 2,200 ft. long takes the ore from mine to loading station. Much of the ore is hand sorted, the lower grade being reduced by three hand jigs. The shipping product averages from 50 to 60 per cent lead and from 20 to 30 oz. in silver.

WASHINGTON

Old Dominion Silver Shipments Expected to Net Well

Colville—Shipment of two cars from the Old Dominion mine made this month, will, it is anticipated, establish a record for high-grade silver ore shipped by any mine in Washington. The ore will net about $80,000 for the two lots. It has been mined from the strike of high-grade ore made in the lower workings last fall.

Republic—A larger hoist is being installed at the Knob Hill mine, and underground development will be resumed. California capital became interested in the property last winter, buying the old company out.

MONTANA

Anaconda Now Operating Thirteen Mines

Butte—No arrangements have been made by the Anaconda company to open up additional mines. Though there have been increasing numbers of miners returning to Butte recently, who have been given employment, they have been distributed around the properties already in operation. At present Anaconda has thirteen mines in full operation, employing about 8,000 men in all departments.

Development work being carried on by the East Butte company on the 1,800 level has resulted in the uncovering of a new orebody, it is announced. The first-class ore runs between 7 and 8 per cent copper, and the second class is reported to be between 3½ and 4 per cent.

CALIFORNIA

Gold Dredging at Oroville Nearing Finish—Mispah Strike in Rand District Causes Rush

San Francisco Correspondence.

San Francisco—Romance never dies among miners. Certain parties are preparing, according to a Bridgeport report, to recover gold and platinum from the waters of Mono Lake. Mono Lake is about twelve miles in diameter, and there is certainly enough raw material to feed the proposed activities for a while.

Oroville gold-dredging operations are drawing to a close. The Natomas company will finish its ground this year, and the American Gold Dredging Co. will finish its ground in two years. About ten years ago, forty dredges are said to have operated in the district.

Reports from Johannesburg, in the Rand district, California, indicate that the strike made upon the Mispah at a depth of 110 ft. is of more than ordinary importance. A rush has started to the vicinity, the Mispah being approximately one and one-half miles south of Johannesburg and between that camp and the California Rand property.

The three largest producing gold mines operating in California are the Carson Hill, the Empire, and the Argonaut. New ground is being opened up in the Argonaut at an approximate depth of 4,000 ft.

The Peabody ranch mine, at Jackson Gate, idle since 1861, has been reopened, and preparations are being made to drift upon the vein discovered in the old workings.

The Columbia Marble Co. is shipping a carload of marble per day from its quarry near Sonora. An air compressor is being installed to operate drills and channeling machines. Thirty-two men are employed.

At Georgetown, El Dorado County, J. B. Kelleher and others, of Sacramento, are preparing to operate the Gold Bug property, on Canyon Creek.

NEVADA

New Freight Rate to Smelters Effective Soon—Tonopah Divide's Shaft Down 1,430 Ft.

From Our Special Correspondent

Virginia City—As reported last week, all work was stopped by the Paramount Comstock Company in the Middle Mines on May 3. No information has been given out, and there is much local speculation regarding the reason. It is considered that the most promising ground, at least to the north, was yet to be prospected. It is said that the north drift is out 888 ft. from the Hale and Norcross tunnel, at approximately which point the bonanza stopes were opened in the Savage mine. The south drift is stated to be out 764 ft. from the tunnel in Chollar ground. The company has already spent about $100,000 in equipment and development.

Carson City.—The Southern Pacific R.R. Co. has notified the P. S. C. that a new rate schedule on ore from Nevada points to Utah and California smelters will be put into effect as soon as possible. The Eureka Nevada R. R. is known to be considering a reduction in rates on ore and mine supplies, between Eureka and Palisade, amounting to approximately 30 per cent, to take effect July 1.

Tonopah.—Bullion shipments for the last half of April were as follows: Tonopah Belmont, $125,600, West End, $94,800; Tonopah Extension, $70,700; Tonopah Mining, $60,000. This makes the total bullion production for April about $650,000. The West End produced 9,600 tons of ore during April, which is a new high record for this company. The largest previous tonnage was in March, 8,400 tons. The West End is milling ore at its own and MacNamara plants, and in addition shipping to the Millers plant of the Tonopah Mining Co.

Divide.—The main shaft of the Tonopah Divide Mining Co. has reached a depth of 1,430 ft. A station is being cut at the 1,400-ft. point and a crosscut will be driven to the vein, about 140 ft. Slight water seepage is noticeable at the 1,400 and it is considered probable that a water flow will be met when the vein is cut. Shipments to the Belmont mill continue at the rate of over fifty tons daily.

Goldfield.—The Silver Pick lease in the Red Top mine shipped four cars of ore during April which averaged over $70 per ton. From reports it appears that the ore is exceedingly hard to follow and that development work to date has not been altogether satisfactory. The ore is not exhausted, however. Two cars were shipped May 6, with more to follow.

Unionville.—The Silver Reef has levied an assessment of 2c. per share on its capital stock. Development of the mine will be continued, and as much ore will be shipped to the Arizona mill as the plant will take. The ore is valued at $13.80 per ton.

Pioche—Officials of the Dixie Power Co. are considering running a power line from Enterprise, Utah, to Pioche, Nev. The principal users of power at present are the Bristol Silver Mines Co., the Black Metals Co., and the Combined Metals. These companies are all controlled by the Snyder interests, of Salt Lake City, and are using about 500 hp. Smaller operators swell this amount to about 800 hp. Should the Prince Consolidated put its development plan through, at a meeting on this matter which was called for May 15, a further 500 hp. could be used.

Shipments from the district for the week ended May 11 were: Combined Metals, 245 tons; Bristol, 210; Black Metals, 100, and Mendha, 45.

Ely—Operations recently begun at both mill and smelter of the Nevada Consolidated, at McGill are proceeding satisfactorily, with a gradually increasing force employed.

UTAH

Assessed Valuation of Mining Property Less This Year

From Our Special Correspondent

Salt Lake City—The assessed valuation of Utah mining property fixed by the State Board of Equalization for this year is $48,003,583, compared with $61,290,470, last year, the first figures being subject to change at public hearings, should mining companies protest. The value of the mineral content of metalliferous mines in the state is fixed at three times the net proceeds, and the falling off in the net proceeds of these mines more than accounts for the decreased valuation. Last year the value of such mineral contents was assessed at $21,095,016, compared with $6,987,723 this year.

Bingham—The number of steam shovels being worked by Utah Copper has been increased to seven, and production is at the rate of 200 cars a day. The Utah Apex and the Utah Consolidated are adding to their forces.

Saint George—Work is being done by the Silver Reef Consolidated Mines Co., which has taken in a number of properties covering a large area. There is stated to be much ore developed, and preparations are being made to build a mill. The ore occurs in sandstone. The district in early days had a gross production of high-grade silver ore of an estimated value of $7,500,000.

Eureka—The Iron Blossom, operating under the leasing system, is shipping to the Tintic Milling Co. at Silver City and producing higher-grade ore also. Earnings are stated to be in excess of the quarterly dividend requirement of $25,000. There are thirty-five to forty machine drills in use, and more have been ordered, with other equipment.

The Sioux mine is being reopened by lessees, who expect to ship to the Tintic Millings Co.'s plant at Silver City.

COLORADO

New Placer Mining Company Organized—State Lands Yield $60,000 to School Fund — Leadville Has New Enterprise

From Our Special Correspondent

Glenwood Springs—A company composed of local people has been organized to operate on placer ground along the Colorado River extending from the Grand County line to the Burns Hole country. The old river bed carries a black sand in which is found the light flaky gold, the successful recovery of which has baffled the prospector and miner for the last forty years. The ground will be worked by hydraulics, jigs, and concentrators, and the product shipped to the smelter. Much of the equipment is already on the ground, and the company expects to be in full operation early in the summer.

Denver—More than $60,000 has recently been paid into the state school fund in the form of rentals and leases on school lands in Colorado, according to the superintendent of mineral lands of the State Board of Land Commissioners. Over 250,000 acres of land have been under oil leases, and thirty-six drilling rigs have been in operation on and adjacent to state lands in the various counties of the state. The superintendent declared that Colorado was now in the midst of an era of oil and gas prospecting, and that every reasonable inducement was being offered to encourage the development of state lands.

Leadville—Among the new enterprises which mark a decided revival of mining activity in this district is the recently incorporated South Ibex Mines Co. The company is officered by a group of the most prominent operators in Leadville, and is financed by St. Louis capital. The company has taken over the old Garbut mine, on Breece Hill, and will at once begin the sinking of a shaft south of the old opening. It is understood that it will employ about 100 men.

Cripple Creek—The Rose Nicol is advancing development work on the tenth level in the south heading, and producing ore from this territory on company account. In addition, six sets of lessees are operating in other parts of the mine. Shipments are being made to the Golden Cycle mill.

NEW MEXICO

Deadwood Mine, at Mogollon, Transferred—Hanover Bessemer Co. Resumes

Silver City—The Sinaloa Exploration & Development Co. has taken over the Deadwood and other mines owned by Cleveland and Weatherhead in the Mogollon district. It is preparing to work these properties, and is shipping supplies from Silver City.

Mogollon has suffered more from the general depression than many other districts, owing to its remoteness from the railroad, being eighty miles from Silver City, the nearest station.

Increased orders for manganese ore from the Boston Hill properties in Silver City have brought the daily tonnage up to between 300 and 400, which is being shipped to the Colorado Fuel & Iron Co. at Pueblo. Operations were started a few weeks ago with a force of about fifty men, producing 100 to 150 tons a day.

The Hanover Bessemer Coal & Iron Co. at Fierro has resumed, and is shipping to Pueblo on a schedule calling for 15,000 tons a month. The force has now reached nearly 100. L. M. Kniffin has returned to take charge.

A car-load of silver ore was shipped recently from the old Lone Mountain district by Stauber & Wright. The ore on the claims worked by Stauber & Wright is in blanket formation and, it is said, will not be difficult to mine if it proves to be profitable. The property is being worked under lease and is the land owned by Clark Rogers and the estate of W. H. Newcomb, which was at one time worked by John Brockman.

MINNESOTA

Mesabi Range

Increasing Activity Reported—Wages Raised at Elba and Wisstar Mines

Chisholm—The Dunwoody open pit, operated by the Tod Stambaugh Co., has started one shovel on stripping and anticipates the operation of a second one soon.

The Oliver Iron Mining Co. has increased the number of shifts at its Chisholm and Clark mines from two to three.

Nashwauk—Stripping at the Hawkins mine, operated by the Wisconsin State Steel Co., has again been resumed. It is expected that ore operations will start soon.

Marble—Ore loading at the Hill-Trumbull open pit has been started by the Cleveland-Cliffs Iron Co. The concentrate ore has also started on a one-shift basis of ten hours, with expectations of increasing to two shifts soon. Stripping operations by A. Guthrie & Co. will be continued at this property.

Eveleth—All underground work in this locality being conducted by the Oliver Company is to be placed on full time. About 200 men, who have been working only half time, will now go on full time.

Buhl—The large electric drag line operated by the M. A. Hanna Ore Co. at the Wabigon open pit has again resumed work. The shovel has taken one complete cut in the pit, in addition to the recasting of dirt from this first cut, and is now taking its second cut.

McKinley—An announcement has been made by the Pickands-Mather Co. that wages for common labor at the Elba mine will be raised from $2.75 to $3.25. A similar announcement has been made by Clement K. Quinn Co., effecting the employees at the Wisstar mine.

Cuyuna Range

Range Operations Now About Half Normal

Ironton—The first two weeks in May witnessed a marked improvement in the mining industry of this range. Following the opening up of the Kennedy mine, at Cuyuna, late in April, three more properties resumed active mining, with good promise for an active season. The Mahnomen mine here, operated by Clement K. Quinn & Co., is shipping ore, and expects to produce a large output this season. The Armour No. 2 mine (Inland Steel Co.) and the Portsmouth mine (Gordon Mining Co.), both at Crosby, also resumed mining early this month. The Armour is the largest underground property in the district and will employ normally more than 200 men. The Portsmouth is an open-pit mine, producing both straight iron and manganiferous iron ore.

The range is now back to about 50 per cent operation as regards the number of mines working, and is considerably above 50 per cent normal in the capacity of mines working.

THE MARKET REPORT

Daily Prices of Metals

May	Copper N. Y. net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
[illegible]	12.75@12.875	[illegible]	[illegible]	5.25@5.35	5.15	5.05
[illegible]	12.875	29.875	30.625	5.25@5.40	5.15@5.20	5.05@5.10
[illegible]	12.875@13.00	29.875	30.75	5.25@5.40	5.15@5.20	5.10
[illegible]	13.00	30.00	30.75	5.25@5.45	5.20	5.125
[illegible]	13.00	29.875	30.625	5.35@5.50	5.20@5.35	5.125
[illegible]	13.00	29.875	30.75	5.35@5.50	5.25@5.35	5.125

*These prices correspond to the following quotations for copper delivered. May [illegible] 13.25c., 15th to 17th inc., 13.25c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

May	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
11	[illegible]	[illegible]	65½	[illegible]	150	24¼	23¼	27	27
12	[illegible]	[illegible]	65½	[illegible]	150⅞	24⅛	23	27	27
13	...	...	...	...	....	...	...	...	...
15	[illegible]	[illegible]	66	149¼	150¾	24	23	27	27
16	60½	60⅞	[illegible]	148¼	149¾	24	22¾	26⅞	26¾
17	61	61½	[illegible]	148¾	150	24	22⅞	27	26⅞

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

May	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	May	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
11	[illegible]	99⅝	70⅜	[illegible]	15	444¼	99⅝	72⅛	36⅜
12	[illegible]	99⅝	[illegible]	35½	16	444¼	99⅝	72¼	36⅜
13	444¼	99⅝	70⅞	35⅞	17	444¼	99⅝	72¾	36½

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, May 17, 1922

Prices of all the non-ferrous metals with the exception of tin have shown increased strength during the last week.

Copper

Some producers report an excellent business, with current production well sold up, while others have remained somewhat above the market or have been disinclined to quote at all except for forward deliveries. Sales as a whole have probably been somewhat in excess of those of the previous week, one particularly large order for delivery well into next year being closed yesterday. Demand has been well distributed. Today two or three producers still have copper available for delivery within the next three months for 13.25c. delivered, but most producers have gone to 13⅜c. So far, only an occasional carload has been sold at the higher level, but all producers are optimistic, and it would not be surprising to find business at that price reach fair proportions within the next two or three days. Stocks of refined copper available for delivery into domestic consumption are rapidly approaching normal proportions, and if demand continues to pick up as it promises to do, a pinch may be felt before any considerable volume of production can be expected from the porphyries. Sales now are largely for forward delivery in July and August, and it would not be at all surprising if the early fall demand would be largely for near-by metal. The position of copper now looks much better than it did two or three months ago, when the resumption of the porphyries seemed premature to some.

Export business has been fair through the week at 13⅜c. c.i.f., European ports for the most part.

Lead

The official contract price of the American Smelting & Refining Co. was raised from 5.25 to 5.35c., New York, on Tuesday, May 16.

Sales of lead have not been large, but scanty supplies, particularly of prompt metal, have resulted in advancing prices. Since the advance by the Smelting company yesterday, lead has been generally quoted at 5.35c., St. Louis and 5.50c., New York, by those having May-June metal for sale, but some actual sales have been made at slightly under these quotations. Many inquiries for July-August metal have been in evidence in the last few days, consumers evidently not wishing to take chances on the forward market. Most producers, however, are not inclined to sell past June, though some average-price contracts have been offered. These, though, are not what consumers are looking for.

Zinc

The zinc market has improved, galvanizers again being in the market for small supplies. Most of these buyers are not buying large amounts, owing to uncertain fuel conditions, but desire prompt deliveries. The premium on futures is gradually decreasing, July zinc now being obtainable at only about 2½ points' premium over current quotations. Shipments abroad are no longer profitable. Statistics issued by the American Zinc Institute are as follows: Stock on hand April 1, all grades, 60,262 tons; produced, April, 25,506; total, 85,768. Shipped, April, 34,040. Stock on hand April 30, 51,728. Stored for account of customers (not included in stock on hand), April 30, 2,212. Total retort capacity, 155,656. Number of retorts available, 137,712. Average number of retorts operating during month, 43,764. Number of retorts operating at end of April, 42,773.

Tin

The market for tin continues dull, though the lower prices are tempting some consumers. Electrolytic has been sold at the same prices as are asked for Straits, but Banca tin, of high purity, has been available at one-half to three-eighths of a cent discount. Tin for delivery within three months has been available at the same price as spot, but September-October commands about one-eighth of a cent premium.

Arrivals of tin, in long tons: May 9, London, 25; 10th, Liverpool, 35; 12th, Straits, 750; 15th, Liverpool, 50; London, 50; 16th, Liverpool, 5.

Gold

Gold in London: May 11th, 93s. 6d.; 12th, 93s. 7d.; 15th, 93s. 3d.; 16th, 93s. 2d.; 17th, 93s. 2d.

General stock of money in the United States: May 1: Gold coin and bullion, $3,766,765,584; standard silver dollars, $372,256,851; subsidiary silver, $272,017,534; United States notes, $346,681,016; Federal Reserve notes, $2,543,299,460; Federal Reserve Bank notes, $91,363,400; National bank notes, $754,622,549; total, $8,147,006,394. Circulation per capita, $48.89. Gold and silver stocks increased during the month by about $21,000,000 and outstanding notes by about $18,000,000.

Foreign Exchange

Foreign exchanges have been generally quiet, with slightly stronger tendencies. On Tuesday, May 16, francs were 9.145c.; lire, 5.2775c.; marks, 0.3525c.; and Canadian dollars, 99.03c.

Silver

Continued buying by China has been the main strength of the market, although the Indian bazaars have given support at times. May 17 established new high records for the current year at 36½d. in London and 72¾c. in New York. The market closes steady.

Mexican Dollars—May 11th, 53¾; 12th, 53½; 13th, 54¼; 15th, 55; 16th, 55⅛; 17th, 55⅝.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17.50@18.50c. for 98@99 per cent virgin grades.

Antimony —- Chinese and Japanese brands, 5.40@5.50c. W.C.C., 6@6½c. Cookson's "C" grade, spot, 8.75@9c. Chinese needle antimony, lump, nominal, 3.5@4c. per lb. Standard powdered needle antimony (200 mesh) nominal at 5¼c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 6.75@7c.

Arsenic—7c. per lb.

Bismuth—$2@$2.10 per lb.

Cadmium—$1.15@$1.20 per lb.

Iridium—Nominal, $150@$170 per oz.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Small tonnages, spot, nominal at 30@33c.

Palladium—$50@$55 per oz.

Platinum—$85 per oz.

Quicksilver—$54@$55 per 75-lb. flask. San Francisco wires $54.70.

The prices of Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten are unchanged from the prices in the issue of May 6.

Metallic Ores

Molybdenum Ore—50c. per lb. of MoS_2, for 85 per cent MoS_2 concentrates.

Tungsten Ore—Chinese, price advanced to $3 per unit.

The prices of **Bauxite, Chrome, Manganese, Tantalum, Uranium, Vanadium, Titanium** and **Iron Ore, Zircon** and **Zirkite** are unchanged from the prices in the issue of May 6.

Zinc and Lead Ore Markets

Joplin, Mo., May 13—Zinc blende, per ton, high, $32.85; basis 60 per cent zinc, premium, $31; Prime Western, $29; fines and slimes, $28@$27; average settling price, all grades of blende, $29.58.

Lead, high, $73.30; basis 80 per cent lead, $70; average settling price, all grades of lead, $69.95 per ton.

Shipments for the week: Blende, 11,165; lead, 2,048 tons. Value, all ores for the week, $473,560.

Purchases of blende this week were 2,300 tons in excess of those of last week, though all efforts to further lower the market proved unavailing. Heavier demand developed early in the week and in midweek it looked as though the price level of the previous week would be restored, and sellers were slow to dispose of ore. As no advance was forthcoming, sales were made today on the price basis current last week.

American Zinc has closed down its lead smelter at Granby and is out of the lead market, and Federal Lead is buying quite lightly, leaving the field practically to the local organizations of the Eagle Picher and Ontario smelters, with St. Louis S. & R. buying intermittently.

Platteville, Wis., May 13 — Blende, basis 60 per cent zinc, $29 per ton. Lead ore, basis 80 per cent lead, $70 per ton. Shipments for the week: Blende, 373 tons; lead ore, none. Shipments for the year: Blende, 5,691; lead ore, 830 tons. Shipment during the week to separating plants, 1,128 tons blende.

Non-Metallic Minerals

Feldspar—One producer reports No. 1 pottery grade has recently been in good demand at a slight recession in price, $6.40 per ton, f.o.b. Eastern mines.

Talc—20 to 200 mesh, $7@$12 per ton, f.o.b. Vermont; $8@$10, f.o.b. Georgia; 200 mesh, $18, f.o.b. California; through No. 25 Swiss silk, $25, f.o.b. California. Market fair.

Prices are unchanged from those in the issue of May 6, on **Asbestos, Barytes, Borax, Chalk, China Clay, Emery, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica and Sulphur.**

Mineral Products

Copper Sulphate — 5.75c. per lb. for large crystals.

Sodium Nitrate—$2.80@$2.90 per 100 lb. ex-vessel Atlantic ports.

Sodium Sulphate—Price has advanced to $20@$25 per ton, New York.

The price of **Potassium Sulphate** is unchanged from that of May 6.

Ferro-Alloys

Ferromanganese—Domestic, 78 to 82 per cent, $67@$69, f.o.b. furnace; English, $67.50; German, $66, both c.i.f. Atlantic seaports. Spiegeleisen, 19 to 21 per cent, scarce at [illegible] per gross ton, f.o.b. furnace; 16 to 19 per cent, $34.

Ferrotungsten—Domestic, 70 to 80 per cent W, 45@50c. per lb. of contained W, f.o.b. works.

Ferrotitanium, Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferro-uranium, and **Ferrovanadium** are unchanged from the prices published May 6.

Metal Products

Copper Sheets — New York base, 19.25c. per lb.; wire, 14.75c.

Lead Sheets, Nickel Silver, Yellow Metal, and **Zinc Sheets** are unchanged from the prices published May 6.

Refractories

Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick, and **Silica Brick** are unchanged from the prices quoted May 6.

The Iron Trade

Pittsburgh, May 16, 1922

Production of steel ingots in April was at the rate of about 36,500,000 gross tons a year, against 30,000,000 tons March 1, 35,000,000 tons March 31, and an average of 32,500,000 tons for the month. Thus the coal strike restricted but did not entirely stop the increase in steel production. The Carnegie Steel Co. has just resumed operations at the Mingo plant, making sheet bars. Coal is being moved longer distances than normal, being brought from non-union districts. The most interesting single development in meeting the strike situation is the Carnegie Steel Co. purchase of a large tonnage of coke, said to be 300,000 tons, from the Sloss company, in Alabama, where there has been much idle coal mining and coking capacity.

Not a few independent mills have advanced asking prices for steel. The 1.50c. price on bars, shapes, and plates now obtains only for desirable business.

Pig Iron—One or two forced purchases of basic iron have developed a market price of $25, Valley, $1 above the nominal price quoted a week ago for all grades, and bessemer is quoted at $26, foundry remaining at $24, with light transactions.

Coke

Connellsville Coke—Market offerings are light and demand at prices asked is also light, the market being about $6.50 for furnace and $6.75 for foundry. Connellsville coal has advanced farther, on account of continued Eastern buying, and stands at $3.25 to $3.50.

COMPANY REPORTS

Ray Consolidated Copper Co.

A report of the operations of the Ray Consolidated Copper Co. for 1921 shows a net loss to surplus of $1,598,318.62 according to the following operating account:

[illegible]		
[illegible] 10,110,131 lb. at [illegible]	$1,335,497.15	
[illegible]	2,072.49	
		$1,337,569.64
[illegible]		
[illegible]	$612,875.37	
[illegible]	109,100.76	
[illegible]	496,546.54	
[illegible]	407,684.60	
[illegible]	32,855.52	
		1,659,062.59
[illegible]		$321,492.95
[illegible]		93,757.74
[illegible]		$227,735.21
[illegible]:		
[illegible]	$437,421.56	
[illegible]	833,136.06	
[illegible]	100,025.79	
		1,370,583.41
[illegible]		$1,598,318.62

SURPLUS FROM OPERATIONS

[illegible] Dec. 31, 1920	$14,264,228.51
[illegible]	1,598,318.62
Balance Dec. 31, 1921	$12,665,909.89

Balance sheet as of Dec. 31, 1921, is given as follows:

ASSETS

	Dec. 31, 1921	Dec. 31, 1920
[illegible]	$8,656,440.27	$8,656,440.27
[illegible]	9,001,865.07	8,961,846.34
[illegible]	3,341,146.35	2,903,724.79
	$5,660,718.72	$6,058,121.55
[illegible]	6,040,307.44	6,057,503.36
[illegible]	$20,357,466.43	$20,772,065.18
[illegible]	3,409,287.65	3,025,220.55
[illegible]	478,432.22	..
[illegible]	62,984.36	56,130.14
[illegible]	1,331,904.35	1,459,499.21
[illegible]	527,670.63	368,799.87
[illegible]	1,497,942.54	5,325,015.24
Cash	3,010,924.33	1,673,753.76
	$30,676,612.51	$32,680,483.95

LIABILITIES

	Dec. 31, 1921	Dec. 31, 1920
Capital stock:		
[illegible]	$16,000,000.00	$16,000,000.00
[illegible]	228,210.00	228,210.00
	$15,771,790.00	$15,771,790.00
[illegible]	244,550.20	327,126.15
[illegible] refining and delivery charges [illegible]	34,909.47	337,516.73
[illegible]	452,806.84	473,176.45
[illegible]	1,506,646.11	1,506,646.11
[illegible]	12,665,909.89	14,264,228.51
	$30,676,612.51	$32,680,483.95

Net production amounted to 10,110,131 lb. of copper. Operations were stopped in April, 1921. Cost of production was 16.41c. per lb., exclusive of gold and silver credits and miscellaneous income, which amounted to 0.16c. per lb. Shutdown expense for the year amounted to $225,923.30.

Arizona Commercial Mining Co.

A report of the operations of the Arizona Commercial Mining Co. for 1921 shows a loss of $335,336.61 according to the following income account:

[illegible]		
[illegible] silver and gold		$336,756.95
[illegible]		
[illegible]	$414,952.80	
[illegible]	52,245.62	
[illegible]		
[illegible]	123,616.08	
[illegible] plant	65,502.07	
[illegible]	35,776.99	
		672,093.56
[illegible] 1921		$335,336.61

The balance sheet as of Dec. 31, 1921, is as follows:

ASSETS

Fixed		
Mining properties, plant, and equipment		$4,103,356.08
Current		
Supplies on hand	$46,329.32	
Finished metals on hand (copper at cost, silver and gold at market)	387,917.22	
Copper sold Copper Export Association, Inc. (carried at cost, less amount received on account)	97,930.37	
Accounts receivable	26,253.20	
Cash and marketable securities	240,776.23	
		799,206.34
		$4,902,562.42

LIABILITIES

Capital stock		
Authorized—300,000 shares of $5 each issued, 265,000 shares		$1,325,000.00
Current		
Loans and accounts payable		659,264.87
Reserves		
For depreciation	$224,151.04	
For depletion	689,639.40	
		913,790.44
Surplus		
Balance Dec. 31, 1920	$2,339,843.72	
Loss for the year 1921, per income account	335,336.61	
		2,004,507.11
		$4,902,562.42

Production amounted to 572,616 lb. of copper, 3,001 oz. of silver, and 162.5 oz. of gold. A total of 2,154 lb. of refined copper was sold and delivered at an average price of 12.79c. per lb.

Eagle & Blue Bell Mining Co.

A report of the operations of the Eagle & Blue Bell Mining Co., for 1921 shows a net operating gain of $97,040.30. Dividends paid in 1921 amounted to $44,657.30. The operating statement for the year, and the profit-and-loss account are as follows:

GROSS EARNINGS

Ore shipments	$632,376.44	
Rents	160.70	
Commissions	777.39	
		$633,314.53

EXPENSES

Smelting, freight, sampling and assaying	$329,241.01	
Mine operations	117,648.49	
Management, office, legal expenses, income and profits taxes	13,268.70	
Insurance, miscellaneous taxes, general expenses	40,063.96	500,222.16
		$133,092.37

MINE DEVELOPMENT

Prospecting and development	$36,052.07	$36,052.07
Net operating gain		$97,040.30

PROFIT-AND-LOSS ACCOUNT

CREDITS

Net operating gain	$97,040.30	
Interest	1,456.58	
Total credits		$98,496.88

DEBITS

Construction and equipment depreciation	$8,404.81	
Mine depletion	73,820.12	
Total debits		82,224.93
Balance to earned surplus		$16,271.95
Earned surplus balance Dec. 31, 1920		27,099.66
		$43,371.61
Less dividends paid in 1921		44,657.30
Earned surplus deficit, Dec. 31, 1921		$1,285.69

Production amounted to 1,985,934 lb. of lead, 518,533 oz. of silver, 3,653.8 oz. of gold, and 2,235 lb. of copper.

The appraisers estimate the life of the mine at fifteen years with an annual production of 30,000 tons.

Mason Valley Mines Co.

A report of the operations of the Mason Valley Mines Co. for 1921 shows a net income of $11,330.24, according to the following account:

Sales of copper		$2,872.11
Cost of sales		3,502.08
Loss on sales of copper		$629.97
Expenses and losses: administration mine and smelter exploration		107,642.63
Gross deficit		$108,272.60
Other income:		
Interest on bank balances, loans and bonds	$20,610.74	
Dividends received	5,100.00	
Profit on purchase and sale of stocks of other companies	93,892.10	
		119,602.84
Net income		$11,330.24

The balance sheet as of Dec. 31, 1921, follows:

ASSETS

Mines, claims and lands (book value)			$1,014,983.98
Buildings and equipment (depreciated book value)			396,933.10
Investment in Gray Eagle Copper Co.:			
Entire capital stock			1,012,000.00
Maijuba Silver, Tin & Copper Mine Co.:			
Capital stock 250,000 shares		$25,000.00	
Note receivable, secured		25,000.00	
			50,000.00
Current and working assets			
Inventories:			
Refined copper at 18c. per lb	$26,986.37		
Ore at cost	32,216.33		
Supplies, book value	125,005.47		
		186,208.17	
Accounts receivable		21,719.00	
Dividends receivable		2,250.00	
Temporary investment in listed stocks of other mining companies, at cost		397,185.00	
Cash in bank		187,376.84	
			794,739.01
Unexpired insurance premiums			4,969.50
Smelter maintenance expenditures during inoperative period prior to Jan. 1, 1921, deferred			80,200.40
Total			$3,353,825.99

LIABILITIES

Capital stock issued		
500,000 shares of a par value of $5 each		$2,500,000.00
Current and accrued liabilities		12,141.75
Surplus		
Balance as at Dec. 31, 1920	$830,354.00	
Add income for 1921	11,330.24	
		841,684.24
Total		$3,353,825.99

Schumacher Gold Mines, Ltd.

A report of operations of the Schumacher Gold Mines, Ltd., for the period June 30, 1920, to Feb. 28, 1922, shows a reduction in surplus of $14,990.68, as the following operating account indicates:

To interest and exchange	$2,094.54	
Administration	3,615.37	
General charges	2,850.48	
Insurance	7,136.29	
By rentals		$706.00
Transfer to surplus		14,990.68
	$15,696.68	$15,696.68

SURPLUS:

By balance June 30, 1920		67,325.70
To transfer from operating account	$14,990.68	
Balance Feb. 28, 1922	52,335.02	
	$67,325.70	$67,325.70

BALANCE SHEET, FEB. 28, 1922

ASSETS

Fixed assets:		
Capital expenditures		$1,727,814.93
Current assets:		
Cash in banks	$167.85	
Accounts receivable	181.71	
Stores	7,486.23	
Insurance paid in advance	2,752.50	10,588.29
		$1,738,403.22
Discount on shares sold		202,500.00
		$1,940,903.22

LIABILITIES

Current liabilities:			
Accounts payable (F. W. Schumacher		$27,647.77	
			$27,647.77
Reserve for depreciation			10,919.43
Liabilities to shareholders			
Capital stock			
Authorized	$2,000,000.00		
Unissued	149,999.00	$1,850,001.00	
Surplus		52,335.02	1,902,336.02
			$1,940,903.22

Butte & Superior Mining Co.

A report of the operations of the Butte & Superior Mining Co. for 1921 states that there were no productive operations during the year. The income of $72,713.15 consisted of interest on investments and bank balances. Expenditures, exclusive of depreciation, amounted to $590,642.47, consisting of $357,973.60 shutdown expense and maintenance of mine. The sum of $232,668.87 was expended for taxes, legal fees, and sundries; and depreciation was charged off in the amount of $235,022.34, which, with the foregoing amounts, resulted in a net decrease in surplus account of $752,951.66.

Costs of zinc and copper development work during the year amounted to $224,860.02. This amount is carried in a deferred-development account to be charged off against operations.

The following summary shows the changes in net current assets during the year and the disposition of the decrease in same:

Net current assets, Jan. 1, 1921 as adjusted		$2,989,766.09
Income during the year		72,713.15
Making a total for disposition of		$3,062,479.24
DISPOSITION:		
Shut down expenses	$357,973.60	
Taxes, legal expenses, and sundries	232,668.87	
Investments	208,318.80	
Development and deferred charges	224,883.02	
Fixed assets	2,610.62	
Expenditures charged to reserves	12,729.48	1,039,184.39
Leaving net current assets, Dec. 31, 1921		$2,023,294.85

Rio Tinto Co., Ltd.

A report of the operations of the Rio Tinto Co., Ltd., for 1921 shows after deducting taxes, cost of administration, hospitals, pensions, and other expenses from the profit on sales of produce and other revenue credits, a balance on revenue account of £126,935 13s. 4d., to which is added the balance brought forward from 1920 of £375,589 14s. 4d., a total of £502,525 7s. 8d. The interim dividend of 2s. 6d. per share on the preference shares absorbed £40,625, leaving £461,900 7s. 8d. Out of this the directors now recommend the payment of a final dividend of 2s. 6d. per share (less income tax) on the preference shares, absorbing £40,625, leaving a balance to be carried forward of £421,275 7s. 8d.

The long strike of 1920 was settled at the end of that year and operations were resumed in January, 1921. A good many of the contracts had been lost, however, and it was well into the spring before most of the departments were operating on even approximately a normal scale.

Kirkland Lake Gold Mining Co., Ltd.

A report of operations of the Kirkland Lake Gold Mining Co. Ltd., for the seven months ended Dec. 31, 1921, shows a surplus of $13,015.90 from operations. Production amounted to 25,717 tons, producing $147,654.83 in gold bullion. Mining account follows:

MINING ACCOUNT

Receipts		
Bullion sales	$125,287.35	
Bullion on hand Dec. 31, 1921	22,309.46	
Rents	518.08	
Exchange	15,377.83	
		$163,492.72
Charges		
Operation	$143,567.62	
Administration	6,909.20	
		$150,476.82
Surplus on operation		$13,015.90

Allouez Mining Co.

A report of operations of the Allouez Mining Co. for 1921 states that no copper was produced during the year. Loss for the year amounted to $94,332.52. On Jan. 1, 1921, the company had on hand 1,265,581 lb. of copper, all of which was sold during the year. Balance of current assets, Dec. 31, 1920, was $658,604.41, and on Dec. 31, 1921, $570,043.12.

MINING STOCKS

Week Ended May 13, 1922

Stock	Exch.	High	Low	Last	Last Div.	
			COPPER			
Ahmeek	Boston	61	59	60½	Sept. '20, Q	$0.50
Alaska-Br. Columbia	N. Y. Curb	5	4	4¼	....	
Allouez	Boston	26½	25	26½	Mar. '19	1.00
Anaconda	New York	53¾	51¼	52	Nov. '20, Q	1.00
Arcadian Consol.	Boston	4	3½	3¾		
Ariz. Com'l.	Boston	9½	9	9	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*28	*22	*25	..	..
Bingham Mines	Boston	15	15	15	Sept. '19, Q	0.25
Calumet & Arizona	Boston	59½	57	59½	Mar. '22, Q	0.50
Calumet & Hecla	Boston	272	265	265	June '20, Q	5.00
Canada Copper	N. Y. Curb	*50	*38	*39	..	..
Centennial	Boston	11	10½	10	Dec. '18, SA	1.00
Cerro de Pasco	New York	37	36	37	Mar. '21, Q	0.50
Chile Copper	New York	20¼	18¾	19¾	.	
Chino	New York	28¾	27⅛	28¼	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*28	*27	*27	..	....
Consol. Arizona	N. Y. Curb			*8	Dec. '18, Q	0.05
Consol. Copper Mines	N. Y. Curb	1¾	1 9/16	1 11/16	..	..
Copper Range	Boston	42	40¼	41	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1¾	1¾	1 11/16		
Davis-Daly	Boston	8¼	8	8½	Mar. '20, Q	0.25
East Butte	Boston	11¼	10	11	Dec. '19, A	0.50
First National	Boston Curb	*85	*75	*78	Feb. '19, SA	0.15
Franklin	Boston	3	2¼	2½	... ...	...
Gadsden Copper	Boston Curb	1¼	1	1¼	....	....
Granby Consol.	New York	28¼	25½	28¼	May '19, Q	1.25
Greene-Cananea	New York	31	30¼	30¾	Nov. '20, Q	0.50
Hancock	Boston	3	3	3	..	....
Howe Sound	N. Y. Curb	3¼	3⅛	3⅛	Jan. '21, Q	0.05
Inspiration Consol.	New York	41¾	39½	40¼	Oct. '20, Q	1.00
Iron Cap	Boston Curb	*9	*6	9	Sept. '20, K	0.25
Isle Royale	Boston	24	23¼	23¼	Sept. '19, SA	0.50
Kennecott	New York	33¾	31	33	Dec. '20, Q	0.50
Keweenaw	Boston	3	2½	3	. ....	..
Lake Copper	Boston	4½	4	4½	......	...
La Salle	Boston	2	1	1½	....	..
Magma Copper	N. Y. Curb	29½	29	29	Jan. '19, Q	0.50
Majestic	Boston Curb	*10	*9	*10	......	..
Mason Valley	Boston	2½	1½	2	...	
Mass Consolidated	Boston	3¼	3½	3	Nov. '17, Q	1.00
Miami Copper	New York	29	28	28½	Feb. '22 Q	0.50
Michigan	Boston	3	2½	3	.	.
Mohawk	Boston	58	56	58	Feb. '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	10	9⅞	9⅞	.	..
Nevada Consol.	New York	17¼	16½	16½	Sept. '20, Q	0.25
New Cornelia	Boston	18	17½	18	Feb. '22, K	0.25
North Butte	Boston	12½	12	12½	Oct. '18, Q	0.25
North Lake	Boston			*40		
Ohio Copper	N. Y. Curb	*9	*8	*9		
Old Dominion	Boston	24	23	23	Dec. '18, Q	1.00
Osceola	Boston	34	34	34	June '20, Q	0.50
Phelps Dodge	Open Mar.	†180	†170		Apr. '22, Q	1.00
Quincy	Boston	43	43	43	Mar. '20, Q	1.00
Ray Consolidated	New York	16	15½	16½	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1⅞	1½	1⅝		
St. Mary's Min. Ld.	Boston	45½	44	45	Apr. '22, K	2.00
Seneca Copper	Boston	13½	12¾	13	..	
Shannon	Boston	*95	[illegible]	*95	Nov. '17, Q	0.25
Shattuck Ariz.	New York	[illegible]	[illegible]	[illegible]	Jan. '20, Q	0.25
South Lake	Boston	*80	*50	*50		
Superior & Boston	Boston	1	1	1¼		
Tenn. C. & C. cfs.	New York	11½	11	11½	May '18, I	1.00
Tuolumne	Boston	[illegible]	[illegible]	*78	[illegible] '13,	0.10
United Verde Ext.	Boston Curb	28½	28	28	May '22, Q	0.25
Utah Consol.	Boston	2	2	2	[illegible] '18,	0.25
Utah Copper	New York	63	61	63	Mar. '22, Q	0.50
Utah Metal & T.	Boston	1½	1½	1½	[illegible] '17,	0.30
Victoria	Boston	2	[illegible]	2	....	...
Winona	Boston	2	1	2	....	....
Wolverine	Boston	13	11½	1[illegible]	....	....
			NICKEL-COPPER			
International Nickel	New York	18	16	17½	Mar. '19,	0.50
International Nickel, pfd	New York	[illegible]	77½	77½	Feb. '22, Q	1.50
			LEAD			
National Lead	New York	94	92	94	Mar. '22, Q	1.50
National Lead, pfd	New York	11[illegible]	110	110	Mar. '22, Q	1.75
St. Joseph Lead	New York	15	14½	14½	Mar. '22, Q	0.25
			QUICKSILVER			
New Idria	Boston	1¼	1¼	1¼	....	....
			ZINC			
Am. Z. L. & S.	New York	18½	17½	17½	May '20,	1.00
Am. Z. L. & S. pfd	New York	44½	41½	41½	Nov. '20, Q	1.50
Butte C. & Z.	New York	6½	6	6½	June '18,	0.50
Butte & Superior	New York	31½	28½	30½	Sept. '20,	1.25
Callahan Zn-Ld	New York	8½	7½	8	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb			145	Mar. '22, Q	2.00
Yellow Pine	Los Angeles	*50	*44	*48	Sept. '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.	
			GOLD			
Alaska Gold	New York	⅞	½	⅝	....	.
Alaska Juneau	New York	1⅝	1½	1½	. . .	. .
Carson Hill	New York	15¼	13¼	13¼		
Cresson Consol. G.	N. Y. Curb	2⅞	2 11/16	2¾	Apr.'22, Q, X	$0.10
Dome Extension	Toronto	1	*95	1		
Dome Mines	New York	28⅛	27	27½	Apr. '22, Q	1.00
Florence Goldfield	N. Y. Curb	*25	*20	*23		
Golden Cycle	Colo. Springs	*77	*76	*76	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*7	*7	*7	Dec. '19,	0.05
Hollinger Consol.	Toronto	9.75	9.60	9.70	May '22,	0.05
Homestake Mining	New York	72¼	71¼	72	Apr. '22, M	0.25
Kirkland Lake	Toronto	*47	*43½	*45		..
Lake Shore	Toronto	2.40	2.25	2.35	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	19.25	18.00	18.50	May '22, K	0.05
Porcupine Crown	Toronto	*29	*26½	*27½	July '17,	0.03
Porcupine V. N. T.	Toronto	*37¾	*36½	*37¼	....	.
Portland	Colo. Springs	*25	*24	*24	Oct. '20, Q	0.01
Schumacher	Toronto	*58	*55	*57½	....	...
Silver Pick	N. Y. Curb	*19	*15	*18	....	....
Teck Hughes	Toronto	*58	*55	*56		
Tom Reed	Los Angeles	*64	*60	*64½	Dec. '19,	0.02
United Eastern	N. Y. Curb	1 11/16	1 9/16	1 11/16	Apr. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*9½	*8	*8	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	.	.	*8		.
Wright-Hargreaves	Toronto	3.06	2.50	2.90	Apr. '22,	0.02½
Yukon Gold	N. Y. Curb	1	1	1	June '18,	0.02½
			SILVER			
Batopilas Mining	New York	1¼	1	1	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*35¾	*34	*35	May '20, K	0.03
Coniagas	Toronto	1.25	1.25	1.25	May '21, Q	0.12½
Crown Reserve	Toronto	*16½	*15	*15½	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	4⅛	3¾	3¾	Apr. '22, Q	0.12½
La Rose	Toronto	*35	*26¼	*33	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*31½	*29	*30	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.15	1.00	1.05	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6	5¾	6	Apr. '22, Q, X	0.30
Ontario Silver	New York	8⅞	8	8	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	.	.	*12	Jan. '12,	0.10
Temiskaming	Toronto	*32	*28	*30	Jan. '20, K	0.04
Trethewey	Toronto	*6	*4	*5	Jan. '19,	0.05
			GOLD AND SILVER			
Boston & Montana	N. Y. Curb	*21	*19	*20	....	.
Cash Boy	N. Y. Curb	*6	*5	*5	....	.
Dolores Esperanza	N. Y. Curb	2⅞	1⅞	2¼	.... ..	
El Salvador	N. Y. Curb	*7	*6	*6	.	
Jim Butler	N. Y. Curb	*8	*8	*8	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	*5	*5	*5	June '16,	0.05
MacNamara M. & M.	N. Y. Curb	*9	*9	*9	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1⅝	1⅝	1⅝	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*80	*73	*74		
Tonopah Extension	N. Y. Curb	1 9/16	1 7/16	1½	Apr. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1⅞	1¾	1¾	Apr. '22, SA, X	0.07½
West End Consol.	N. Y. Curb	1 1/16	*95	1	Dec. '19, SA	0.05
			SILVER-LEAD			
Caledonia	N. Y. Curb			*7	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	†1.00	†*94	*95	Dec. '20,	0.15
Chief Consol.	Boston Curb	4⅜	4¼	4½	May '22, Q	0.05
Consol. M. & S.	Montreal	23	22	22¼	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†2.50	†1.50		July '20, Q	0.10
Daly-West	Boston	2	2	2	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†3	†2½	2½	Apr. '21, K	0.05
Electric Point	Spokane	7½	*7	*7	May '20, SA	0.03
Federal M. & S.	New York	12½	12	12	Jan. '09,	1.50
Federal M. & S. pfd.	New York	44½	41½	43½	Mar. '22, Q	1.00
Florence Silver	Spokane	22½	*21	*22½	Apr. '19,	0.01½
Grand Central	Salt Lake	†*65	†*60	75	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	6¼	6⅛	6¼	Mar. '22, Q	0.15
Iron Blossom, Con.	N. Y. Curb	22	21	22	Apr. '22, Q	0.02½
Judge M. & S.	Salt Lake	2.60	†2.30	2.60	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*21	17	*19	June '21, I	0.02
Prince Consol.	Salt Lake	*4¼	*3½	3½	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	6¼	*4	*6	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*10	*9	*10		
South Hecla	Salt Lake	†*60	†*35		Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	22	*19	*21	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	12	*10	*11	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.50	2.45	2.45	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.02½	2.00	2.02½	Dec. '21, Q	0.05
Utah Apex	Boston	3	3	3	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	....	....	*2	Nov. '17,	0.01
			VANADIUM			
Vanadium Corp.	New York	51½	44½	51	Jan. '21, Q	1.00
			ASBESTOS			
Asbestos Corp.	Montreal	55	54	54	Apr. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	75	75	75	Apr. '22, Q	1.75
			SULPHUR			
Freeport, Texas	New York	19⅝	18	19⅜	Nov. '19, Q	1.00
Texas Gulf	New York	43⅜	42	42¼	Mar. '22, QX	1.00
			MINING, SMELTING AND REFINING			
Amer. Sm. & Ref.	New York	59	54⅞	58½	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	98½	97	97	Mar.'22, Q	1.75
Am. Sm. Sec. pf. A.	New York	92½	92½	92½	Apr. '22, Q	1.50
U. S. Sm. R. & M.	New York	46¼	38½	40¼	Jan. '21, Q	0.50
U.S. Sm. R. & M. pf.	New York	45⅝	45⅝	45⅝	Apr. '22, Q	1.75

NEW MACHINERY AND INVENTIONS

Gunite Used in Construction of Fertilizer Plant

The accompanying photographs show the plant used in the manufacture of phosphoric acid by the Anaconda Copper Mining Co., which is situated at Conda, Idaho. The buildings shown, as well as the mill, storage and coal bins, are gunite covered.

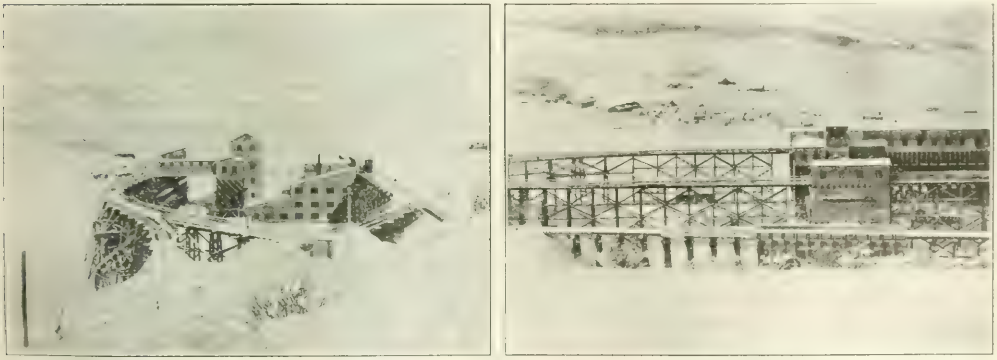
The photograph at the left shows a side view of mill and storage bins. The trestles are 45 ft. above the railroad track. In the foreground at the intersection of the two mine tracks is a small hose house, of which there are six. These are of gunite construction similar to the mill building and are placed directly over the various fire hydrants.

The compressor house does not show in either of the pictures. It is a building 20 x 50 ft. in plan and is 20 ft. high, and has a steel frame with double walls of granite reinforced with poultry netting and a two-ply felt paper backing. The roof is of corrugated iron over steel purlins over which a heavy coat of gunite was placed. The refrigerating plant is a building 17 x 36 ft. and is divided into two rooms, a compressor and cold-storage room. It has a timber frame with double gunite walls and ceiling. Expanded metal lath was used to support the ceiling. In the immediate foreground of the photograph at the right is shown the 350-ton capacity railroad coal bin. The bin is lined on the walls with 2 to 3 in. of gunite and 4 in on the bottom. Beyond this coal bin is the rear of the mill building which contains a 420-ton feed bin. The building itself has gunite walls supported on a timber frame. The walls are about 1½ in. thick and were shot from the inside on a poultry and rabbit-wire fencing reinforcement. Common lumber forms were hung from the outside for temporary backing. These forms were removed and the outside given a light stucco coat to cover the irregularities around the timbers and to smooth the surface.

At the rear of the feed bin is No. 2 elevator tower and a 1,000-ton dried rock storage bin. The elevator tower and house over the bin are of the same type of construction as the building proper. The storage bin is lined on the sides and bottom with gunite over rabbit-wire reinforcement. The thickness varies from 2 to 4 in. Between the 1,000-ton bin and the large bin shown in the picture is a house about 80-ft. long covering a conveyor from the smaller to the larger bin. This and the house over the 3,000-ton bin were constructed in the same manner as the mill.

Corrugated iron roofs were used on the structures mentioned, but it was proposed to cover that of the 3,000-ton bin with gunite about ¼ in. deeper than the corrugations. This has been done as a means of protecting the iron and to make the roof waterproof. To give a more pleasing finish, a dry, red mineral paint was mixed with the cement used for the final covering of the roofs, and this has produced a dark and pleasing red color. A roof colored in this manner does not run, and the color seems to be permanent. All the work on these structures, except the coal bin, was done from one set-up of the cement gun, which was placed in the small shack shown to the left of the mill feed bin and just below the mill trestle. The 3,000-ton bin is about 180 ft. long, and the roofs of these buildings are about 60 ft. above the ground. The buildings are all supported on concrete foundations, the main wood sills bolted down and leveled up with shims. The space between the top of the concrete and the long sills was then filled with gunite. In the case of the large bin the sill on the loading chute side is 24 in. wide.

In the background of the picture is shown the temporary townsite.



The fertilizer plant of the Anaconda Copper Mining Co. at Conda, Idaho

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The General Smelting Co., of Philadelphia, has recently purchased a 4½-ft. diameter x 16-in. cylinder Hardinge conical ball mill for treating its zinc skimmings preparatory to reclaiming this metal.

Recent Development in Hollow Rock Drill Steel

In response to a demand among mining men for a superior drill steel, there has been considerable improvement in the manufacture of hollow steel for drilling purposes. The method employed by the Ludlum Steel Co., Watervliet, N. Y., in the manufacture of hollow drill steel is to insert a high-grade, low-carbon mild steel tube, suitably cleaned by sand blast, into an ingot mold and cast the hot metal around the tube. The tube is filled with air-excluding material so as to prevent oxidation and scaling of the inside of the tube, generally using a high-grade sand for this purpose. The ingots are then rolled in the usual way down to the finished bar. The bars are cut up to required length and the sand is extracted by a special method, which is said to be speedy and extremely effective.

The tube method of making hollow ingots for the manufacture of hollow drill steel is a decided departure from the old methods, and the logic of it seems to show that the resultant hollow drill steel should be superior to that made by the older method. Tests made by the Ludlum Steel Co. to date show that such is the case; whether or not the premises are accurate, it is believed that hollow drill steel made this way will withstand alternating stresses better than anything that has yet been produced of similar analysis. The reasons why it is thought the tube method of hollow drill steel manufacture is superior to the older methods are that it possesses greater freedom from external and internal straining; because of the inherent small crystal size; absence of harmful segregation resulting in weakness of the wall of the hole; less liability of the steel to crack in the inside of the hole during forging or hardening, and toughening effect, arising from the mild steel wall of the hole, limiting the intense hardening on quenching.

The Ludlum Steel Co. has improved its regular Chippewa brand of carbon hollow drill steel and is now making two [illegible] types known under the following trade names: Chippewa Special and Chippewa Special Reinforced. Both brands have been subjected to prolonged tests under actual drilling conditions, and are said to have proven exceptional merit for drilling efficiency and fatigue-resisting qualities as well as ease in handling in the forging and hardening operations, producing the greatest percentage of good bits as compared with standard brands of hollow drill steel.

Diesel Engine Piston Repaired by Welding

The accompanying illustration shows a 2,800-lb. cast-iron piston of a Diesel engine after completion of a repair by oxy-acetylene welding. The piston was cracked across the head in the form of an X, and is one of a series of thirty pistons which were damaged in a similar manner. In preparing this piston for welding, a standard Oxweld C-3 cutting blowpipe was used to cut out a deep chamfer at the best angle for making the weld. Approximately 75 gal. of coal oil were used in preheating the casting, 105 lb. of cast-iron rods were used as filler, six cylinders of Linde oxygen and three tanks of Prest-o-Lite acetylene were consumed, and the work required thirty-five blowpipe hours.

Repaired Diesel engine piston

The repair of the piston shown was so satisfactory that it was decided to weld the entire series of thirty pistons. The work was done by the R. E. Parrish Welding Shop, of Iola, Kan., for the Lehigh Portland Cement Co.

The Eighth Chemical Show

The eighth national Exposition of Chemical Industries will be held in the Grand Central Palace, New York City, during the week of Sept. 11, following the fall meeting of the American Chemical Society. The exhibits will consist of raw materials, machinery and products. The machinery exhibits cover apparatus, equipment, and instruments for control, precision, recording, gaging, and measuring, and machinery for every mechanical operation in the manufacture of products from the raw materials. The products themselves are the finished products and the exhibits will contain those of organic and inorganic origin, of solid, liquid, or gaseous form, and of every conceivable nature. Many new things upon which manufacturers were working when the war ended, and which have been since more leisurely perfected, will be shown for the first time.

The managers report that three full floors of the Grand Central Palace and part of the fourth are already taken for the exposition and that 350 exhibitors have contracted for space. The office of the managers, Charles F. Roth and Fred. W. Payne, is in the Grand Central Palace, New York City, and inquiries should be directed to them there.

An Intensive Scrubber Grid

The most important part of a condensing or scrubbing tower is the method of bringing about the contact between the gases and the washing or scrubbing medium. The capacity of the tower depends absolutely on the number of square feet of active scrubbing surface per cubic foot of scrubber volume.

Steere scrubber grids, manufactured by the Steere Engineering Co., Detroit, Mich., with ½-in. spacing, give 30 sq.ft. of active scrubbing surface per cubic foot of volume. The spacing may be reduced, if the service will permit, thereby giving a corresponding increase in the active scrubbing surface. These grids are bound rigidly together in bundles convenient for handling. Heavy boards are bound on both sides of each bundle which is held together by heavy rods and steel plate sides. These side boards carry all the weight. Serrated bottom edges of the grids insure equalized distribution of the scrubbing medium.

INDUSTRIAL NOTES

The Eureka Metallurgical Co., of Eureka, Utah, has purchased a 4½ ft. diameter Hardinge conical ball mill for use in its test plant.

W. S. Greene, designing engineer for Cia Minera Mexicana los Tejones, Yaga, Hayaritt, Mexico, will be pleased to receive catalogs on equipment pertinent to the construction of a 250-ton cyanide mill. His address is 211 Pacific Hotel, Los Angeles, Cal.

The Golding Keene Co., of Keene, N. H., has purchased an 8-ft. Hardinge conical pebble mill for grinding feldspar. The system that will be used is the new method of continuous grinding which has caused such favorable comment within the last few months in the feldspar industry, being similar to that recommended by Raymond B. Ladoo, of the U. S. Bureau of Mines.

H. H. Buckman and G. A. Pritchard announce that they have sold their interest in and severed their connection with Buckman & Pritchard, Inc., Mineral City, Fla. This company mines and prepares titanium ores from which are made titanium alloys and white titanium pigments. Messrs. Buckman and Pritchard take this occasion to express their appreciation of pleasant relations in the past and to bespeak for the new owners the same good will extended to the original partners.

The Chain Belt Co., of Milwaukee, Wis., has announced the appointment of G. F. Sherratt as manager of the Pittsburgh office in the Union Arcade Building.

The Denver Engineering Works Co. announces the removal of its general offices, including the engineering and sales department, from 30th and Blake Sts. to Suite 333, Cooper Building, 17th and Curtis Sts., Denver, Col. The company will continue the design, manufacture, and installation of machinery equipment for mining, metallurgical and sugar operation.

TRADE CATALOGS

Filter Paper—E. H. Danziger & Co., Inc., 17 Madison Ave., New York City, distributors of Carl Schleicher & Schüll filter papers, have issued a four-page pamphlet giving sizes and grades of these brands of filter papers.

Melting Furnaces—W. S. Rockwell Co., 50 Church St., New York City, have just issued Bulletin No. 243, which describes stationary and tilting crucible melting furnaces for aluminum, brass, bronze, copper, gold, monel metal, nickel, silver, and other non-ferrous metals. These may be oil- or gas-fired. Three different sizes of stationary crucible furnaces and four of the tilting types are listed. Specifications of these are given.

Pump Units — The Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has recently issued leaflet No. 2061, which points out the advantages and uses of the 1½-in. Type "22" Centrifugal Pumping Unit. The pump is a single suction pump and the driving motor is type "AR," continuous-rated 50 deg. squirrel-cage induction type provided with moisture-resisting windings.

Steel Belt Conveyors—Sandvik Steel, Inc., with works at Sandviken, Sweden, and offices at 233 Broadway, New York City, have issued a twenty-six page, illustrated booklet describing Sandvik steel belt conveyors. These belts are made of high-grade charcoal steel by a special process, cold-rolled, hardened, and tempered. They are manufactured in one-piece lengths of 250 to 325 ft., in various widths, and in thickness from 19 to 20 s.w.g. Their flexibility and dense, hard surface provide the elastic and wear-resisting qualities so essential in a conveyor belt. There has been little material in print on steel conveyor belting, although the Sandvik works have been producing this type of belts for the last twelve years and have made 1,300 installations of conveyors of varying dimensions up to 800 ft., center lengths.

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Volume 113 New York, May 27, 1922 *Number* 21

Persistence of Tertiary Veins in Depth

WHEN WE TALK about veins persisting in depth, or dying out, it is first of all necessary to specify what kind of veins. There are veins and veins. And the known laws vary accordingly.

Take, as one type, the shallow-formed veins, which have formed in or near volcanic rocks of Tertiary age. These have been sometimes called the bonanza type. They were formed in the Tertiary, in a belt around the rim of the Pacific Ocean, and to some extent elsewhere. In North America they form a prominent type of vein in all the regions from the Rocky Mountains to the Pacific—the Cordilleran belt.

The ores of these veins never had great vertical range of ore-deposition; this was due to the conditions of formation. The greatest demonstrated vertical range which we know for ore deposits of this type is at Guanajuato, in Mexico, where, at the Valenciana mine, from top to bottom, the extent was around three thousand feet. At Guanajuato they had the top of the orebody as well as the bottom; so they had the whole vertical range. Other similar veins, however, are cut by erosion at various planes—near the top, around the center, or near the bottom. So your typical Tertiary bonanza-type vein (predominantly gold-silver bearing) may go down five hundred, a thousand, fifteen hundred, feet. You are very lucky if it goes down two thousand (from top to bottom of orebody); and it is probable, from the above observations, that around three thousand feet is the greatest depth you can hope for—and ten to one your hopes will be blasted.

Where these veins are bottomed—and our Western country is very full of these veins which have been bottomed—there is no more. Useless to theorize about "barren zones," "secondary enrichment," and other ignorant, pseudo-scientific claptrap, and spend good money in deep sinking. It has been tried, and never succeeded. Theoretically, also, the chances are all against success.

These observations apply only to the type of veins described. We may take up the question of other types later. The extreme vertical limit of some types has never yet been reached.

The Tractor in Mine Operation

THE INTRODUCTION of underground mining machinery marked the beginning of an epoch which may well be regarded as an important one in the annals of mining. The compressed-air drill, the various types of haulage equipment, the loading machine, the small-type air hoist, all registered advance in underground work and have aided in keeping costs at figures that have permitted a margin of profit despite increasing wages and other advancing expenses. The trend toward mechanicalization of operations has been noticeable not only in underground work; in fact, considerable advances have been made in surface-machinery design, the greater part of which has a direct application to underground operation, although situated "on top." Here, however, the trend has been toward larger capacity machines, such as hoists and compressors, rather than toward perfecting equipment for a diversity of purposes.

With the advent of the automobile, and later on the automobile truck, many of the vexatious problems concerning transportation were solved, but there remained a demand for a machine which would successfully, and at a moderate cost, perform certain functions that were done either by large machinery, manual methods, or not at all. This was particularly true, and still is, at some of the smaller mines and those to which shipment is expensive and difficult. This demand is met, to some degree at least, by the small-type tractor, which seems to combine portability, power, low cost, and simple operation. The capacities of the different makes vary, but it may be said that 20 hp. is about an average. Fuel consumption is small, and other considerations make its use most advantageous to the mine operator.

The application of the gasoline-driven tractor to uses other than those for which it was primarily designed is proving to be a boon that should not be overlooked. Not only is such a design suitable for all sorts of transit problems about the mine, mill, and smelter, but with slight modifications it can be transformed into a complete power unit applicable to such operations as the hoisting and loading of materials, the operating of certain types of drills, and serving as a driving unit for portable air compressors.

Cyanidation and Seaweed

INTERESTING RESEARCHES have been made lately at the experimental plant of the Department of Agriculture at Summerland, Cal., on the utilization for various industrial purposes of what is termed kelpchar. The harvesting of seaweed and the burning or other treatment of the kelp assumed large proportions in California during the war, the monthly output of weed handled during 1917 amounting to about 24,000 tons. A number of products were made; these included acetone, used in the manufacture of munitions. Attention is now being paid to the utilization of the char as a bleaching and purifying agent.

The use of lump charcoal as a precipitant of gold in aurocyanide solution is of historic interest only. Finely powdered, however, it is remarkably efficient for the purpose. The decolorizing and purifying of liquids by such material is essentially a physical action, depending on adsorption. It is not strange, therefore, that a recognition of the bleaching properties of kelpchar should have led to an inquiry as to its utilization as a precipitation of gold in solutions resulting from the cyanidation of ores. Tests have been made by Dr. W. J. Sharwood, of the Homestake company, who has demonstrated that kelpchar is an efficient substitute for the metallic precipitant that is ordinarily used in metallurgical plants.

Not long ago a patent was taken out in England to cover a process whereby it was alleged that the gold in sea water could be recovered by adsorption on colloidal carbon. Dr. Sharwood's tests indicate another link in the chain of investigation by which it may be possible to concentrate the gold in sea water by means of a "precipitant" found in close proximity to the "mine." The problem would seem to lie in the selective adsorption of the gold compound, to the exclusion of the other constituents of sea water; and this is doubtless where any practical application of the idea would fail.

Experimentation of this kind may appear to have no immediate commercial application; but every step in progress toward a comprehensive knowledge of all such reactions will help to formulate a satisfactory explanation of much that is now obscure in many phases of wet chemico-metallurgical operations. It may, moreover, form the basis of further research that may point a way to more economical and efficient treatment of low-grade ores.

Revival of the Slate Industry

THE USE OF SLATE for covering places of human habitation probably dates back to the prehistoric period when the cave man sought refuge from storms beneath arched piles of slate that had fallen down in precipitous ravines. When man progressed beyond the stage of merely seeking refuge, to that of rudely hewing his home in the face of a cliff, undoubtedly slate still held its own as a roofing material; and possibly it covered the homes of a larger proportion of the human race than it does in the year of grace 1922. However, as the statistics of that period are somewhat less accurate than those of today, it is clearly out of the question to settle the matter conclusively.

Coming down to more modern times, a slate-roofed chapel built in the eighth century at Bradford-on-Avon, Wiltshire, England, affords evidence of the use of this mineral product many centuries ago. Through succeeding years the slate industry has experienced alternate periods of activity and depression. Cheaper and more easily handled, though less-enduring materials, have found public favor; and one after another has fought with slate for supremacy in the roofing industry. The struggle is by no means over; in fact, the competitors in the field are increasing constantly. The extension of the slate industry to include the manufacture of steps, panels, baseboards, and electrical switchboards has alleviated the situation to some extent, but competition in these branches also is remarkably keen.

During the war some activities in the slate industry were seriously curtailed, for structural and roofing slate were classed as non-essential products from a military standpoint. On the other hand, the manufacture of slate switchboards received added impetus, for they were regarded as essential, and were greatly in demand. On the whole, slate recently has experienced a succession of lean years. For roofing it must compete with tile, various composition materials, wood shingles, asbestos shingles, and lately with zinc and copper also. For structural and switchboard purposes, soapstone, marble, and tile are active competitors.

The depressed condition of their industry has lately aroused slate producers to a realization of the great need for united action to obtain the recognition that their product warrants. Two conferences have recently been held, with the result that a National Slate Association has been formally organized. A committee is now preparing bylaws and making plans for future activities.

Heretofore the demand for slate have been governed largely by increases or decreases in the popularity of competing materials, the slate producers having passively accepted whatever came their way. The recently established organization should mark a new era in the slate industry—an era when passivity will give place to aggression. There is now evident in the industry a spirit of unity that heretofore has been sadly lacking, a tendency for everyone to put his shoulder to the wheel in an earnest endeavor to improve the product and broaden the market; there has been an awakening to present-day industrial tendencies and opportunities and a realization of the need for co-operative effort, instead of the unorganized and ineffective policy of every man "going on his own."

Fabricating Copper Articles at the Mine

A CLOSER CO-OPERATION between mining and manufacturing promises to result in the avoidance of so much economic waste that it is interesting to note that experimentation in connection with the direct production of copper sheeting from leach solution is still in progress at one, at least, of the large copper plants in the Southwest. For this purpose a revolving drum is employed, somewhat similar in appearance to an Oliver filter, the bottom of which dips in the high-copper solution from the leaching vats, the level being maintained constant, despite a continuous flow into and out of the trough. Cord is wound spirally on the surface of this drum and spaced about three inches apart. The surface is then coated with a solution of sodium sulphide. Current is then applied from an electrode in the bath and travels through the solution to the surface of the revolving drum, on which copper is deposited. A thin but perfectly smooth sheet of copper is deposited. This is wound off on spools, being washed en route. It is then passed through machines and pressed into shapes, which are afterward soldered together to form radiators for automobiles. A number of other all-copper articles might successfully be made in a similar manner.

Congress and Efficiency

DELAY BY CONGRESS in passing the usual appropriation bills is resulting in a stagnation of the U. S. Geological Survey field program. Parties that should be started for the field at once are marking time, and waiting for the necessary action. For work which has to be done as far off as Alaska, and where the season must be carefully parceled out, this is a serious matter, and results in a great loss of efficiency. It would pay the country if Congress would consider these things more—not only how much money it allots to this and that, but what result is obtained for each dollar. Instead of this practical interest in efficiency, Congress is considering lengthening the working day for Government bureaus to eight hours. Efficiency is not measured by hours but by results.

Under existing Federal regulations, a Government employee may hire a horse or a "horse and buggy"; but it is not legal to hire an automobile. The regulations have not yet been brought up to the automobile era. General Dawes might well look into some of these stupid obstacles to obtaining adequate returns for expenditures.

The Wrong Word

FOR MANY YEARS Mr. Rickard has been a crusader in the cause of better writing among technical men—primarily among mining engineers. He does not contend that literary elegance should be the goal of every engineer, but he does maintain that the engineer should be as efficient in his writing as he is in his technical work. He argues that the first requisite for effective writing, in fact the prime purpose of technical writing, is to express ideas in a form in which they cannot be misunderstood by the reader. It must be clear to be convincing, and, to be successful, an engineer, like a financier, for example, must be able to convince his clients or his associates.

There is no use denying the fact that technical men have been lax in this respect; at the same time it is pleasant to note a tendency to take greater pains with writing. And when a competent engineer takes pains with anything he is likely to do it well. Mr. Rickard has published two books on technical writing, and he is now preparing a third, which will include several chapters of the earlier work, thoroughly revised, and a number of entirely new ones. Of the latter, one is entitled "The Wrong Word." It will be found in the present issue of the *Journal-Press*. Mr. Rickard does not expect everyone to agree with all of his ideas; in fact, he anticipates disagreement with particular details. He hopes, as he says in the preface of his second book, to cause engineers to "sit up and take notice." He strives to arouse intelligent interest in the proper use of language.

Should an Engineer Advertise?

SHOULD A CONSULTING ENGINEER who desires to sell his experience and services undertake to get in touch with prospective clients by the modern method of publishing advertisements in the press? To this question the answers will be many and various.

On the one side is the conception of engineering as a profession—a fourth profession, added to the ancient aristocratic trio, the doctor, the lawyer, and the minister. Tradition prescribes that these three shall not advertise. The doctor who advertises at once places himself in a definite category in our minds—that of the exploiter and quack. The lawyer does not advertise. For such professional men it is understood that advertising is unethical; and, being so considered, it is unprofitable. We once knew an able lawyer who ruined his career by breaking the bounds of tradition and resorting to advertising in order to extend his practice. A professional man, according to custom, lets his work speak for itself. His first case, if the work is well and skillfully performed, procures a reputation growing by word of mouth, and his clientele gradually spreads. And this is practically the custom among consulting mining engineers.

On the other hand, engineering, as has often been pointed out, is a business as well as a profession. This becomes more decided and evident in the case of engineers who specialize in the designing of industrial plants—paper mills, foundries, textile plants, and the like. Such engineers, in addition to being consulting and constructing engineers, may also undertake the management of business, especially of public utilities like gas and electric operations, and street railways. They are essentially business men; and in business; advertising is the chosen and highly devoloped device for securing business. It is not only customary but ethical; it is practical; it answers the purpose of putting the purchaser of goods or services in direct touch with the seller, in the most businesslike and efficient manner.

At a recent meeting of the American Association of Engineers a successful engineer of the type last described took the ground that "Outworn codes of ethics, timidity, custom, and the popular opinion gradually formed from these seem to have set a limit to those who may advertise. But it is a wholly artificial limit. In discussions with engineers regarding advertising I have found no logical objection to it." And he concludes that "The best test of whether advertising is ethical is the test of its truthfulness. If it states the truth, there is no justifiable objection to it."

This wide divergence of opinion comes largely from the wide spread of the great inclusive group loosely called engineers. Mining engineers, it may be stated in general terms, do not advertise. True, they carry their professional cards in the *Journal-Press*, but that is a sort of directory, a method of letting their friends know their postoffice and cable address, rather than a bid for work. Yet most engineers have a lingering hope that on occasion this custom may bring them practice: at the least they look upon it as a necessary precaution, so that they may not be difficult to find if anybody should want them, and an insurance that a sudden undefined opportunity will not perchance pass them by; therefore, in a refined and gentlemanly sense, such a card is an advertisement. Nay, many complain frankly that these cards are not efficient enough, because they are read by other engineers, and not by the men that hire the engineers. And it is not an unknown experiment, as we recall that a firm of consulting mining engineers inserts a conspicuous card—an advertisement, in short—in a sober and conservative financial paper, one read by that class that owns and controls mines: and such an experiment has been made with no loss of prestige. If the practice has not spread, it is perhaps as much on account of the expense as because of any feeling that a breach of professional ethics had been approached.

We have read an interesting account by a Spanish traveler, of his visit to the great Valenciana mine, in Guanajuanto, a couple of centuries ago. According to custom, he "walked" down into the mine, by the tortuous "camino," but was granted the favor of being hoisted up the great octagonal shaft by one of the mule whims which slowly elevated the ore in rawhides. He was put into a sort of saddle, made by looping the end of the hoisting rope, so that he stuck his legs through loops and held on with his hands; and his guide was similarly provided for, directly above him, on the same rope. If he let go his hand-hold, his legs would slip out of the loops. The hoisting operation took half an hour or more, and the guide regaled him with conversation on the way up. "The last man whom I escorted," he observed, "let go and fell when we were about half-way up, but *with such discretion* that I did not perceive the occurrence till I had arrived at the surface."

The engineer who desires to extend his practice by advertising will perhaps find no logical obstacle, as was claimed by the speaker quoted above. As a practical matter, traditions and popular opinion are also powerful and tangible factors; and he will find it necessary to proceed with as much discretion as the investigator of mines of whom the Spanish author so quaintly writes. And even in this case, although the tale does not specify, we suspect that the exemplary discretion did not save the discreet one from being badly bumped.

The Tariff on Cyanide

DOWN IN CONGRESS there is much discussion about the tariff on cyanide. The Western Senators are divided on the question; but the two Senators from Nevada, respectively Republican and Democrat, are a unit against the tariff. The supporters of the tariff argue in favor of keeping alive an American industry for national emergencies. But its opponents point out that the American industry is a monopoly, of largely German ownership, and that the same company is agent for the German cyanide industry. Therefore, the Nevada Senators do not believe that the mining industry should have to pay a tax, even though a slight one, on its supplies, but that it should buy as cheaply as possible.

Supporters of free cyanide have been somewhat disappointed at the attitude of the American Mining Congress, which has remained neutral in the matter; possibly, it has been surmised, because it does not want to spoil its unbroken record of being in favor of a tariff on everything; and partly, perhaps, for other reasons. We can see no adequate reason for this tariff.

Assaying Without Chemicals

APPROXIMATE assays of certain substances may be determined without the services of the skilled chemist, without fire or chemicals, without grinding the sample, and in a small fraction of the time ordinarily required. All that is needed is a specific-gravity apparatus, such as the Jolly balance, which permits the determination of the weight of a substance first in air, and secondly when submerged in water.

In a paper presented at the annual convention of the American Society for Steel Treating last fall, Arthur S. Townsend, chief chemist of the Cleveland Twist Drill Co., outlined a method for the determination of tungsten in high-speed steels by their specific gravity which was accurate to within 0.3 per cent of the amount of tungsten present. The method, of course, is valuable only when it is known that the steel *is* a tungsten steel and that the amounts of other constituents except iron show little variation in different samples. That is, the tungsten and iron are the variables, the specific gravity of the former being 18.7 and of the latter, 7.8. Then it is [illegible] necessary to make up a table giving actual analyses and corresponding specific gravities for reference purposes.

This method would seem to have application in other fields. Why, for example, would it not be possible to determine the amount of copper in blast-furnace matte by this method? The sample could be taken, the weight in air and water determined, and the result calculated by the use of the slide rule or logarithms in five or ten minutes without any more chemical or arithmetical skill than is possessed by the ordinary shift boss or furnace foreman. Matte varies only in its copper and iron content, and, although the difference between the specific gravities of copper and iron is not great, the results should at the very least be as accurate as is necessary for operating purposes. Lead-containing materials offer even greater opportunities for the use of this method than do copper. Slags, as a rule, do not offer quite the possiblities, but valuable information might be obtained here also, where the charges do not show wide variation in composition. At any rate, it would seem to be worth while to assemble the results of a series of chemical analyses and specific-gravity determinations on daily samples and see if some useful relation cannot be found between the two. Diamond-drill cores, and even samples of mine rock, in which the character of gangue and mineral are constant, might also be roughly assayed by this method.

Wanted, More Information About Mines

STATE MINE INSPECTORS or officials who perform their functions should consider it their duty to publish at regular intervals comprehensive lists of the companies operating or having property within their several states. Many of them do, but in some states they do not. Some of the lists published give little more than the name and address of a company. Others are more informative. The report of the Idaho Inspector of Mines, for instance, is practically a handbook of Idaho mines.

Frequently, though it may seem odd, some one who has been offered the opportunity to invest in mining stock is inquisitive enough to want to know about the property. The number of mining companies, with and without holdings, is legion, and often it is with difficulty that such a desire for knowledge can be satisfied. No one should be better posted than a state inspector on the properties within his state. Not that he should knock or boost, or be expected to pass upon the reliability of a company. This would be unwise. But such facts as the address of a company, the location and description of its property, its officers, capitalization, its history in brief, with other kindred data, could well be published annually.

Recently we sought a list of the mines of Alabama. From Birmingham comes word that an up-to-date list of coal-mining operations exists, but not of ore mines. It seems that the state inspector has not been able to establish his authority over operations of this class, and cannot therefore secure authoritative information regarding them. This is but a case in point. If the inspector can secure the information, the public has a right to know it.

Fraudulent stock promotions are made more difficult the more the public knows of the property concerned. They will not be made impossible, however, by any amount of published information, for the boob will still remain a boob and will never stop to ask. Still the information is desirable, that protection be afforded the public, and as a matter of record.

Alaskan Affairs

By T. A. Rickard

THE Governor of Alaska, Mr. Scott C. Bone, stated recently at Washington that the administration of the Territory is "chaotic" and that "the overshadowing need is a simplified and co-ordinated system". For several months there have been rumors of dissension in the President's cabinet, on account of the proposal to remove the Forestry Service from the Department of Agriculture to that of the Interior. It is well to note that even the supporters of the Secretary of Agriculture concede that the development and progress of Alaska are hindered by a bureaucratic control that not only is scattered among several departments but suffers from the fact that it is exercised at a distance of more than 4000 miles.

Surely something is wrong up North. The population decreased from 64,356 in 1910 to 54,933 in 1920. The white people numbered only 30,000 in 1920 and yet they produced and shipped minerals, fish, and furs worth $69,000,000 in that year. Today the whites do not exceed 20,000. The area of Alaska—586,000 square miles—is equal to the combined areas of Minnesota, Wisconsin, Iowa, Illinois, Missouri, Kansas, and Nebraska. It was bought from Russia for $7,200,000. The fisheries alone have yielded over $50,000,000 in a single year and the gold mines in one year have produced three times the purchase price.

At the present time half the population, white and Indian, is engaged in the fishing industry, which has declined, for the reason that the fish have been so ruthlessly killed that the Department of Commerce has had to impose restrictions. On the other hand, the protection of the forests, with their 20,000,000 acres of spruce and hemlock, is in the hands of the Forest Service, with headquarters at Juneau, but acting under the Secretary of Agriculture. Again, the Navy Department has been operating coal mines in the Matanuska field and has spent a million dollars already in these operations, which it is proposed to place shortly in the care of the Secretary of the Interior. The complaint is made that this distribution of control among the various bureaus of the Government is paralyzing the industrial life of Alaska, and that the only remedy is to co-ordinate and consolidate the administration of the Territory. That is desirable, but it will not cure the *malaise* that has crippled the progress of Alaska. I am in agreement with Maurice D. Leehey, who, in an article appearing in 'Northwest Mining Truth' of February 15, insists that Alaska needs "a return to the simple freedom of individual opportunity which peopled and prospered the United States". Mr. Leehey claims that the withdrawal by the Government of the coal-lands in 1907, the futile prosecution of honest pioneers, and the enforcement of the Leasing Act have hindered development. The people of Alaska have no voice in their own government, they are governed by bureau chiefs that do not know either their circumstances or their needs; they are harassed by petty officials. The inevitable result is to discourage initiative, particularly on the part of the small operator, on whom depends the pioneer work requisite for the development of the North. It is noteworthy that one-fifth of the value of the products exported from Alaska in 1920 was copper, nearly all of which was produced by one big corporation. More than half of the exports was canned salmon, and most of this was shipped by half a dozen packing companies. Of the $8,000,000 of gold produced, more than half was from lode mines, and chiefly from the properties of two big companies. In 1920 only $3,630,000 of gold came from alluvial workings. The number of placer miners—the pioneers of industry—has diminished sadly during recent years.

The Federal Government has done much for Alaska; notably in building the railroad to Fairbanks, in establishing agricultural stations for the encouragement of farming and gardening, and, as we miners know, in conducting an elaborate series of geological investigations under the leadership of Mr. A. H. Brooks. These favors are appreciated by the Alaskans, but I think Federal help in developing the region has been frustrated, in large measure, by the restrictions on enterprise, particularly by means of the regulations applying to location and tenure of mineral land, and obstructions to prospecting offered by the Forestry Service.

The idea prevails in some circles that Alaska needs the interest and industrial participation of large capital, working under the patronage of the gentlemen at Washington. The people of Alaska are of the opinion that what is needed is more encouragement for the small operator. It is believed that this can be furthered by the passage of the bill for the better development of Alaskan resources introduced by Mr. Charles F. Curry, of the House Committee on Territories; and I note that at the recent Northwest Mining Convention at Spokane a resolution was passed endorsing this bill, "to the end that the several bureaus in Washington having to deal with the natural resources of Alaska be co-ordinated and united in so far as their Alaskan activities are concerned, with an authorized representative resident in Alaska". In the same resolution an early return was urged "to that liberal public-land policy which has been so successful in the Great West, both in the United States and Canada, by the encouragement it gave to individual initiative and pioneer effort". Unfortunately the affairs of Alaska are mainly in the hands of persons representing the populous parts of the United States, they are administered by individuals ignorant of conditions in the North, they are controlled by large corporations having headquarters many thousand miles from the scene of productive activity. The people of the Territory ask for a modified kind of home rule. For example, that stalwart Alaskan, Mr. Falcon Joslin, suggests an administration such as that of the Philippine Islands, with Commissioners of Public Lands, of Public Works, of Fisheries, of Education and Health, an Attorney General, and a Secretary Treasurer, appointed by the Governor and confirmed by the territorial Senate. To these departments would be delegated the duties exercised by the bureaus and commissions that now exist for the same purpose, at Washington and in Alaska. It seems fair that the people of Alaska should have at least as much self-government as the people of the Philippines; and I venture to add that the geographic distance that separates these outlying parts of the United States from the seat of Federal government is sufficient to explain the mistakes that have been made in administration and to justify the demand of the people of Alaska as expressed at the Spokane convention.

DISCUSSION

Russian Placer Mining

An Engineer with Long Experience in the Gold-Producing Region of the Country Presents Facts Respecting Recent Operations There

THE EDITOR:

Sir—When I criticized the American sluice (pp. 416-418, in the *Mining and Scientific Press* of March 26, 1921), condemning it as a poor washing appliance, I anticipated a rebuttal from C. W. Purington, the initiator of its introduction at the Lenskoe mines, but I expected his arguments would be based on technical reasoning, instead of on bookkeeping, and, as *ultima ratio*, on a testimonial of the board of directors of the Lenskoe Gold Mining Co. This testimonial is absurd, because in the year 1913-14 there was only one American sluice in operation on the Lenskoe mines—i.e., the one on the Feodosieffsky mine, which, after the misfortunes described in my article, finally started washing in July, 1914, and, as Mr. Purington well knows, until the end of the operating year it washed 25,000 cu.yd. at a maximum. This amounts to *less than 3 per cent of the year's total output of gravel washed.* It is obvious that so small a percentage could not possibly lower the average cost of washing, reduce the loss of gold, or have any of the other beneficial effects on the operations which Mr. Purington claims. The testimonial mentioned might have been unsolicited, but the board of directors was evidently led astray by the reports and statements of those, who particularly advocated the introduction of the American sluice at the Lenskoe mines.

Mr. Purington states that the final diminution of working costs was attained by improvements reducing the cost of the different manipulations. He is quite right, and no objection can be made to this, as it is the normal procedure, I should think, and certainly there was no hocus-pocusing at the Lenskoe mines. But everyone who has a thorough practical knowledge of mining operations, who has figured estimates of the output and prospective profits, and has had the responsibility for their fulfilment knows that improvements and reductions of cost in different manipulations become manifest only some time after the changes are accomplished, especially when these improvements and reductions have to be made gradually, keeping the operations going on at full speed without lowering the production. Under such circumstances, bookkeeping, for reasons with which every mine manager is familiar, does not reflect the saving on the different items immediately the changes are made, but some time after. This is exactly what happened at the Lenskoe mines, where the fundamental improvements made in every department by Russian engineers in 1913-14 revealed their full value at the time the mines came under the control of Messrs. Purington and Smith, who thus reaped the benefit of the efforts of the former. Thanks to this "curious coincidence," Mr. Purington ascribes the obtained diminution of costs to the "methods introduced by foreign engineers."

"The marked increase in yardage treated from drifting operations, comparing the seasons 1913-14 and 1914-15" is not a coincidence, as Mr. Purington equivocally says, but is due solely to the extensive development and preparatory work done in 1913-14, and the plan should have been followed instead of making "considerable modifications" which led to a gradual decrease of the output of gravel, as shown by Mr. Purington's table, relating to winter washing.

As for the increase in the gold production, which Mr. Purington ambiguously calls "recovery," it has nothing to do with foreign or other washing methods, being merely the result of the fabulous richness of the Bolshoi Chanchik Creek, which I discovered and prospected in 1913-14, and on which the workings were chiefly concentrated during 1914-15 and subsequent years. The great total drifting output for 1914-15 of $8,600,000 is a natural consequence of the rich contents per cubic yard of gravel treated.

One of the would-be foreign methods eulogized by Mr. Purington is the winter washing of the gravel, but he omits to mention that winter washing was introduced a year before the gentlemen named gained control of the operations at the Lenskoe mines; true, on an experimental scale, only with the purpose to ascertain whether under the rigorous climatic conditions on the Lena winter washing was profitably feasible. On account of the results of these experiments it became possible to develop winter washing further in the following seasons.

Mr. Purington states that for the winters 1916-17 and 1917-18 the percentage of gravel washed attained 36½ and 52½ per cent respectively, of the entire season's output. Quite so, but it appears that Mr. Purington does not fully understand the language of the figures he summarizes. In fact, these figures show a difference in the amount of winter-washed gravel of only 15½ per cent comparing the seasons 1914-15 and 1915-16, and a further microscopic increase of 4 per cent for the season 1916-17. These figures show further that the 52½ per cent of gravel washed in winter as mined was not by actual improvement and development of the method in question, but by a tremendous drop of 65½ per cent in the yearly output of the mines, from 873,835 cu.yd. in 1913-14 to 569,679 cu.yd. in 1916-17. This appears to be the final and most striking result of the much-lauded control of Messrs. Purington and Smith. Everybody will agree that such a result is contrary to the fundamental principle of all industry—efficiency.

The enormous decrease in the output cannot be attributed to war conditions, because up to 1918 the mines were furnished with all provisions and supplies necessary for the work, nor was there shortage in labor, as, according to a resolution passed by the Government Committee for Gold Mining Affairs, to which I was appointed representative of the Minister for Trade and Industry, all workmen on gold mines were exempted from conscription. The only draft occurred at the outbreak of the war, at the end of July, 1914, during my management, when about 1,800 miners and eighty men of the staff superintendents, mine bosses, and foremen were called to the colors. But for this draft the year 1913-14 would by far have beaten all records concerning gravel output and washing on the Lenskoe mines.

Another feature of the control of the operations by Messrs. Purington and Smith was the erection, at the Tikhen mine, of a plant, consisting of a rope-way combined with an elevator, for the purpose of working the high bank of an old open cut. Mr. Purington told me of this plan soon after his first arrival at the Lenskoe mines, but I did not consider the scheme any further, as it was bound to fail. And so it did, when it was tried, after I had resigned, involving a heavy loss to the company.

Mr. Purington contends the trommel washing plants are inadaptable to winter washing. Such an affirmation is ridiculous, for according to the laws of heat transmission it is easier to heat a more or less parallelepipedal housing of a trommel plant from a central heating apparatus than the corridor-like extension of a sluice say 300 ft. long. Mammoth 17-ft. dredges are successfully heated on the Klondike and in Alaska, trommel, washing appliances, transmissions, digging apparatus, and all. Why not a stationary plant?

Apropos, no such trommel washing plants as were erected at the Schouvaloff and Lenskoe mines are used in Australia and California, as Mr. Purington states. The one he describes in Bulletin No. 263 of the U. S. Geological Survey is a parody of a modern Russian trommel washing plant and far more inadequate than even the old Siberian washing appliances. But, poor as it may be, this plant, from an engineering point of view, is infinitely superior to the long sluice, because, being based on the right principle of ore dressing, it can be improved in the details, whereas the idea of the sluice is primitive in itself, and not susceptible of improvement.

Mr. Purington thinks it a great advantage to dispose of the tailings by means of the transporting power of water. This system was extensively practiced on the Russian placer mines in times past, and abandoned as being a near-sighted policy, unless the local conditions of surface relief are exceptionally favorable. Distribution of the tailings by the transporting power of water may prove economical for a year or two at the beginning of operations, or while working on a small scale, but if 700,000 to 800,000 cu.yd. of tailings are annually in the course of many, say ten or fifteen, years carried away by the water courses the result will infallibly be that all flumes, water races, and ditches, and even the rivers themselves, will be choked with sand, silt, and mud, which would threaten the very existence of an enterprise wholly dependent on water-power, as are the Lenskoe mines. This would cause a lot of trouble at the power stations, wearing out the turbines and so on. Besides, the underground workings would surely be flooded in a short time, as a consequence of the obstruction of the natural drainage system.

Mr. Purington asserts, that I "attack well-established methods of mining alluvial gold," and omit "a general criticism of gravel mining methods in all countries outside Russia."

This sounds like German war-sophism. I am the defender; Mr. Purington is the assailant. In the editorial of the *Press* of March 19, 1921, there is defined in a few concise words the aim of my articles, which was to combat erroneous ideas about Russian placer mining propagated by articles such as Mr. Purington's contribution to the issue of Sept. 6, 1919, of the *Press*, which appeared also a couple of months earlier in the English edition of the Vladivostok paper *Echo* for June 21, 22, and 23, 1919.

Facts are facts, and the failure of all foreign gold placer enterprises in Russia, with the few exceptions I mentioned, is manifest to all who in one way or the other have been connected with the disasters. Having had during thirty years of activity in Russian placer mining the opportunity of watching most of the foreign enterprises from the start to their final debacle, I have tried to explain the reasons for these wholesale failures as I saw them, and I wanted at the same time to give, as far as is possible within the scope of a few columns, a general picture of Russian placer mining methods, their origin, and all the factors having an influence on their development. My remarks on individual mining undertakings, the Lenskoe, the Kolchan, the Schouvaloff, and other placer mines, were cited as illustrations only in support of my statements concerning the different gold-producing regions of Russia, in which conditions, naturally, vary greatly, the gold fields being scattered over a territory covering, as Mr. Purington rightly remarks, a lateral range of eighty degrees of longitude, and, I may add, ten degrees of latitude.

It would have been of interest and would better have served the purpose if Mr. Purington had given his explanation as to the causes of the failure of foreign ventures in Russian placer mining, instead of limiting his arguments to the Lenskoe property only and making a technical controversy a personal issue. W. E. Thorne's letter published in the *Press* of Dec. 31, 1921, fully explains the real situation. L. A. PERRET.

Yokohama, Japan.

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Inconsistencies in Mine Depletion Acts

THE EDITOR:

Sir—The acts of Congress under which depletion deductions are being made by mines, provide as follows:

Act of 1918: A reasonable allowance for depletion not to exceed the market value in the mine or the product thereof which has been mined and sold during the year for which the return and computation are made. Provided, that when the allowance authorized shall equal the capital originally invested, or in case of purchase made prior to March 1, 1913, the fair market value as of that date, no further allowance shall be made.

Act of 1919: A reasonable allowance based upon cost, including cost of development not otherwise deducted. In case of a mine operated by the discoverer, the fair market value at the time of discovery or thirty days thereafter.

Act of 1921: A reasonable allowance for depletion and for depreciation of improvements according to the peculiar conditions in each case based upon cost, including cost of development not otherwise deducted. Provided, that in the case of such properties acquired prior to March 1, 1913, the fair market value of the property (or the taxpayer's interest therein) on that date shall be taken in lieu of the cost up to that date.

The joker in each of these three acts is the words "The fair market value at that date" (March 1, 1913).

The act of 1918 provides that "when the allowance authorized shall equal the capital originally invested"; thus basing it on cost. The act of 1919 states "a reasonable allowance based upon cost." The act of 1921 states also "based upon cost." But in all three acts, in the case of property acquired previous to March 1, 1913, "the fair market value" is stipulated.

Therefore, let us take a concrete example: A mine was purchased on March 1, 1913, for $100,000. Under the wording of all three acts, only $100,000 depletion can be taken, development costs being taken care of as a charge to the ore when mined. Had that same mine been purchased on Feb. 28, 1913, the purchase price being the same, according to the wording of all three acts, the $100,000 purchase price can be designated and the "fair market value" as of the next day guessed at, which of course will be more than the purchase price, because no one pays $100,000 for a mine if he thinks there is only that much in value of metal in it.

After passing a few more acts regarding depletion, someone in the Congress may think of having an act drawn to provide, "That in case of a mine purchased prior to March 1, 1913, the cost, less the value which has been extracted from the date of purchase up to March 1, 1913, will be the amount to be taken after that date as a depletion allowance, to be pro rated over the units of metal or ore mined subsequent to that date, on the same basis as that on which the amount subject to depletion on that date was arrived at."

That will say what the Congress has been trying unsuccessfully to say for several years. As above illustrated, why should a company purchasing a mine on March 1, 1913, be allowed to take as depletion only its purchase price, when, had the company bought the property on Feb. 28, 1913, it could take any amount as the "fair market value" as of the next day which it is able to "put over"?

And in the case of the discoverer who is operating the mine, why should he be allowed any depletion deduction? The Government gave it to him. His development costs are taken care of as a charge to mining when the ore is mined. C. B. Holmes.

Albuquerque, N. M.

Oil Leases and Contesting Claimants

The Editor:

Sir—In the act of Congress relating to oil and gas prospecting permits, Sec. 13 states that:

> "The Secretary of the Interior is hereby authorized under such necessary and proper rules and regulations as he may prescribe, to grant to any applicant qualified under this act a prospecting permit . . ."

On page 8 of Circular 672 of the regulations of the General Land Office is the plain statement:

> "It should be understood that under the act, the granting of a prospecting permit for oil or gas is discretionary with the Secretary of the Interior, and any application may be granted or denied, either in part or in its entirety, as the facts may be deemed to warrant."

In July, 1921, an application was filed for a permit upon land already covered by a previous permit, and a contest filed for the land, the second applicant alleging that the first permittee had lost his rights by failing to drill the land within the time specified by the regulations. This contest was rejected and dismissed and the fact noted on the records of the local land office.

In the Los Angeles *Oil Age* of August, 1921, was published a letter from the Assistant Commissioner of the General Land Office, George R. Wickham, in which that gentleman refers to a letter from his office to the Register and Receiver of the Visalia Land Office, wherein it was held that:

> "To allow contests against permits for such purpose would be to invite endless litigation, which would tend to defeat the very purpose of the oil and gas leasing act, to wit: development of the oil and gas resources of the country . . . The only question raised by the protest is whether an oil and gas permit is subject to contest by a third party. The only parties in the case of an oil and gas permit are the permittee and the United States, and a contestant could acquire no preference right to a permit, though the contest were sustained and the permit cancelled. The enforcement of the stipulations in the permit rests with the department, and contest by a third party is not the proper procedure in such cases."

It would seem to the uninitiated that the matter was ended by such plain statements, made public by letter to the press from the General Land Office and backed by the undoubted authority of the department to decide the question; but it must not be forgotten that the "endless litigation" referred to would be a source of endless fees for land lawyers, and the latter are human.

Owing to the failure of a wildcat well in the region, the right to oil in the land is not now considered of much value, and the "urge" behind the matter must be from those who would be most benefited by a reversal of the commissioner's former decision and the inevitable "endless litigation."

There are many regulations regarding the working and development of permits, and if failure to drill within proper time makes them liable to "jumping," then any minor infraction of the rules would legally have the same effect, and chaos would follow.

Many tracts under permit were not drilled in accordance with the regulations, owing to the financial stringency of 1921. A recent act of Congress allows the Commissioner of the Land Office to extend the time of such permits if he so decides; but will the extension of an invalid permit validate it? Especially, will the title be good in court afterward if oil is discovered on the land?

Must permit holders expect that as soon as they discover oil their claims will be "jumped"? It will be a pleasant prospect for land lawyers, and will increase fees in local land offices, but will make it extremely hard to interest capital in oil development under the permits.

The wearisome litigation occasioned by the Taft withdrawals has made investors "shy" of dealing in Government leases, and if to their fears there be added the danger of claim jumping, the intent of the oil and gas leasing bill will certainly be defeated.

It would naturally be expected that the commissioner would certainly decide this case as formerly, but great pressure will be brought to bear on him to do otherwise and to allow this first "jumping" application. With that precedent the flood gates will open.

To the mind of an engineer, the proper way to avoid rupture of a fixed (and high quality) support, liable to be strained beyond its limit, is to oppose an opposite strain. I therefore suggest that each reader of this letter cut it out and send it to his Congressional representative with a request that that gentleman's weight be added to such opposite strain.

Los Angeles, Cal. M. A. Knapp.

Mining iron ore at Gorumahisani, Mayurbhanj State, India, showing "witnesses" used in measuring work done

Coolie Labor in India

Mining Operations Lack Sufficient Workers, in Spite of Large Population—Contractors Are Depended on for Supply, Which They Often Fail To Furnish—Characteristics of the Natives

By H. J. Volker

At first thought the teeming millions of the East should seemingly provide ample labor for every enterprise conducted there. It is, however, my experience that though India may have 300,000,000 inhabitants, there are almost as many excuses for avoiding mining work. In fact, the Westerner's whole conception of a "job" is changed in India, where the coolies' work, other than that of the fields, is not taken seriously, and is a family matter, to be indulged in only on rare occasions.

Those starting enterprises in India should not, therefore, be misled into a belief that operations there are free from labor troubles because of the density of population or the cheapness of coolie labor. In India, it is not unusual to see coolies sitting on the "bunds" of their rice fields doing absolutely nothing as far as the observer can see. But it is not to be supposed that coolies thus occupied are available for work at a mine. For, despite the density of population in India, labor is not abundant there. In fact, abundance of population and abundance of population that is willing to work for the mine operator are dissimilar terms.

The mining work (open cut only) that I have observed is not taken seriously by the coolie. He is assigned a certain stretch of territory, and, when it is his desire to work, he comes with his household effects, his goats, babies, adolescent and adult members of his family and game cocks, for he loves a cock fight and indulges in this form of amusement every bazaar day. Although the work that he does is piece work, one sees none of the feverish activity that might be expected under that class of payment. All able-bodied members of the family work in a leisurely manner—children, wife, and husband. Although this looks like child labor with a vengeance, it really is not, as it is open-air occupation, and the children are as often playing with each other as helping their parents.

Large Operations More Affected Than Small

Then, the coolie comes to work quite irregularly. The monsoons, of course, are the most aggravating causes for his non-appearance, for it is then that he is planting rice, transplanting it, and doing other work in the fields. But there are also many festivals which demand his attention. For small-scale operations, this seasonal availability of the coolie may not be a serious detriment, but for those conducted on a large scale, where regularity is necessary, entire dependence upon such labor is unwarranted. In small-scale work, the entire community is not drained, and even during the monsoon a certain amount of labor is available, because of an overlapping in point of time of the various rice-field occupations. But in large-scale work, the community may be almost completely drained, so that a seasonal diminution is serious.

Of course, in mining work the practice is followed of using stockpiles to act as a balance wheel. But the natural fluctuation of mine labor is so large that an [illegible] stockpile at a smelter becomes essential. This may be impracticable from several reasons.

It is the custom in India to place the labor in the hands of native contractors. The contractors in turn may give parts of the work to petty contractors. Therefore two complete organizations may be present at a mine—namely, the company's, which is responsible for the equipment (rolling stock, crushers, tracks, gravity planes, machine shop, surveyor's office and the like), and the contractor's, which is responsible for the labor to do the unskilled work of mining, loading, and certain other jobs. This means that the contractor is a labor specialist. The arrangement appears to be an inefficient way to handle a job, and it is, but it saves the company a great deal of worry about labor supply. The company usually has enough worry without having to solve the labor problem.

Ore stacks and screen used at Gorumahisani

The fluctuations in labor may be as violent as from about 3,000 miners daily to 750, with the ore mined dropping from 74,000 tons in a month to 20,000 and less. These figures provide an indication of what to expect when complete dependence is placed upon labor. It is this fluctuation that forces large mining operators in India to realize that "cheap Indian labor" is a dangerous shibboleth; that in dealing with it alone, total dependence is being placed upon an unreliable element, and that where large output is demanded machinery must be installed.

Iron Ore Abundant

In several states of India rich deposits of hematite occur. These sometimes consist of ore in place as the principal supply and again as boulders. The latter, of course, are the more easily worked. At Gorumahisani, in Mayurbhanj State, the ore occurs as boulders mixed with earth, the whole as a blanket from a few feet to perhaps 20 ft. thick covering parts of the mountain and its lower reaches. The extent of the remaining ore in place from which the boulders have been eroded is not definitely known, but it is probable that the boulders form the chief supply.

The amount of ore that is contained in several deposits in place, other than at Gorumahisani, is enormous. The reserves of Indian iron ore are such that cheap pig iron should be easily obtained. There are, however, other factors that enter here that militate against final cheapness, such as long hauls for flux, coal and ore to the blast furnaces. The boulder deposit at Gorumahisani is about forty miles from the smelter at Jamshedpur. It is owned by the Tata Iron & Steel Co., Ltd., and most of my observations refer to conditions as seen there, although I believe that my conclusions regarding labor apply fairly generally throughout India.

Operations at Mayurbhanj depend on coolie labor. These coolies are simple, tractable, and childlike. They come under the general head of Dravidians, and in the region discussed several tribes of Dravidians are available. Among these are the Santals, the Kols, the Bumij, and the Oraons. The main consideration of these people is their rice fields, and when such work calls them, the difficulties of maintaining a large force at the mine are enormous and I believe practically beyond solution. Other work is secondary to them at these times.

To offset the depletion of labor during the rice-growing season, the contractor conducts a vigorous recruiting campaign, but in spite of all, the results at Gorumahisani show that "good" labor conditions occur only during February, March, April, and October. In January, festivals break up what should be, from crop considerations, a good month. May is an exceedingly hot month, and labor is not inclined to work. From June to September monsoons keep most of the coolies at their fields. In October a slight betterment occurs, but November and December are reaping and threshing months, so again the labor supply is poor.

Mining and Loading Done by Contractor

Labor operations at Gorumahisani are divided into mining and loading. These are done by the contractor. The company trams the ore to gyratory crushers from the place of loading in V-bottom side-dump cars, or "tubs," of 25-cu.ft. capacity (1.7 long tons) and 2-ft. gage, in trains of from sixteen to twenty tubs, by steam locomotives. From the crushers the ore goes direct into ore cars on the Bengal Nagpur broad-gage railway and is hauled to the smelter.

Mining consists simply in picking out the boulders and pebbles of hematite from the earth in which they are mixed. Sometimes the boulders are so large that blasting is required. As nearly all the boulders and pebbles are ore, and almost none of them granite or other waste, screens were introduced as a twentieth century improvement. This meant that the coolies simply had to throw the "run of mine" on a ½-in. screen and the oversize was ore. Even this small improvement took a deal of persuasion, as the coolie is a conservative.

Upon the miner devolves the work of stacking. Therefore during the week he roughly assembles the fruits of his labor in a pile and then takes all of one day to stack it in blocks called *paras*, which are 7½ ft. square and 1 ft. high. The miner is then paid by the contractor at varying prices per *pava*, the price depending upon the amount of ore mixed in the bank, the distance from the working place to the *pava*, the latter being placed as near as possible to the tram line, either existing or proposed, and the amount, if any, of barren earth that may be on the top of the blanket of mixed earth and ore. Each *pava* contains, at 16 cu.ft. per long ton, about three and one-half tons, and the labor of mining and stacking costs from Rs. 1-0-0 to Rs. 1-10-6 per *pava*, depending upon conditions. The records show that without screens the capacity per miner is slightly over half a long ton per day; but with screens, the capacity is nearly one ton.

WEEK HAS FOUR WORKING DAYS

The coolie has only four working days per week in which he actually engages in extracting ore. Sunday is measurement and pay day. Monday is a day of rest, Tuesday to Friday are mining days, and Saturday is set aside for stacking! In giving the above estimate of a miner's capacity his week's winnings are divided by six. The inefficiency of this system is apparent, and stacking seems to take at least one-sixth of the miner's time. To a limited extent this is avoided by loading into tubs direct from the first rough piles and paying the coolie per tub. This is not possible in all operations, for several reasons. First, the amount of ore mined is often far in excess of that loaded. Second, if the two operations could be equalized, the amount of rolling stock necessary would be excessively large, as the area covered at Gorumahisani is extensive. Third, with equal mining and loading a stockpile would, of course, not materialize, and it is desirable to have one at the mine, especially in consideration of the unreliability of the miner, weather difficulties, and the like. Storage in bins, to be drawn as desired from chutes, may not be practicable, as the area is large and working faces advance rapidly, and, in addition, timber construction is expensive. Furthermore, changes in general are difficult because of the conservative nature of the coolies.

The loading of ore, except as noted, is done from large stacks by special gangs of loaders. It is usually found that a gang of eighty coolies per rake of twenty tubs is best. At each tub three women (called *rejahs*) and one male coolie are placed. It is found that the capacity per coolie is about three and one-half tons per day. In fact from eight to eleven trips are made per rake of tubs, a great deal depending upon the load, the weather, and the ability of the loaders. This operation is done both by day labor and by piece work. Perhaps, on the whole, day labor is the more satisfactory, for here regularity of output is so essential that the added control under which daily labor works is desirable. Under this arrangement the cost of day labor is no greater than that of piece work. The reason is that in piece work the petty contractor reaps a rather higher profit than with the other work because it is so important that he bring all his loaders to work that an extra monetary inducement is given him. Also, the number of loaders is small, so that far more attention can be given here than to mining. This part of the work is the most difficult for the contractor. By virtue of his ore stacks, his mining operations can fluctuate as widely as the weather. It is of no importance so long as his stockpiles are never exhausted, and it turns out that he maintains them in ample size with little trouble. But the loading must be regular. And the fickleness of the coolie, to say nothing of incidental difficulties, makes this task severe. This difficulty is enhanced by limitations placed upon the stockpile at the smelter, and by failure to obtain a sufficient number of ore cars from the railway during the times when labor is abundant.

SETTLEMENTS BUILT FOR COOLIES

To obviate the difficulty of an unstable labor supply, the contractor builds settlements or camps, which he tries to fill with coolies who depend upon him alone for their living—that is, with coolies who have no fields. This, of course, helps a great deal, but here, also, coolies who have more fields than they can tend hire the resident coolies, and, pastoral work being always preferred, the old difficulty ever remains. Also, during the whole of the monsoons, continual absconding of recruited coolies takes place. If such a thing as an epidemic occurs, like cholera, the coolies becomes terrified, and whole droves of them will leave. In the midst of this trouble the contractor may find that his newest and best coolie houses have been "tabooed"; that the superstitious coolie believes that he will contract cholera if he lives there, and no amount of incantations or *pujahs*, or sacrifices of goats, pigs, and chickens will reinstate the said houses to favor. This condition I have witnessed after a cholera epidemic so that the best houses (made of sun-dried bricks, and roofed with tile) had to be abandoned, the only salvable thing being the tiles on the roofs.

In the tea gardens of India the coolies are given small plots of ground which they till and thus grow vegetables. In this way the absconding is prevented. This may not be practicable if the tillable fields have already been taken up by resident coolies.

IS HAND LABOR DESIRABLE?

It is at this point that one must consider whether it is desirable to use hand labor in India or not. The cost is undeniably low. It seems, however, that when regularity of a large output is demanded, machinery is far more desirable, even though at an apparently higher cost. Thus, at Gorumahisani the problem boils down to one of loading. Therefore, if a machine could be introduced to work at all times, regularity would be assured. The point to be emphasized is that in Indian operations labor is not abundant, that is *available* labor. Furthermore, it is unreliable and absolutely subject to occupations which are seasonal.

Some other of the primitive methods in use in India are shown in the accompanying illustrations. The blast furnace works on a charge of finely broken iron ore and charcoal. The bellows are pots covered with goat skin. Air is admitted through a hole in the latter, which is covered by the operator's heel when he forces the air into the furnace on the downward stroke. The photograph of the quarry that has been flooded shows a peculiarity in earth removal. This is the "witness." It will be observed that several small pillars appear in the picture. These have been left by the coolie to show the level at which his block of earth was before excavating. Needless to say there are various methods of increasing the height of the "witness" after the work of excavation!

The Wrong Word

By T. A. Rickard

FLAUBERT, as we know, laid stress on the selection of the right word, *le mot juste*, the precise epithet, "the word that belongs" to the thing. A sentence, or even a paragraph, may be spoiled by the use of a word that is not proper, that does not fit, or is foreign to the meaning intended.

An Australian mining expert is reported to have said:

> You have a property of considerable value, and what I saw warrants a good development of very rich **cubicular** galena, with gossan intermixed.

"Cubicular" means "belonging to a small bedroom," a "cubicle" being a sleeping compartment. He meant "cubic," of course. This is a malapropism, and reminds me of the lady from Chicago that, on her return from Europe, said how much she had enjoyed the rural parts of France, because, among other things, it was "so delightful to hear the French pheasants singing the mayonnaise."

> It is impossible to **amalgamate** coal-tar thoroughly with the pulp in the agitating-tank.

In metallurgy, "amalgamate" refers to the combination of mercury with one or both of the precious metals, forming an amalgam, which is an alloy of mercury with another metal. It differs from other alloys, such as brass or bronze, in being made without the aid of heat, because mercury will melt at an ordinary temperature. The word comes to us from the Greek through Old French and means "something soft." It is a mistake to use technical terms, having a specific meaning, for purposes that are foreign to that meaning. The writer of the quotation is not discussing any combination of metals; he is dealing with the physical process of mixing and is using "amalgamate" wrongly as a synonym for "mix intimately" or "emulsify." The effect is confusing.

> The **classical** formula $P = 2\pi$ should be abandoned.

He was referring to a familiar formula in physics. "Classical" refers to that which is of standard excellence in literature. "Classic" means "of acknowledged excellence." It is not the right word in such a context, though preferable to "classical," which usually connotes Greek or Latin. He meant no more than "well-known" or "generally accepted."

> The orebodies are reported to be more **permanent** than is usual in limestone.

If a thing be permanent, that suffices; it "stays put," as it were; one thing cannot be "more" permanent than another, but one thing may be either more or less impermanent than its neighbor, according as it is moved sooner or later. The geologist or pseudo-geologist whom I have just quoted did not mean "permanent," but "persistent." "Permanent" means "lasting" or "intended to last"; for example, a permanent foundation. When ore is found in a mine it is not intended to last or to be left where it is; the intention is to remove it to the surface for the purpose of extracting the valuable metal or metals that it may contain. "Persistent" is "to continue in a course"; when applied to ore it means "continuous," as against "patchy" or "interrupted" in its extension.

> The particles of mineral may become attached to the air-bubbles by means of which they are **floated up to the surface.**

A thing does not float until it rests on the surface; the mineral particles levitate to the surface by aid of the rising bubbles. "Levitate" means to rise by reason of lightness, from the Latin *levis*, light; it is the antonym of "gravitate."

> Senator Harding will advocate measures designed to promote increased production of the **necessities** [necessaries] of life.

Of necessities there are too many already; it were cruel to make more. "Necessity" means a state of need, the lack of things that are indispensable; "necessaries" means the things that are needed. This misuse of "necessities" is common. In Spanish the same distinction obtains between *necesidad* and *necesario.*

> The phenomenal **emergency** [emergence] of a great American merchant marine is one of the most striking economic consequences of the World War.

This is taken from Mr. Harding's speech accepting nomination to the Presidency. "Emergency" means a "sudden juncture demanding immediate action." "Emergence" means "coming out of" or "issuing from." He meant that the creation of the mercantile marine was one of the extraordinary results of the war. "Phenomenal" is redundant; if it was "the most striking" it must have been highly extraordinary, which is the sense in which "phenomenal" is used in this context.

> The wolfram is of a very friable nature, and, as the quartz gangue is the **medium** of crushing the molybdenite, a happy **medium** has to be **struck** in the size of battery screens, care being taken to slime the wolfram as little as possible and to crush the molybdenite as much as possible.

The use of "medium" in two senses within the same context is a blunder; moreover, in both cases it is the wrong word, for the first "medium" should be "means" and the second one should be "mean." The idiomatic phrase is to "strike a happy mean." The crushing is not done through the quartz but by means of the quartz, which abrades the soft molybdenite when brought in violent contact with it inside the tube-mill. The word "struck" is unfortunate because the ore is struck by the stamp in the mill, and it savors of a pun to say that "a happy medium" is "struck" in "the size of battery-screens." The phraseology as a whole is muddled and confusing. "Struck" means "chosen." The "very" before "friable" says nothing, for there is no standard of comparison. The entire statement needs rewriting, but is so obscure that I hesitate to offer a substitute.

> The old furnaces are being **torn out** and **substituted** with others of larger capacity.

A substitute is a person or thing that performs some function instead of another person or thing; the larger furnace would not be a substitute for the smaller furnace, because it would do more work in a given time, and possibly it might do that work with greater metallurgic efficiency; that is, it would take the place of the smaller furnace with economic advantage. "Torn out" is not a word that fits this technical context. I suggest:

"The old furnaces are being dismantled and will be replaced by others of larger capacity."

One of the springs of unrest in Ireland is that the Land Acts have only been **partial** [incomplete] in their operation.

If Ireland has been governed badly, it is likely that the laws regulating the tenure of land have been administered unfairly; as to that, we are not meant to be informed in the foregoing quotation. The context shows that the writer intended to convey the idea that the Land Acts had been "only partly effective in their operation."

The Paris conference attempted **partially** to meet the issue by providing that the development of resources in mandatory countries should be managed to the best interest of all nations in the League.

The Paris conference may have acted partially or shown itself partial in some of its decisions, but the meaning here is "incompletely" or "without entire success."

The temperature is much too high for **economic** [economical] practice.

"Economical" means cheap or thrifty; "economic" relates to economics, or political economy.

The new method permits the **economic** [economical] leaching of the entire output of the mine.

I do not overlook the fact that the primary meaning of one word may be the same as the secondary meaning of another, but it should be obvious that the use of words in their primary meaning serves to clarify writing and also to enlarge the vocabulary of the writer by putting each word to its proper function, whereas, the use of words in their secondary meaning produces, or may produce, confusion; moreover, it has the effect of crippling the writer's vocabulary.

Words may have several meanings; most words have a primary or usual meaning, and after that they have their secondary meanings. Take such a word as "economic"; it is the adjective corresponding to "economics"—that is, relating to the science that deals with the production and distribution of wealth. "Economical" primarily means "saving" or "thrifty," but it can also be used in the sense of economic. Again, take "proposition." Its primary meaning is a "statement" or "assertion," yet it is used commonly instead of "proposal," a proposing of something, an offer put forward for consideration.

Now, if we use the wrong word—that is, the word that does not fit—we spoil our vocabulary. The man who uses "economical" for "economic," and "proposition" for "proposal", has only two words in his vocabulary, whereas he who uses these words in their primary meaning has four words at his service. Moreover, the man who uses words interchangeably, making them do duty for various meanings, will fail to convey his ideas as clearly as he who holds each word to its primary function. One can find other examples in the writings of mining engineers. For example, "locate." Its primary meaning to a miner is the marking of a claim; that is to say, its technical use is its principal function in affairs dealing with mining. Its common meaning, "to establish in a place", is considered a secondary one by an intelligent writer on mining affairs, and for that meaning he chooses another word. A writer may say that "the mill was located" in the same context as the one in which he speaks of "locating the mill-site." In the first phrase he means that the building, with its contained machinery, was "erected" or "constructed" at a certain place; in the second he means that certain legal formalities were fulfilled for the purpose of securing the ground on which such a plant is to be placed. He will speak undiscriminatingly of "locating a claim" and of "locating the orebody," the latter signifying the finding of the orebody or the obtaining of evidence that determines the position of the orebody.

It is best, in technical writing, to hold technical words to their technical meaning. We have seen how "amalgamate" was used as a synonym for "mix," although in the technology of metallurgy the word "amalgamate" has a precise meaning—namely, the alloying of mercury with gold or silver. A technical writer should not speak of the "amalgamation" of a group of companies or corporations, because he is distorting the precise meaning of a common technical term, and because he has other words, such as "consolidation" or "combination," at his disposal. Again, we read about the solution of a problem and we are told that a problem is "insoluble." In chemistry, one of the sciences helpful to the art of mining, this word "insoluble" means something that cannot be dissolved—in water, acid, or some other specified liquid. We have the word "unsolvable" as the adjective appropriate to the solution of a problem; why not, then, use "unsolvable" for the problem and "insoluble" for the metal or mineral? If this be done, two words are available, each with its own distinctive meaning; thus we shall avoid the confusion of thought that arises when we are discussing problems of metallurgy in which the solving of troubles and the dissolving of refractory substances have to be discussed in the same context.

A **native** [domestic] fuel-supply is assured.

An industrial product is domestic; a human product is native. The word "ship" is of the feminine gender; the animal "mare" is of the female sex.

Like others of my **ilk** [fraternity or profession] I have devoted much thought to the subject.

"Ilk" means "of that same," and is used when a person has the same name as his estate, as Guthrie of Guthrie. The use of it in the above quotation is incorrect.

The German **vegetable**-fibre industry.

One might suppose that the word "vegetal" did not exist; for it is rarely used. "Vegetable" at once suggests peas, carrots, and cabbages, and so switches the thought in the wrong direction. The adjective of "vegetation" is "vegetal"; we ought to speak of "the animal, vegetal, and mineral kingdoms." Neither flax nor hemp, neither sisal nor hennequin, is a vegetable, nor is it of vegetable origin; they are vegetal fibers. Asbestos is a mineral fiber.

The use of the wrong word causes a derailment of thought from the intended line of reasoning; it evokes an image that is incongruous. Every inapt word is an obstacle to the communication of ideas; it is like a hurdle that has to be jumped or evaded; the effort is tiring to the reader, and if it be repeated he may be pardoned for declining to proceed.

It may be argued that it is **unethical** [improper] for a Senator to be retained in a lawsuit of this kind.

An imposing word is used incorrectly. "Ethical" means relating to morals or to the science of ethics. All that the writer meant was that the Senator's retainer was in bad taste or contrary to etiquette.

Since the **dawn** of cyanidation, the most surprising methods of anticipating the results of practical operations have been in vogue.

The pretty word "dawn" is incongruous with the remainder of the statement; it conveys no clear idea. The writer means "since [illegible] was first introduced" or "since the beginning" of the process. "Practical" is redundant. Another word frequently misused for the same purpose as "dawn" is "advent." Thus:

> The advent of the [illegible] process led to the reconstruction of the mill.

"Advent" is the season before the Nativity; it may be used figuratively for any important arrival, but it is wholly inappropriate to the introduction, beginning, or first application of a metallurgic process.

> This method is applied **universally** [generally] throughout the province of Huelva.

Huelva is a province of Spain, not a universe. The word "universally" is too comprehensive; it is a fine and large word that should not be used in a context wherein the idea of limitation is implicit. In this quotation it is redundant, for "throughout" suffices.

> The results are good when the **universal** [general] high cost of operations is considered.

Here the meaning has a wider range, but even in this quotation the writer is thinking only of the copper-mining industry of the United States, not of the entire world.

The word "cosmopolitan" is used in a similarly incorrect way. A man may travel around the world without becoming "cosmopolitan"; on the contrary, he may be as provincial, even as parochial, when he returns as when he started on his journey. A gathering is not "cosmopolitan" because it includes an American, a Frenchman, a Spaniard, and a Greek; it is only international in its character. A group of men of the same nationality may be "cosmopolitan." "Cosmopolitan" means "free from national prejudice" or "belonging to all parts of the world." It is used wrongly in the following, taken from a local newspaper:

> To give a **cosmopolitan** flavor to the function a light refreshment was served, after which the joyous participants **departed for their domiciles** [they were too "cosmopolitan" to go home, of course] with the happy reminiscence of having spent a wondrous evening [and with the "light refreshment"].

In short, "a good time was had," as might be said by the society reporter of the "Podunk Gazette," which probably would be considered locally a highly "cosmopolitan" newspaper.

A word may be overworked, particularly by the illiterate, to such an extent as to render it undesirable in serious writing. For example, "eliminate." This word is belabored to death by every newspaper scribbler, so that the use of it becomes a tiresome vulgarism. It appears, with wearisome iteration, in descriptions of golf.

> The last American professional was **eliminated** in the qualifying rounds of the tournament at Glen Eagles today. T. G. Renouf, of Manchester, **eliminated** Walter Hagen, of Detroit . . . Jock Hutchison was **eliminated** by Abe Mitchell.

To "eliminate" is to "remove" or "get rid of." Therefore the usage in the quotation is correct; but as the defeat of a player in match-play during a tournament involves his elimination, it is better to use the simpler word. I suggest:

"The last American was eliminated in the qualifying rounds of the tournament at Glen Eagles today. T. G. Renouf, of Manchester, defeated Walter Hagen, and Abe Mitchell won from Jock Hutchinson."

> In this way it was possible to wash the whole of the winter output and **eliminate** the collection of winter dumps completely.

Here "eliminate" is used for "avoid" or "cease" doing something—namely, the making of a winter dump, that is, the storage of gold-bearing gravel at a mine in Alaska. The adverb "completely" should follow the verb, otherwise it may seem to modify "collection."

A distinguished administrator, referring to the Federal Government, says:

> We must proceed to the **elimination** of duplication of the work in the various departments.

Here again "elimination" is not wrong, but the use of two long words ending in "ion" is ugly; moreover the active verb is stronger and clearer than the abstract phrase. He means that it is high time to stop duplicating.

The common misuse of "eliminate" is illustrated by the following story:

Two men were in a dining-car ordering breakfast. The first one said to the waiter:

"George, you may bring me two fried eggs, some broiled Virginia ham, a pot of coffee, and some rolls."

"Yessa."

The other said:

"You may bring me the same."

"Yessa."

The second man then called after the waiter and remarked:

"Just eliminate the eggs."

"Yessa."

In a moment the waiter came back.

" 'Scuse me, boss, but just what did you all say erbout dem aigs?"

"I said just eliminate the eggs."

"Yessa." And he hurried again to the tiny kitchen.

In another moment he came back once more, leaned confidentially and penitently over the table and said:

"We had a bad accident jest afo' we leave de depot dis mornin', boss, an' de 'liminator done got busted off, right at de handle. Will you take 'em fried same as dis hyar gemman?"

> Twelve thousand persons watched these two young **tyros** in their battle for the big silver cup **on which** the names of leaders dating back to the beginning of things in golf were inscribed **on it.**

So says a writer in the New York *Times* when describing the final match in the amateur championship. The two players were champions, one became champion at the end of the match that is being described and the other was an ex-champion; they were the very opposite of a "tyro," which means a beginner or novice, from the Latin *tiro*, a recruit. Note that the writer himself appears to be a tyro in writing, for he repeats the preposition "on" clumsily.

> The average number of deaths in Mexico City **only** [alone] was 20,000.

At first the idea is that only 20,000 deaths were recorded, whereas the writer means that in the one city the number of deaths was 20,000.

> The native women wear gay shawls and much **meretricious** finery; the men wrap themselves in blankets of brilliant colors.

> This mining enterprise would have continued to prosper

> if the president of the company had not introduced his **meretricious** methods of mining finance.

Here a word that is deeply significant if used with correct reference to its derivation is applied carelessly and inaptly. "Meretricious" comes from the Latin *meretrix*, meaning "harlot." To speak of the finery of the native women as "meretricious" is to convey a suggestion that evidently is not intended. The writer meant "gaudy" or "bright"—nothing sinister was implied. In the next quotation the word is used in place of "flamboyant" or "tricky"; it is a usage not without precedent, but it is objectionable, because it spoils the word for effective employment, as for example in referring to the prostituted journalism of Hearst and Brisbane.

"Lay" and "lie" are used wrongly, partly because most people forget that "lay" is not only a verb distinct from "lie" but also the past tense of "lie." Moreover, "lay" is transitive; it requires a direct object.

> He **laid** [lay] awake.
> The limestone **overlays** [overlies] the quartzite.
> The choice **lays** [lies] between these extremes.

The hen lays the egg, and the egg lies where it has been laid. I am reminded of the story about the Boston terrier. A gentleman from the West said: "Lay down pup. Lay down. That's a good doggie. Lay down, I tell you." The dog was obdurate. A Harvard graduate overhead this, and remarked: "Excuse me, sir; you'll have to say, 'Lie down'; he's a Boston terrier."

> The ore-reserve was worked up to a maximum in order to permit the **installation** of a smelter.

Here we have an example of the use not only of an unfitting word but of one that is ridiculous in its incongruity. To install is to place in a seat; a person is installed when he is placed with ceremony in an office of dignity. To use grandiose words, words so eloquent of dignity, in such a context is an abuse of language. The writer meant nothing more than the "building," "erection," or "construction" of a smelter.

> This process will **inaugurate** the production of oil from shale in the Rocky Mountain region.

To "inaugurate" is to introduce a person to an important office with appropriate ceremony, or to initiate something of dignity or importance. It is a sonorous word befitting public affairs; it is not the word to use in a technical article, more particularly one that is of no consequence, as was the one from which I quote; a bishop is installed; a President is inaugurated. The simple word "start" covers the meaning in the above context. Unfortunately, the silliness of much of the pompous scribbling of newspaper reports is not recognized, otherwise ridicule would be the meed proper to such a statement as:

> The Great Fake management proposes to inaugurate a vigorous campaign of development, and prosecute an extensive exploration, and then proceed to the installation of a large mill, in the confident anticipation of prolific dividends.

Such statements are common in mining papers. They are found elsewhere; for example:

> Rachmaninoff's truly artistic playing, his wonderful interpretations, and his unique personality, all blended together in painting tone poems of infinite beauty, so eminent in color value that after striking the ear they progressed to the heart and nestled there.

> The output has been maintained at a level not **pronounceably** [pronouncedly] below that of last year.

One can "pronounce" a thing good, as well as pronounce a word correctly, but when something is done decidedly or emphatically, we use "pronouncedly" to convey that meaning, as above.

> The ore is **growing less rich** [becoming poorer] in depth.
> The production has **grown less** [diminished] every year since then.

Growth connotes increase, the antithesis of shrinkage.

> The economic geologist has been able to assist the miner **materially** in following his ore through the **vicissitudes** [vagaries] of folding and faulting if [where] the deposit was bedded or in sheet-form.

"Materially" has no meaning to fit this context; the use of it is a mere illiteracy. The writer means that the assistance has been considerable. "Vicissitudes" refers to changes of fortune; it does not fit natural phenomena; he might use "vagaries," which means capricious wanderings. I suggest:

"The economic geologist has been able to assist the miner in the effort to follow the ore amid the complexities of folding and faulting, particularly where it was in the form of beds or sheets."

The last phrase reminds me of the Australian engineers and his "cubicular" galena!

> The equilibrium between the oil **in** [on] the surface and the oil in the **volume** [body] of the emulsion . .

The use of the wrong preposition indicates defective mental vision, and this inference is confirmed by the misuse of the word "volume." The contrast is between the surficial and the interior parts, between "on" and "in," between outside and inside.

> In no other way can the cost of living be normal and an **equable** [equitable] division of the comforts of life be obtained for all.

The editor—for he was an editor—must have been thinking of the climate of California, where he lived. "Equable" means "not easily disturbed," "uniformly even," or "unvarying." "Equitable" means "fair" or "just"; and that is what he intended to say.

When we have a technical word for a specific purpose, we gain nothing by using another. For example:

> This ore makes a most desirable **diet** [feed] for blast-furnaces.

Perhaps he was beguiled by apt alliteration's artful aid. In the zinc-mining district of Wisconsin they talk about "mill-diet." "Diet" means "a way of feeding" or a "prescribed course of food," not the food itself. "Feed" is a technical term signifying the ore and other materials that are put into a machine for metallurgic treatment.

Those who adopt the vernacular of the mining camp tear language from its literary moorings and set it adrift in the shoals of ignorance, thus:

> When special accuracy was demanded in surveying underground, as in **locating** an **upraise** to **meet** a shaft . . .

A raise (or, better, "rise") is an upward opening in a mine; the idea of "up" is as implicit in "raise" as the idea of "down" in "sinking." "Locating" here means the establishing of the place where the raise is to be started; surveyors use the technical term "spotting" for this purpose, meaning the selecting of the spot at which to start. One can guess what is meant by "meeting" a shaft, but the precise word is "connect," which signifies the joining of two things. The engineer who made the statement as quoted is a scholarly gentleman, but he thought, I presume, that the use of such vulgarisms would give local color or a touch of reality to his description of mining conditions. He might have said:

"When special accuracy was demanded in the surveying underground, as in pointing a raise to connect with a shaft . . . "

> In order to **find** how much a body of ore will **pay**, it is first necessary to **find** what is the lowest grade of ore it will pay to work. **Without first finding** this, the value of an orebody can not be **found**.

He used the wrong word five times. The word "find" is used aptly when referring to the discovery of ore, but in this quotation it is unsuited to the context. The first "find" can be replaced usefully by "ascertain," the second by "determine," and the third by "estimate." The first "pay" is wrong; he means "yield." The second "pay" is colloquial. "First" is redundant. I suggest:

"To ascertain the total profit that can be won from a given orebody it is necessary to determine what is the lowest grade of ore that can be worked profitably; until this is done, the value of the orebody cannot be estimated."

The use of one wrong word leads naturally to the use of many that are equally ill chosen, for example:

> **Investors** in Kimball's Kentuck and Kimball's Optimo Syndicates have had the **value** of their **earnings** doubled in just seven days.

Here we have an example of the purposeful misuse of words. Those who subscribe for the stock of an oil syndicate—that is, run the risk of allowing their money to be used by irresponsible promoters—are not investors: they are speculators; they may be gamblers. "Investment" and "investors" are words habitually misused by writers in the financial press.

> He **invested** his savings in a Californian gold mine, and within two years won a competence for life.

Any mine that yields a person a fortune within the short period of two years is a gorgeous speculation, not an investment. If he put his savings into the mine recklessly, and without adequate information, he did not even speculate; he gambled. In the previous quotation the persons who profited temporarily from their plunge into an oil deal did not have "the *value* of their *earnings* doubled." The promoter who made the statement meant that his victims had doubled the amount of the money they risked; they did not "earn" anything, because their gain was not the reward of labor or of merit; nor did the "value" of their receipts increase, for "value" is the worth of a thing. Moreover, the value of their dividends was much less than they supposed, because the money that was returned to them was not interest on their capital, it was not a true dividend, but a part of the money they and others had subscribed; it was distributed among them for the purpose of deluding them into the belief that they were participating in a lucrative business, thereby prompting them to buy more stock at a fictitious price. Such terms as "investment," "dividend," and "ore" are key-words in the economics of mining, and the misuse of them is the stock-in-trade of unscrupulous promoters. To "invest" is to place money where it is safe, in the expectation of receiving interest on the principal; to "speculate" is to take the risk of losing money in the expectation of increasing the principal, rather than to look for a return in dividends; to "gamble" is to speculate recklessly, looking to luck rather than knowledge as the chief factor of success. A "dividend" is the periodic return on capital invested; until the capital has been redeemed one cannot know whether the periodic return of money from the profit of an enterprise be a dividend or only a return of part of the capital. "Ore" is metal-bearing rock that can be exploited at a profit at a given time and place; it is a term in mining economics, not in mineralogy or geology, and when used in these sciences it is without precise meaning, having reference to mineral that may possibly become ore if conditions favorable for exploitation supervene.

> Since graduation from a leading engineering university, **which includes** a period of more than twelve years, I have been in the game of **self-location** of engineering positions. During this time **I have relocated** myself many times in various cities throughout the country.

This was the first paragraph of an article that was submitted to me for publication. It was returned as soon as the paragraph had been copied for the purpose to which I have put it here. The wording is so bad that the statement needs to be rewritten, but I have marked a few of the obvious blunders. The period to which he refers "covers," not "includes," the twelve years. To "include" is to comprise or embrace something that is necessarily smaller. If the time had been lengthened to more than twelve years, it would include twelve or any less number; it did not, for it covered just twelve years, and no more. The "university" did not include the period; the reference is to "Since graduation." The finding of a position for oneself is not a "game," unless it involve amusement or trickery. Incidentally, I may say that the use of the phrase "the mining game" for the business of mining is much to be deprecated, except when used by fakers and fraudulent promoters. A mining engineer should not refer to his own honorable profession as a "game," because it is neither a jest nor a diversion. "Self-location" is absurdly wrong as a word to express the obtaining of a professional appointment or position. This applies also to "relocated." A claim may be "relocated" when the time of the first location expires or the right to it otherwise lapses. When a man says that he intends to "locate" in Chicago, for example, he is using a vulgarism that is particularly objectionable among mining engineers, because they use the term "locate" to describe the technical operation of obtaining a preliminary right to exploit a piece of mineral land. What the writer probably meant to say was something like this: "Since my graduation from an engineering college—twelve years ago—I have been compelled to seek a position for myself several times and in many cities."

> The Mary Malone Mining Co. has been **exploiting** its main vein at depth with a diamond drill.

"Exploitation" and "exploration" are words of distinctly different meaning, although newspaper reporters and other careless people seem to ignore the distinction. Sometimes, unfortunately, the typist and the compositor use one in place of the other, especially if indistinct handwriting leave the choice open to them. To "explore" is to examine or investigate; in mining it refers to various kinds of prospecting, as in the case cited by aid of the diamond-drill. To "exploit" is to turn to account, to work or utilize a thing for one's benefit. An ore deposit is first explored and then, if it justify the further effort, it is exploited for the benefit of the owner of the ground or of those to whom the owner has transferred his rights.

Turning to something more pleasant, let me cite an example of the fortunate effect of selecting the right word in an oratorical climax. The references that follow may be foreign to technical writing, but they will serve to illustrate the function of language in transmitting thought. The speaker was John Bright, a Quaker, a man simple and unaffected in all his ways, a political leader of acknowledged sincerity. He was addressing the House of Commons in 1855 on the subject of the Crimean War and the loss of life before Sebastopol. He said:

"An uneasy feeling exists as to the news which may arrive by the very next mail from the East. I do not suppose that your troops are to be beaten in actual conflict with the foe, or that they will be driven into the sea; but I am certain that many homes in England in which there now exists a fond hope that the distant one may return—many such homes may be rendered desolate when the next mail shall arrive. The *Angel of Death has been abroad throughout the land; you may almost hear the beating of his wings.* There is no one, as when the firstborn were slain of old, to sprinkle with blood the lintel and the two sideposts of the doors, that he may spare and pass on; he takes his victims from the castle of the noble, the mansion of the wealthy, and the cottage of the poor. It is in behalf of all these classes that I make this solemn appeal."

The effect was tremendous: "It seemed," says the chronicler, "that the House was hushed to listen for the beating of the wings." As Cobden said to Bright afterward, "You went very near that time. If you had said 'flapping' instead of 'beating' of the wings, the House would have laughed." To which Trevelyan adds: "But Bright could no more have said 'flapping' than Mr. Gladstone could have made a false quantity."[1] Another great speech—a greater speech—may be instanced. In Lincoln's Gettysburg address will be found numerous examples of the fitting word, of the one word that is appropriate to the sense. At the moment, the long and florid oration delivered by Everett had impressed the audience more than Lincoln's short and simple utterance. As an English biographer (Lord Charnwood) says: "The few words of Abraham Lincoln were such as perhaps sink deep, but left his audience unaware that a classic had been spoken which would endure with the English language." It will. Even in such a context as this I do not hesitate to quote the whole speech:

"Fourscore and seven years ago our fathers brought forth on this continent a new nation, conceived in liberty and dedicated to the proposition that all men are created equal. Now we are engaged in a great civil war, testing whether that nation, or any nation so conceived and so dedicated, can long endure. We are met on a great battlefield of that war. We have come to dedicate a portion of that field as a final resting-place of those who here gave their lives that that nation might live. It is altogether fitting and proper that we should do this. But, in a larger sense, we cannot dedicate—we cannot consecrate—we cannot hallow—this ground. The brave men, living and dead, who struggled here have consecrated it, far above our poor power to add or detract. The world will little note nor long remember what we say here, but it can never forget what they did here. It is for us the living, rather, to be dedicated here to the unfinished work which they who fought here have thus far so nobly advanced. It is rather for us to be here dedicated to the great task remaining before us—that from these honored dead we take increased devotion to that cause for which they gave the last full measure of devotion—that we here highly resolve that these dead shall not have died in vain—that this nation, under God, shall have a new birth of freedom—and that government of the people, by the people, for the people, shall not perish from the earth."

The key-words are "consecrate" and "dedicate," the "living" and the "dead." Behind the choice of the right words is the cause of the right choice, and that is sincerity, the sincerity that inspires all true art. Stephen Douglas could not have said what Lincoln said at Gettysburg, nor could Disraeli have spoken as Bright did. Without sincerity the words of a man are as sounding brass or tinkling cymbal.

U. S. Bureau of Mines Personnel

The personnel of the U. S. Bureau of Mines was recently published in a bulletin of that organization, as follows:

H. Foster Bain, Director.
E. A. Holbrook, Assistant Director.
F. J. Bailey, Assistant to Director.
H. E. Meyer, Chief Clerk.

DIVISION CHIEFS

Investigations Branch

G. S. Rice, Chief Mining Engineer.
O. P. Hood, Chief Mechanical Engineer.
R. B. Moore, Chief Chemist.
D. A. Lyon, Chief Metallurgist and Supervisor of Stations.
A. W. Ambrose, Chief Petroleum Technologist.
R. R. Sayers, Chief Surgeon.
C. E. Munroe, Chief Explosives Chemist.
H. S. Mulliken, Special Assistant to the Director.

Operations Branch

T. T. Read, Chief, Information Service.
G. S. Pope, Chief Engineer, Government Fuel Yards.
D. J. Parker, Chief Engineer, Mine Safety Service.

DIVISION OF EXPERIMENT STATIONS

D. A. Lyon, Supervisor of Stations.
H. H. Hill, Superintendent, Petroleum Station, Bartlesville, Okla.
O. C. Ralston, Superintendent, Pacific Station, Berkeley, Cal.
W. R. Crane, Superintendent, Southern Station, Birmingham-Tuscaloosa, Ala.
R. T. Stull, Superintendent, Ceramic Station, Columbus, Ohio.
J. A. Davis, Superintendent, Alaska Station, Fairbanks, Alaska.
C. E. Julihn, Superintendent, North Central Station, Minneapolis, Minn.
A. C. Fieldner, Superintendent, Pittsburgh Station, Pittsburgh, Pa.
S. C. Lind, Superintendent, Rare and Precious Metals Station, Reno, Nev.
——— ———, Superintendent, Mississippi Valley Station, St. Louis-Rolla, Mo.
Thomas Varley, Superintendent, Intermountain Station, Salt Lake City, Utah.
C. E. Williams, Superintendent, Northwest Station, Seattle, Wash.
C. E. van Barneveld, Superintendent, Southwest Station, Tucson, Arizona.
J. J. Rutledge, Superintendent, Central District Station, Urbana, Ill.

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[1] "The Life of John Bright," by George Macaulay Trevelyan, page 385.

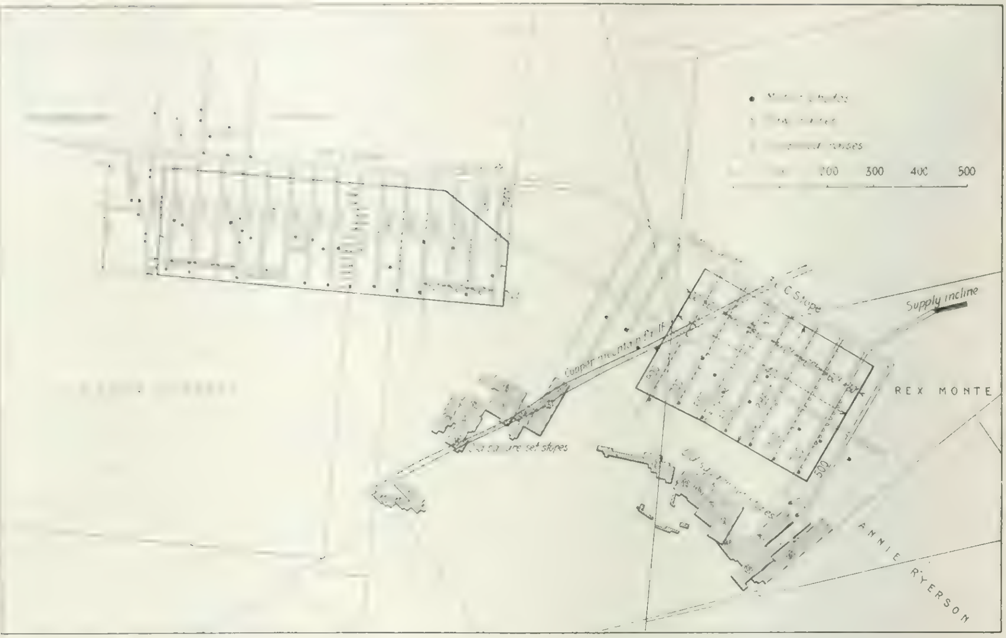

Fig. 1. Plan of Nos. 34 and 36 incline slice stopes, Humboldt mine, Morenci, Ariz.

The Incline Slicing Method as Applied to Large Orebodies

Tons Per Man Increased Over Figures Obtained by Flat Slicing System and Costs Show Decrease of 15 Per Cent in Favor of Incline Method of Stoping—Mexican Labor Employed and Bonus System in Force

By Joseph P. Hodgson and John Kiddie

THE ADAPTABILITY of the incline slicing system to large blocks of ore has been questioned in an article written by J. Parke Channing, appearing in *Mining and Metallurgy* for January, 1922, so that it is opportune to describe briefly the progress which has been made by the adoption of the method in the mines of the Morenci, Ariz., district. The general scheme of preparatory work and the method of operation of incline slicing at the Coronado mine, in stoping a long and comparatively narrow vein, has been previously described.[1]

Owing chiefly to the satisfactory results obtained at Coronado, the incline slice was introduced in the Humboldt mine, at Morenci, in 1918. Subsequently, several flat slicing stopes have been changed to the incline system. This method of mining has yielded the following tonnages:

Year	[illegible] Incline Slicing	Per Cent of Total Humboldt Tonnage
1918	62,394	11
1919	154,694	21
1920	200,888	27
1921	153,635	36

The percentage of ore mined by the flat slice system has decreased during the same period, from 76 per cent of the total in 1917 to 24 per cent in 1921.

The incline slice method was first tried out in stope No. 36, in a block of ground extending 55 ft. in height above the Humboldt adit level. This stope had been previously mined down from the capping, for a distance of 44 ft., by brow caving, on two floors; and below this, by flat slicing for 55 ft., by five slices each 11 ft. in height. The incline slices were started under this flat mat, and have been continued, until at present a maximum vertical distance of 77 ft. has been removed by this method.

To show the comparative efficiency obtained in this stope by the flat vs. the incline system, we give below yearly figures for two years preceding the change and for the first two years of the incline method after the change:

Year	Method	Dry Tons	Tons per Stoping Man
1916	Flat slicing	90,684	5.4
1917...	Flat slicing	123,980	5.4
1918	Incline slicing	62,394	6.4
1919..	Incline slicing	154,694	8.8

The tonnages shown for the first two years include all ore from flat slicing in the stope, whereas the figures for the last two years represent ore from incline slicing only, and exclude the diminishing tonnage from flat slicing. All the labor employed in this stope, below the grade of shift boss, was Mexican. In the tons-per-man figure is included timbermen and helpers, miners, muckers, and hand trammers.

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[1] [illegible] Engineering and Mining Journal, April 7, 1917; [illegible] Scott, Transactions A. I. M. E., Vol. 59.

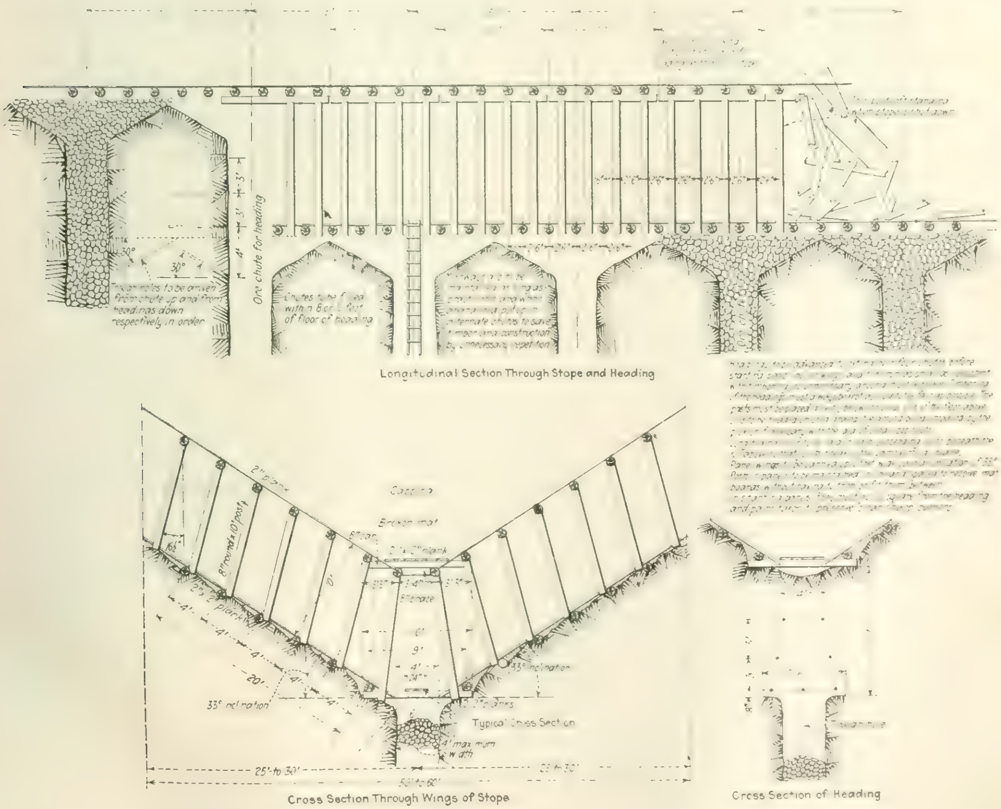
Fig. 1 shows a plan, on the —55-ft. level, of the two largest incline slicing stopes of the Humboldt mine. These stopes are respectively 230 x 750 ft. and 285 x 420 ft. in area. The preparatory work in No. 34 stope consists of blocking out the area to be stoped by parallel raw drifts spaced at 50-ft. centers. Each drift has a timbered raise at its extreme east end, 55 ft. in height, and raw raises at 15-ft. intervals, 44 ft. high, for its entire length. One extra finishing raise, also raw, is placed to the west of the stope, outside the actual stoping area. A large haulage drift for supplies, to the west of the stope, is connected to each of the cross drifts. The incline slices begin at the east side of the stope, as shown, and are carried back over each drift, with the raises forming the center line of the slice. The over-all width of these slices is 50 ft. By this method of blocking out, approximately fifty-three tons of ore is stoped per foot of preparatory work.

In No. 36 stope the drifts were driven with 60-ft. centers to conform to the work already done on the adit level, 55 ft. above. In other respects the blocking out is similar to that just described. By this arrangement, sixty-five tons are stoped for each foot of preparatory work.

MODIFICATION IN METHOD OF STOPE PREPARATION

In the stopes described, the slices were taken across the orebody, making their total lengths 230 ft. and 285 ft. respectively. It was necessary to lay out the areas as indicated, on account of the stoping already in progress on the adit level, as a continuous production of ore had to be maintained during the period of change. Had no previous work been done in the orebody, it would have been feasible to run the slices parallel to the long axis of the ore, making them 750 ft. and 420 ft. respectively. This latter system would necessitate laying out the stoping drifts 50 ft. apart for the full lengths of the orebodies; for handling supplies and men, it would be necessary to drive several cross drifts. Inasmuch as the time of maximum trouble and minimum production from any particular slice is during the starting period, there are distinct advantages in making the slices as long as possible.

Figs. 2 and 3 show the method of stoping, which is similar to that described in previous articles, differing only in some of the details. The present modification



Longitudinal Section Through Stope and Heading

Cross Section Through Wings of Stope

Cross Section of Heading

Fig. 2. Cross-sections showing incline slicing method, Morenci, Ariz.

has been developed to facilitate the shooting down of sections as the panels, or wings, are completed. In this way the mining of the wings can be done by bonus or contract system, rather than by day's pay. It has been found that stopes of 50-ft. width have an advantage over those of 60-ft., as the ventilation at the extreme top of the wings in the 60-ft. slices is not as good and interferes with the efficiency of the workmen. In the stopes shown in Fig. 1, the ore is hand-trammed in one-ton cars on the sublevel to motor chutes. In No. 34 stope one motor chute is situated between each two drifts. In No. 36 stope a separate motor chute serves each drift. The possibility of eliminating the hand-tramming should be considered, particularly in orebodies which are continuous from the stope floor to the main haulage drift.

The chief difficulty encountered in stoping by the incline method has resulted from the presence of old motor tunnels on the adit level. These tunnels are large in cross section, and as the slices come down to the level it becomes necessary either to fill them by hand or to hold them open, as the conditions require. Both operations are not only expensive but also interfere with production.

Prior to the time when the stope approached the adit level, it was possible to install a gang bonus, with results mutually beneficial to the company and the men. The bonus was in force eight months, and during that time an average of 10.6 tons per stoping man was obtained, covering a total extraction of 94,000 tons of ore.

A comparison of the timber consumption for both incline and flat slicing is as follows:

	Board Feet of Lumber per Ton
All incline slicing for four years (1918 to 1921 inclusive)	9.0
All flat slicing for seven years (1915 to 1921 inclusive)	7.9

The comparison of costs between the incline slice method and the flat slice system shows a reduction of 15 per cent in favor of the incline method for the four years under review, and proves that the application of the incline slice in these properties, to large ore areas, has been successful.

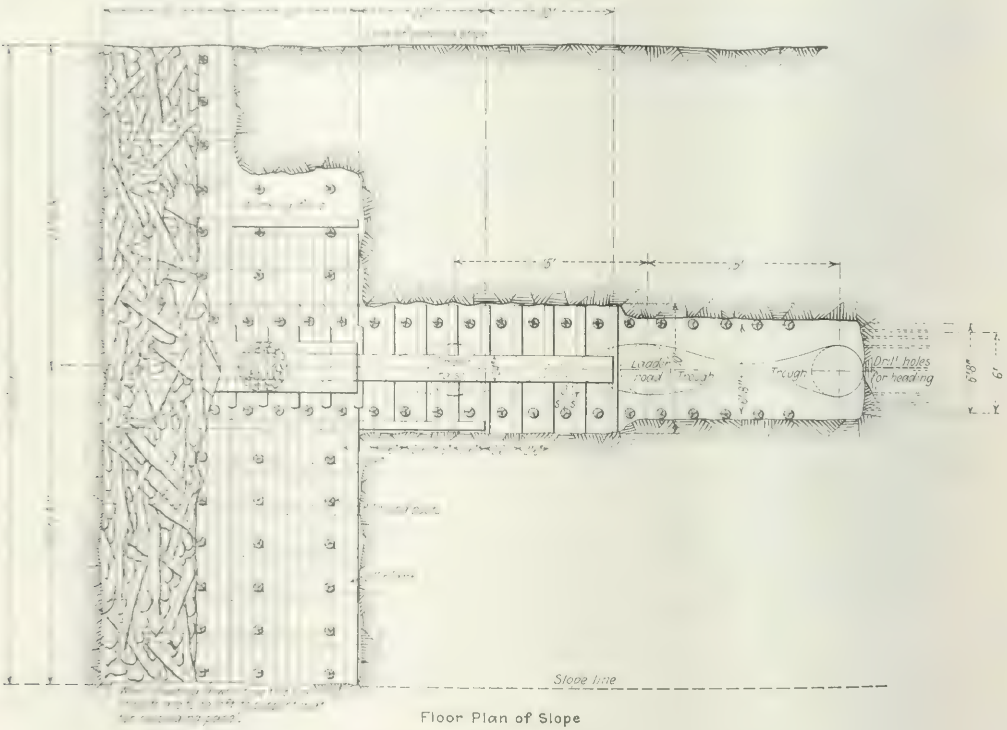


Fig. 3. Plan showing incline slicing method, Morenci, Ariz.

Magma Copper Co. Recovers 94 Per Cent in Milling

According to the report of the Magma Copper Co. for 1921, operating at Superior, Ariz., the ore mined and milled during the three months that the plant was in operation was as follows:

	Dry Tons	Per Cent Copper	Ounces Silver	Ounces Gold
Total ore mined	21,445	5.25	3.15	0.038
Hand-sorted ore shipped direct to smelter	2,238	16.45	7.74	0.090
Mill feed	19,207	3.94	2.61	0.032
Mill concentrates	6,130	11.60	7.44	0.100
Mill tailings		0.357	0.351	Trace

The mill recovery was 93.83 per cent. At present the mill has a capacity of 300 tons per day, but it is planned to enlarge this to 600 tons. Plans have also been completed by Bradley, Bruff & Labarthe for the construction of a smelter, and it is expected to construct a standard-gage railroad to Magma Junction with maximum grades of 2 per cent into Superior and no adverse grades out.

Why the Mines of Asia Minor Are Not Worked

Many Difficulties To Be Overcome—Foreigners Kept from Acquiring Property Roads Bad and Forests Destroyed—Labor Conditions Difficult

By P. A. Georgiades

ASIA MINOR is a country with a great future from both the agricultural and the mining points of view. It is estimated that if all the non-productive land were taken out, there would still remain 75,000,000 to 80,000,000 hectares of first-class productive land, which could supply food to more than 100,000,000 inhabitants. The mineral wealth is also great. In recent years many deposits of minerals have been discovered, and active prospecting has been carried on in the various vilayets (districts). During the World War, numerous German and Austrian scientific missions visited the country to determine the importance of the deposits. Mining of coal, chromium, emery, boracite, and meerschaum was carried on seriously before the war, but since the Armistice little work has been done. Little has likewise been done toward exploitation of the copper, iron and zinc mines.

The difficulties encountered in the exploitation of mining properties in Turkey are numerous. The principal ones have to do with the mining law, the absence of roads, the destruction of forests, labor and the conditions of work, and the selling of mines.

The mining industry was greatly handicapped by the mining law up to 1861, but conditions were improved slightly by the law of 1869, which was based on the French law of 1810. According to this law, the right of priority was conceded to the discoverer of the mine. The royalty was reduced to 5 per cent, and the concession was not to exceed ninety-nine years. In 1887, a new law gave to the mining industries further facilities, but the law of 1906 (which is still in force with some alterations) brought with it new difficulties.

It is the Turkish policy to keep mining property from passing into the hands of foreigners. For this reason foreigners often associate themselves with an Ottoman subject, who ostensibly becomes proprietor. If, however, this Ottoman subject is a Christian, he encounters so many difficulties that he finally thinks the affair is impossible and retires, thus leaving his place to a non-Christian Ottoman subject, who readily gets the concession.

Anatolia is characterized by the poorest of roads, few of which can be called roads at all. In certain vilayets there are only paths, or trails, which, after a rain, become virtually impassable. The railroads also are not sufficient to provide means of communication, and are entirely lacking in many of the provinces. Generally speaking, all goods have to be transported either by buffalo carts or on camel back. This is the only mode of transportation, and it is so expensive that much of the country's raw materials cannot be utilized. Transportation fees are also so high that establishment of factories in the interior is impracticable.

The forests of the country have been cut down and destroyed without realization of the necessity of replanting the trees. Furthermore, the rain has carried away all soil from these cut forests, so that the rock is laid bare and there is no possibility of reforestation. Except in the provinces of Trebizond and Erzeroum, the timber resources of Turkey are greatly reduced, if not completely exhausted. For example, twenty to twenty-five years ago it was possible to find within 15 km. the wood necessary for timbering the Arghana copper mines, and also for making charcoal, much used at that time for smelting the ore. Today one must go more than 50 km. to find it. The destruction of the forests is in many districts the greatest drawback to the development of the mining industry.

Suitable laborers for working the mines are not easily secured and retained. The real Turk works slowly. Under the most favorable conditions, when he gives his maximum work, his output, compared with that of a European workman working under similar circumstances, is about one-third of the latter's. Turkish labor, moreover, is not dependable, for the reason that the workmen are both miners and agriculturists. During the rainy season they work in the mines and when it is time to go to the fields they suddenly leave the mines to look after the planting. Unless there is a foreign element, such as Armenians or Greeks, employed in the mines, the work closes until the rainy season comes again. The Turkish workman lacks education and training. Rapidity of work and economy of time due to the use of improved methods and machinery are altogether unknown to him. The old saying "time is money" has no significance in Asiatic Turkey.

As mentioned, the work in the mines is carried on in the most primitive manner, with the exception of the operations for coal at Zongouldak and those for silver and lead at Balia. In these places, compressed air and electricity are both utilized. Again, some of the mines are given to the villages in the vicinity for exploitation. In such instances the mining is done by the inhabitants, who, owing to lack of capital, cannot purchase machinery and employ a mining engineer. The result is that they produce little and sometimes they actually destroy the mines.

It frequently happens that men without any capital at all ask and obtain the so-called *permis des recherches* (claim), for six months, this period being afterward extended to two years. If during this period it is proved that the mine is of value, the man who has a *permis des recherches* applies for a concession or firman (imperial irade or order). The concession is given usually for a period not exceeding ninety-nine years.

A man with such a claim considers that he owns the mine and is already in possession of a fortune. If the property is of value, he will propose, if approached, that he be furnished the capital to operate it, and in return he will allow a small percent of the net proceeds. He never by any chance offers to sell or lease the mine, or even to become associated in the work of development. Generally it is difficult to treat with those who are in possession of such a firman, although many of them live in poverty.

Cost of Milling and Treating Ores*

Data from Various Sources Show Wide Variations, but, Knowing Location and Character of Plant, It Is Possible To Arrive at General Conclusions

THE COSTS given in the following tables have been collected from a variety of sources, such as company reports, technical articles, hand-books, manufacturers' catalogs, and private information. Usually, the method of estimating the costs of the various operations and the distribution of overhead expense differs considerably; so that unless all details are known and comparable, sound judgment must be used in applying the figures. The only safe method of estimating milling costs for proposed plants or processes is to furnish to competent engineers all the facts available, and let them make an estimate. In plants of the same type, the factor affecting the wide variation in costs per ton is the capacity of the plant, greater economies being possible in a large plant than in a small one.

Recent figures show increased costs because of the World War; it is believed that costs for the period 1912 to 1916 will be of as much value as those for the period 1917 to 1920 and that actual costs will be found midway between these two for the period ahead of us.

Tables of itemized costs are given, together with tables indicating the results of operations of individual plants. Total costs may be obtained by aggregating the individual items, using the tables of total costs for the purpose of checking and for estimating the effect of variables, such as freight, transportation, power, labor, and climate.

The value of metal extracted from the ore is believed to have some bearing upon the amount that may be expended on a plant to treat the ore; for that reason the production has been calculated in value of metal extracted rather than in assays of mill feed. In some operations this figure is approximate; it is intended to be used only for its bearing upon the cost, however variable that may be. In mills treating gold and silver ores, a study of the question indicated that more consistent costs were obtained by a classification according to climatic conditions:

Desert Conditions involve high costs for power, water, and transportation, with unfavorable labor, living, and climatic conditions, or most of these.

Average Conditions indicate that not more than two of the unfavorable factors mentioned under desert conditions are present, the remainder being normal or favorable.

CRUSHING COSTS

It has been found desirable to classify the operations as follows:

Breaking (preliminary crushing, coarse crushing) is the first operation and is done in gyratory or jaw breakers or crushers. Costs depend more upon the character of the ore, the cost of power, and the load factor of the crushing unit than upon the relative capacity of the plant, according to most reported costs.

Stamps, Chilean mills and ball mills are occasionally used for the combined operations of secondary crushing and grinding, at a cost about equal to the sum of the two incomplete costs given on page 920.

CONCENTRATING COSTS

By vanners and tables in stamp mills, after amalgamation, per ton of mill feed	$0.04 to $0 15
By jigs, tables and vanners on lead and copper ores, per ton of mill feed	0 20 to 0.40
By tables after flotation, per ton of mill feed	0.05 to 0 10
By flotation, per ton of mill feed	0.06 to 0.30

CYANIDATION COSTS

Exclusive of Crushing

	Per Ton Milled
Leaching	$0.15 to $1.25
Sliming, silver ore	1.00 to 2.00
Sliming, gold ore	0.50 to 1.00

DETAIL COSTS

Chemicals, gold ore	$0.25 to $0.60
Chemicals, silver ore	0.75 to 1,25
Classifying	0.02 to 0 05
Agitation	0.05 to 0 10
Filtering	0.05 to 0 15
Clarifying, precipitating, and refining	0.15 to 0 50
	Per Ton
Roasting ores and concentrates	$0.65 to $1.25

LEACHING COPPER ORE

	Per Ton
Tailing, with sulphuric acid, precipitated on scrap iron, 1914, 2,000 tons daily	$0.70
Oxidized ores, with sulphuric acid, 1918, 1,200 tons daily	1.06

DREDGING

River bottom carrying an average of 8.66c. per cu.yd., 1919

	Cents
5,000 cu.yd. per day, cost per yd.	6.41

MISCELLANEOUS

	Per Ton Milled
Water	$0.01 to $0.25
General expense, including superintendence and assaying	
Small plant	About 0.75
Large plant	About 0.10

POWER COSTS

STEAM POWER

	Costs per Horsepower per Twenty-four Hours
Non-condensing engines, coal at $7 per ton	$0.20 to $0 22
Condensing engines	0.17 to 0.19
Compound condensing engines	0.14 to 0.17

For each variation of $1 per ton in the cost of coal, costs per horsepower should be varied: 1⅓c. for non-condensing engines, 1¼c. for condensing engines, and 1c. for compound condensing engines. A rough general figure for power costs in mining camps is $0.30 per horsepower per twenty-four hours.

ELECTRIC POWER

Charges for electric power are usually based on a variety of factors, in which the total power consumed and maximum demand have most influence in determining the rate. The following rate comparison is based on reported costs of power in milling plants:

Per Horsepower-Year	Per Horsepower-Month	Per Kilowatt-Hour, Cents	Conditions
$150	$12.50	2.0	Desert and unfavorable
120	10 00	1.6	Desert and unfavorable
90	7.50	1.2	Desert and unfavorable
75	6 25	1 0	Average
60	5 00	0 8	Average
45	3 75	0 6	Favorable
30	2.50	0.4	Favorable

The above figures are for 360 days of twenty-four hours, per year, and an average motor efficiency of 85 to 88 per cent.

ERECTION COSTS

MILLING PLANTS

	Cost per Ton per Twenty-four Hours
Coarse concentration, no flotation	$300 to $450
Gravity concentration and flotation	800 to 1,200
All flotation	600 to 800
Cyanide, all slime, stamps or ball mills, tube mills, filtering or counter-current decantation	1,000 to 1,400
Stamps with vanners	475 to 550

An empirical figure for the erection and installation of ore mills and similar reduction plants is $1.25 to $1.50 for each $1 spent for machinery, f.o.b. factory.

Under ordinary conditions, as in mining camps, the cost of mill buildings may be estimated as follows in per cubic foot of volume:

	Cents
Wooden buildings	3 to 6
Steel buildings	7 to 10

Erecting mill and smelter buildings:

Wood	$30 to $40 per 1,000 ft.
Steel	0.75 to 1.5c. per lb.

Erection of sectionalized machinery will cost twice or three times that required for standard equipment.

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FLOTATION CONCENTRATION MILLS

Tons per Twenty-Four Hours	Locality	Value Extraction per Ton	Extraction per Cent	Outline of Treatment	Cost per Ton	Per Cent Through 200 Mesh	Date	Product and Remarks
125	New York			Crushers, [illegible]	$1 31		1919	
200	Arizona	$19 00	93	[illegible] concentration [illegible]	0 87	45	1916	
1,100	Montana	19 00		[illegible]	2 75		1919	[illegible]
5,000	Arizona	9 00	78	[illegible]	0 78	60	1918	[illegible]
5,000	Arizona	5 80		[illegible]	1 01		1919	[illegible]
10,000	New Mexico	7 00		[illegible]	1 37		1918	[illegible]
12,000	Nevada	6 40	68	[illegible]	0 93		1918	[illegible]
12,000	Utah	5 00		[illegible]	0 93		1918	[illegible]
15,000	Arizona	5 66	75	Crushers, [illegible] crushers, ball mills, [illegible]	0 53	60	1916	[illegible]

GRAVITY CONCENTRATION MILLS

125	Utah				$1 44		1912	
150	Utah				1 07		1917	
200	Utah			Sorting, crushers, [illegible]	0 58		1912	
300–400	Missouri			Crushers, [illegible]	0 41		1915	[illegible]
400	Colorado	$6 50		Crushers, [illegible] gravity concentration	2 08			Concentrates cyanided
500	Missouri			Crushers, [illegible] concentration.	0 97		1912	
500	Idaho				0.55		1917	
1,000	Idaho	11 00	91	Crushers, [illegible] concentration.	0 37		1908	Lead-silver
1,000	Idaho	17 00		Crushers, [illegible] concentration.	0.72		1918	Lead-silver
1,250	Idaho			Crushers, [illegible] concentration.	0.36		1911	Lead-silver
1,250	Missouri			Crushers, [illegible]	0 36		1912	Lead
2,500	Missouri			Crushers, [illegible]	0 34		1913	Lead
3,300	Arizona	4 80	70	Crushers, rolls, [illegible] concentration, vanners	0.57		1912	Copper disseminated
4,500	New Mexico	3.40	70	Crushers, rolls, table concentration, vanners	0 50		1912	Copper disseminated
6,500	Arizona	3 15	67	Crushers, rolls, table concentration, vanners	0.45		1913	Copper disseminated
8,000	Nevada			Crushers, rolls, table concentration, vanners	0 49		1912	Copper disseminated
21,000	Utah	2.30	66	Crushers, rolls, table concentration, vanners	0 31		1913	Copper disseminated
1,000	Michigan	2 to 4	70–80	Crushers, steam stamps, jigs, table concentration.	0 27–30		1908	Copper amygdaloid
2,000	Michigan	2 to 4½	70–80	Crushers, steam stamps, jigs, table concentration.	0 24–30		1908	Copper amygdaloid
4,000	Michigan	1¾ to 3½	70–80	Crushers, steam stamps, jigs, table concentration	0.17–40		1908	Copper amygdaloid and conglomerate

SILVER MILLS — ALL-SLIME CYANIDATION

AVERAGE CONDITIONS

180	Canada	$30 00	90	Milling	$2 53		1913	Costs only approximate
250	Canada		92	Crushers, stamp mill, tube mills, cyanidation	2 95	28	1913	
350	Canada	10 25	95	Crushers, stamp mill, tube mills, cyanidation	2 10		1913	
450	Mexico			Crushers, stamp mill, gravity concentration, tube mills, cyanidation	2.64		1918	
500	Canada			Crushers, ball mills, tube mills, cyanidation	2 64		1919	
100	Nevada	15 30	90	Crushers, stamp mill, tube mills, gravity concentration, cyanidation.	3.29	90	1913	
110	Nevada	13.00	94	Crushers, stamp mill, tube mills, gravity concentration, cyanidation.	3.54		1913	
130	Nevada	19 00	92	Crushers, stamp mill, tube mills, gravity concentration, cyanidation	2 62		1913	
135	Nevada	16.00	93	Crushers, stamp mill, Chilean mills, tube mills, cyanidation	2.75	69	1914	
175	Nevada			Milling	3.80		1912	
250	Mexico	11 00	93	Crushers, stamp mill, tube mills, gravity concentration, cyanidation.	3 86		1913	
400	Nevada			Milling	2 90		1912	
500	Nevada	16 30	90	Crushers, stamp mill, tube mills, gravity concentration, cyanidation	2 67		1913	
500	Nevada	16 00		Crushers, stamp mill, tube mills, gravity concentration, cyanidation	2.57		1914	
500	Nevada	24.00	94	Crushers, stamp mill, tube mills, gravity concentration, cyanidation.	2.05	80	1914	

GOLD MILLS — ROASTING-CYANIDATION

100	Washington	$8 00	91	Crushers, rolls, roasting, tube mills, cyanidation.	$2 00		1915	
550	Utah			Crushers, rolls, roasting, tube mills, cyanidation	1 10		'11-'12	35 per cent roasted
600	West Australia	5 00		Crushers, rolls, roasting, tube mills, cyanidation	2 29		1913	
700	West Australia	9 50	85	Crushers, stamp mill, grinding pans, gravity concentration, roasting, cyanidation.	2 08		1912	Concentrate only roasted

GOLD MILLS—AMALGAMATION-CONCENTRATION

30	California	$3 00		Crushers, stamp mill, amalgamation	$1 92 (a)		1912	Followed by cyanidation
50	California	13 50	90	Crushers, stamp mill, amalgamation, gravity concentration	1 07		1913	
200	Korea			Crushers, stamp mill, gravity concentration, amalgamation	0 67 (a)		1914	Followed by cyanidation
300	California			Crushers, stamp mill, amalgamation.	0 22 (a)		1915	Followed by cyanidation
1,000	Alaska			Crushers, stamp mill, gravity concentration, amalgamation	0 24		1912	
1,300	Transvaal			Crushers, stamp mill, amalgamation.	0 27 (a)		1913	Followed by cyanidation
2,500	Alaska	2 50	92	Crushers, stamp mill, amalgamation, gravity concentration	0 185		1912	
4,000	South Dakota			Crushers, stamp mill, amalgamation	0 28 (a)		1914	Followed by cyanidation
7,000	Alaska	1 05	82	Crushers, rolls, tube mills, gravity concentration	0 24	35	1917	No amalgamation

(a) These are incomplete costs, as extraction is continued in cyanide operations that follow.

GOLD MILLS — CYANIDATION

AVERAGE CONDITIONS

85	California	$14 00	95	Crushers, stamp mill, tube mills, cyanidation	$1 73		1912	
115	Montana	11 55	.	Crushers, tube mills, cyanidation.	2 00		1918	Sand leaching
150	Colorado		.	Milling	1 90		1912	
200	Korea	6 50	92	Crushers, stamp mill, tube mills, cyanidation	1 01		1914	
200	Central America	7 00		Milling	1.50		1910	
250	Colorado	26.00	94	Crushers, stamp mill, tube mills, gravity concentration, cyanidation.	1.80		1908	
250	New Zealand		..	Crushers, stamp mill, tube mills, gravity concentration, cyanidation	1 52		1915	
300	California		..	Crushers, stamp mill, amalgamation, tube mills, gravity concentration, cyanidation	0 79		1913	
300	California	11 00	97	Crushers, stamp mill, gravity concentration, tube mills, cyanidation	0 98		1912	
350	Canada	20.50	95	Crushers, stamp mill, tube mills, gravity concentration, cyanidation	1 49		1913	
400	Colorado	2 25	75	Crushers, rolls, tube mills, gravity concentration, cyanidation	1 31		1915	
400	California	9.35		Crushers, stamp mill, amalgamation, tube mills, gravity concentration, cyanidation	1 07		1917	
500	Colorado	6 50	93	Crushers, stamp mill, amalgamation, tube mills, gravity concentration, cyanidation	1 38	74	1913	
500	Transvaal	6 25		Crushers, stamp mill, tube mills, cyanidation	0 96	60	1915	
500	Transvaal	11 25		Crushers, stamp mill, tube mills, cyanidation	1 09	60	1915	
600	Canada	13 00		Crushers, stamp mill, tube mills, cyanidation	1 24		1914	
700	India	17 00	85	Crushers, stamp mill, tube mills, cyanidation	0 86		1907	
875	Transvaal	4 70		Crushers, stamp mill, tube mills, cyanidation	0 87	60	1915	
1,000	Transvaal	4 50		Crushers, stamp mill, tube mills, cyanidation	0 91	60	1915	
1,100	Transvaal		93	Crushers, stamp mill, tube mills, cyanidation	0 82	62	1915	Sands treated separately
1,350	Transvaal	6.20	..	Crushers, stamp mill, tube mills, cyanidation	0 85	60	1915	
1,400	Transvaal	10 00		Crushers, stamp mill, amalgamation, tube mills, cyanidation	0 84		1918	
1,500	Transvaal		93	Crushers, stamp mill, tube mills, cyanidation	0 69	60	1913	
2,000	Transvaal	4 00	.	Crushers, stamp mill, tube mills, cyanidation	0 85	60	1913	
2,000	Transvaal	9 70		Crushers, stamp mill, tube mills, cyanidation	1 22		1919	
2,500	Transvaal	8 70		Crushers, stamp mill, tube mills, cyanidation	1 02		1917	
4,000	South Dakota	3 4	.	Crushers, stamp mill, amalgamation, tube mills, cyanidation	0 79	59	1914	Sand is treated separately

[illegible]	Locality	[illegible] per Ton	[illegible] per Cent	Details of Treatment	Cost per Ton	Per Cent Through 200 Mesh	Date	Products and Remarks
				DESERT CONDITIONS				
[illegible]	[illegible]	$[illegible] 70	[illegible]	[illegible] amalgamation, cyanidation	$4 02	..	1912	30 tons stamped; remainder rejected
[illegible]	[illegible]	[illegible]	[illegible]	[illegible] Chilean mills, grinding pans, cyanidation	2 05		'12 '13	
[illegible]	[illegible]	20 [illegible]	[illegible]	[illegible] tube mills, cyanidation	2 50	70	1913	
200	[illegible]	7 [illegible]		[illegible] tube mills, cyanidation	2.04		1917	
[illegible]	[illegible]	22 [illegible]	[illegible]	[illegible] tube mills, cyanidation	1 79	82	'17–'18	
[illegible]	[illegible]	6 50	[illegible]	[illegible] tube mills, cyanidation	1 59	70	1914	
400	[illegible]	7 [illegible]		[illegible] tube mills, cyanidation	1 61		1912	
[illegible]	[illegible]	[illegible]		[illegible] tube mills, cyanidation	1 12		1912	
1 000	[illegible]	[illegible]	[illegible]	[illegible] tube mills, cyanidation	1 11		1912	
1 000	[illegible]	13 70	[illegible]	[illegible] Chilean mills, tube mills, gravity con[illegible] cyanidation	1 97	75	1913	
[illegible]	[illegible]	12 [illegible]	[illegible]	[illegible] Chilean mills, tube mills, gravity con[illegible] cyanidation	1 61	75	1914	

POWER REQUIREMENTS

	Horsepower Per Ton Milled Per Twenty-four Hrs
[illegible] minus 200 mesh	0.80 to 2.50
[illegible]	0 50 to 0 80
[illegible]	0 75 to 1 00
[illegible]	1 50 to 1 75
[illegible]	1 25 to 4 00
[illegible]	0 50 to 0 80
[illegible]	2 00 to 3 50
[illegible]	0 25 to 0 50
[illegible]	1 50 to 1 75

Size of product: all through 1½ to 3 in. Cost of breaking, per ton of mill feed, $0.07 to $0.13.

Secondary Crushing (intermediate crushing, fine crushing, stamping) follows breaking, and aims to give a product almost all of which passes a 4-mesh screen; it is performed with rolls, disk crushers, or stamps. Cost of secondary crushing, per ton of mill feed, $0.10 to $0.20.

Grinding (comminuting, pulverizing, primary grinding) gives a product of which 15 to 50 per cent passes a 200-mesh screen; ball mills, Chilean mills, or pans are the machines commonly used. Cost of grinding, per ton of mill feed, $0.10 to $0.20.

Sliming (regrinding, fine grinding, secondary grinding, tube milling) reduces a feed all of which passes a 10- to 20-mesh screen, and gives a product of which 90 per cent or more passes a 200-mesh screen. This is generally done in tube mills using pebbles or small balls; it is also done in ball and rod mills. Cost of sliming, per ton of mill feed, $0.15 to $0.50.

Cost of crushing to slime, for each percentage of product that will pass a 200-mesh screen, per ton of run-of-mine ore, ¾c. to 1½c.

Physiological Effects of Carbon Monoxide

Although the extremely poisonous nature of carbon monoxide is understood, there is little available information on the physiological effect of small percentages of carbon monoxide in otherwise respirable air. It is always a poison, whether in small or large proportion, and in the latter case is the most dangerous gas encountered in underground operations. Fortunately, it rarely occurs other than from a mine fire.

Doctors R. R. Sayers and F. V. Meriwether, of the Bureau of Mines, and W. P. Yant, chemist, recently concluded experiments to determine the physiological effects of low concentrations of carbon monoxide under varying conditions. The result of their investigation indicates that exposure for six hours to two parts of carbon monoxide in 10,000 caused a 16 to 20 per cent saturation of the hemoglobin of the blood, resulting in "[illegible] mild subjective symptoms of carbon monoxide poisoning" at the end of the test and no noticeable effects after the test. An exposure to four parts in 10,000 caused 15 to 19 per cent saturation at the end of one hour; 21 to 28 per cent at the end of two hours, and moderate to marked after-effects. Under the conditions of strenuous exercise, the time for saturation to 14 to 16 per cent was one hour in a mixture of two and one-half parts in 10,000 and resulted in moderate symptoms of carbon-monoxide poisoning with after-effects mild to moderate. At higher proportions of carbon monoxide up to four parts in 10,000, the poisoning and after-effects were slightly increased.

According to the investigators, high temperature and humidity, with a given concentration of carbon monoxide, cause more rapid absorption of the noxious gas than do normal conditions of temperature and humidity. It is of interest to note that none of the subjects experimented upon has shown any permanent deleterious effects from the exposure to carbon monoxide.

Technical Operations of the Chile Copper Co. During 1921

The annual report of the Chile Copper Co. contains a summary of mill operations for the year 1921. A total of 1,671,936 dry tons, assaying 1.70 per cent copper, was crushed. The primary crushing is by 84 x 60-in. jaw crushers. This is followed by No. 10 gyratory crushers, and by 48-in. vertical and horizontal Symons disk crushers, which prepare the ore for leaching. During 1921 the oversize on 0.371-in. square mesh of final product from the fine Symons crushers was 9.69 per cent, compared with 13.54 per cent during 1920. The average leaching extraction from 163 charges was 92.24 per cent.

In the tank house, only circuits A, B, C, D, and G were in service during the greater part of the year. Two new 24-in. wood-stave pipe lines were completed, making ample provision for supplying solutions to the tank house. The acid plant was closed down the entire year. Wire-bar furnace No. 1 was dismantled and completely rebuilt.

The following table shows the more important metallurgical data:

	Ore Crushed, Tons	Per Cent Copper in Ore Crushed	Average Tons Crushed per Operating Day	Per Cent Current Efficiency, Tank House	Tons Copper Produced	Per Cent Net Recovery
1918	3,745,083	1.64	10,762	82 4	51,068	82 2
1919	2,961,465	1.62	11,303	83 0	38,359	86 0
1920	4,243,301	1 51	11,760	82 83	55,566	89.68
1921	1,671,936	1 70	5,573	85 43	27,004	91.07

At the power house at Tocopilla, a total of 102,894,500 kw.-hr. was developed, requiring 125,107,927 lb. of fuel oil, or 1.215 lb. oil per kw.-hr. The 18,000-kw. extension to the station was practically completed at the close of the year.

USEFUL OPERATING IDEAS

A Sublevel Slicer

Type Devised by Cleveland-Cliffs Iron Co.'s Engineers Uses Trolley and Has Power Unit Distant from Breast

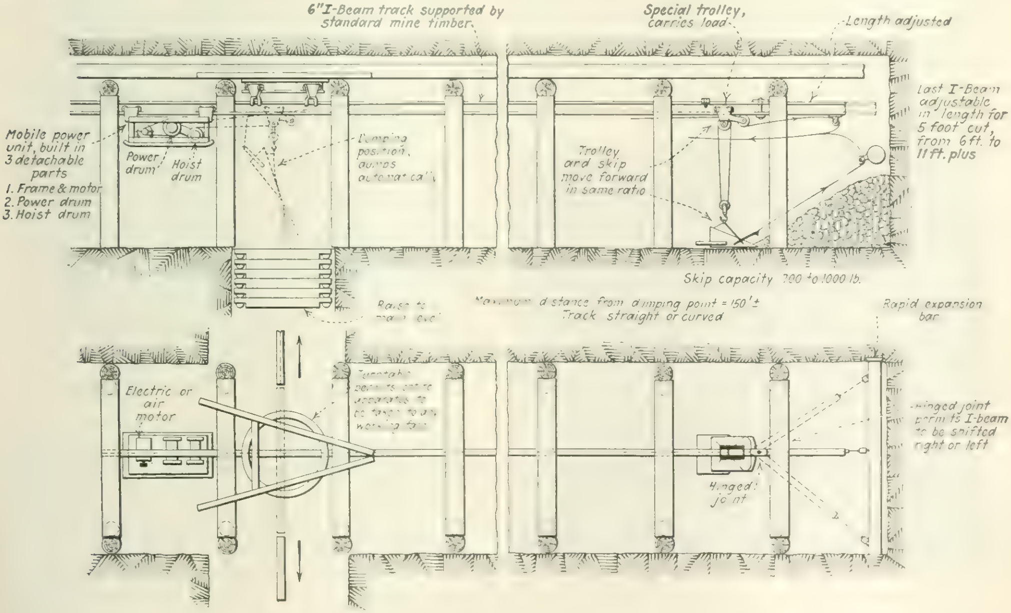
By William H. Newett

A NUMBER of underground loading machines have been perfected in the Lake Superior iron region during the last few years, and several different types are now being manufactured and sold. One of the newest inventions is a sublevel slicer, designed by H. O. Moulton and D. McCarthy, engineers in the employ of the Cleveland-Cliffs Iron Co. They have had one of these slicers at work in the company's Negaunee mine, at Negaunee, for four months, and the results are said to be satisfactory.

The special need for which the machine was designed was that of a small and flexible device which could be taken into any part of a mine and made to substitute for hand labor in the most inaccessible sublevel. In devising this the inventors have departed from the lines of other similar inventions which involved the use of a power loader placed as a unit at the breast, and have worked out a device the power unit of which is fixed at a point distant from the breast.

The machine in its simplest form consists of a scraper or shovel-skip which is forced mechanically into the dirt with a forward and upward motion, and, when filled, is hoisted to the carrying position and automatically locked on an overhead trolley, quickly transported to the raise or other dumping point, where an automatic device dumps it, when it returns to the working place. The entire operation is controlled through the use of cables by the operator seated at the power unit. When two machines are installed side by side in a drift, the shovel-skips will alternate, one going forward empty as the other comes back loaded. Only a small adjustment is needed at the breast to keep the shovel-skip moving forward into the dirt.

The machine which was tried out in the Negaunee mine has loaded, trammed, and dumped successfully at the rate of one ton in five minutes, using a skip holding one-fifth of a ton. More power would have increased this rate.


6" I-Beam track supported by standard mine timber
Special trolley, carries load
Length adjusted
Last I-Beam adjustable in length for 5 foot cut, from 6 ft. to 11 ft. plus
Mobile power unit, built in 3 detachable parts
1. Frame & motor
2. Power drum
3. Hoist drum
Power drum
Hoist drum
Dumping position, dumps automatically
Trolley and skip move forward in same ratio
Skip capacity 200 to 1000 lb.
Raise to main level
Maximum distance from dumping point = 150'±
Track straight or curved
Rapid expansion bar
Electric or air motor
Turntable permits entire apparatus to be taken to any working face
Hinged joint permits I-beam to be shifted right or left
Hinged joint

Method of using Moulton and McCarthy sublevel slicer demonstrated

The device is designed to be operated by electricity, although where this is not available air may be used. The hoist is contained in a frame 2 x 2 x 4 ft. in dimensions, which is supported from an I-beam by means of trolley, so that it can be easily moved about. It is situated during the operation on the opposite side of the raise from the working face. The machine is equipped with two drums, which work independently, so that the operator has control of the scoop at all times. It is demountable into three parts, none of which weighs over 300 lb., the total weight being about 800 lb.

Sublevel slicer dumping into raise

The trolley is so designed that it trips the empty scoop near the loose pile of ore on the forward trip, and dumps the load automatically on the return trip. The scoop may be replaced with timber tongs or sling when timber is being brought from the main level through the raise and carried to the working face. Above the raise is a turntable, so that the slicer may be revolved and used to work as many breasts as are available from one raise. Another advantage is that the machine can work equally well on a curved or straight track, being able to go around a curve on a 3-ft. radius, while idlers on the legs take care of the cables. The trolley and scoop can pass through a 3-ft. opening.

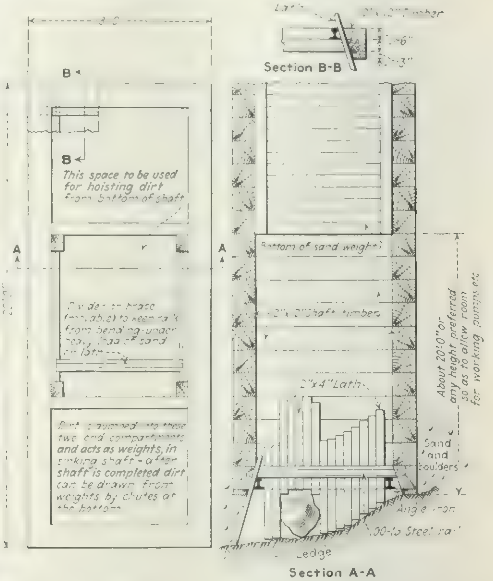
Sublevel slicer taking load

Dating Progress Maps

Frequent erasure of the date on current maps, progress drawings, and the like that are changed from time to time soon wears a hole in the original sheet. This may be avoided by cutting a small square from the lower right-hand corner of the sheet on which the drawing is made and filling this in, when blueprinting, with a square of the same material carrying the date.

Method of Sinking Drop Shaft in Soft Water-Bearing Soil

In a method of sinking drop shafts, cofferdams, and the like, which was worked out by C. T. Roberts, of Crystal Falls, Mich., use is made of 100-lb. steel rails, as shown in the accompanying drawing, the main object of which is to permit the lath to be driven at any time where there is likely to be an excessive inflow of sand and gravel, a frequent occurrence in a shaft of this kind. Such inflows often cause much damage, sometimes throwing the shaft out of line, especially if boulders are encountered.


Lath
12"x12" Timber
6"
3"
Section B-B
3'0"
B
B
This space to be used for hoisting dirt from bottom of shaft
A
A
Divider or brace (movable) to keep rails from bending under heavy load of sand on lath
Dirt is dumped into these two end compartments and acts as weights, in sinking shaft - after shaft is completed dirt can be drawn from weights by chutes at the bottom
Bottom of sand weights
12"x12" Shaft timber
2"x4" Lath
About 20'0" or any height preferred so as to allow room for working pumps etc
Sand and boulders
Y
Angle iron
100-lb Steel rail
Ledge
Section A-A

Method of sinking drop shaft using 100-lb. steel rails

The illustration shows one edge of the shaft resting on the ledge, with about 3 ft. of difference in the contour of the ledge at the other side of the shaft. The lath is shown driven to the ledge and around a boulder. This will permit cutting down the ledge on high sides so that the shaft timbers will rest level on the ledge.

The steel rail dividers or braces can be used in any part of the shaft where the most weight comes while driving lath and can be moved at will along the flanges of the two side rails.

Shaft Arrangements

Spillage is unavoidable in skip-hoisting, and it is customary to arrange a bin below the skip compartments to receive it. The spillage bin is emptied into a car which is handled in a separate cage and compartment alongside of the skip compartment.

At the entrance to shaft compartments from stations some form of gate is necessary. In cage hoisting, a heavy wooden bar which is held by a pin at one end and caught in a metal crotch at the other is the customary arrangement. For skip hoisting a boiler-plate door is recommended, as there is always danger of ore falling down the shaft, and it may be projected into the station.

THE PETROLEUM INDUSTRY

El Dorado Oil Field in Arkansas Warrants Extensive Exploration*

In Spite of Unusual Features, Indications Are Encouraging — Possibility of Finding Similar Fields in Same Region

THE El Dorado oil field, in Arkansas, was discovered by the Constantine Refining Co. when that company's Armstrong No. 1 well struck an immense flow of gas, estimated at 40,000,000 cu.ft. per day, and a small quantity of oil. The oil men of the mid-Continent region paid comparatively little attention to this discovery for several months, although a few companies, acting on the advice of geologists, leased some land near the gas well; but when a well drilled by Mitchell & Busey came in on Jan. 10, 1921, with a flow of about 1,500 bbl. per day, there was a stampede for the field. Leasing and drilling were pushed with an intensity so tremendous that in spite of several months' delay in getting an adequate pipe-line outlet for the oil produced, the field was developed with remarkable rapidity. The oil sand is only about 2,150 ft. below the surface, and the rocks above it are mostly beds of shale and clay that are easily penetrated by the rotary drill. Wells that gave a large output were the rule rather than the exception, several yielding more than 10,000 bbl. per day, although most of these wells produced much salt water with the oil. The output reached about 82,000 bbl. per day during the week ending Aug. 20, 1921, but declined rapidly to about 32,000 bbl. during the week ending March 11, 1922. Since then the output has increased slightly.

Structure in El Dorado Field Is Unique

Each oil-yielding district has its own peculiarities, and the rules that may guide prospecting in one area may not apply to another. The great number of test wells that have been drilled in southern Arkansas without finding oil in large quantity except in the El Dorado fields show either that the oil pools in this region do not bear the same relations to anticlinal structure that they commonly bear elsewhere in the mid-Continent oil fields, or that geologists have not learned how to locate the anticlines in this field by studying the surface formations.

The geologic structure of the El Dorado field is unlike that of any other known field of similar size. The studies made covered only the northern part of the producing area, but there is no reason to think that the structure of the southern part is materially different. If the sand, clay, and gumbo could be stripped off the producing bed in the area covered by the work, no large dome or great anticlinal arch would be uncovered. The surface of the oil sand is so nearly level that it might remind one of gently rolling prairies or of meadows made up in part of smoothly rounded knolls and swales or hollows whose slopes rise in even, sweeping curves. The evenness is interrupted by a number of low, almost vertical cliffs that mark faults where the rock has been broken and one side of the break has risen from 1 to 30 ft. above the other. There are probably a great many more of these breaks than have been identified. Almost without exception they trend northeastward, forming a sharp angle with the longer axis of the field, and most of the low folds that vary the flatness of the surface of the oil sands also trend northeastward.

Some Anticlinal Areas Exist

A study of well records in areas east and west of the El Dorado field shows that this field is not upon a pronounced regional uplift, although there may be a slight bulge or gentle arch in the El Dorado region. The strata dip gently to the east and southeast over most of southern Arkansas. If the El Dorado field is on a regional bulge or uplift, there is a synclinal depression west or northwest of it. A flattening of the regional dip was detected, but no true syncline. Furthermore, if the field were on an uplift the strata immediately east of it would probably show steeper dips than are common in this region, but no suggestion of such steep dips was found. The location of this field is therefore not controlled by the manner in which the rocks are folded. There is no true major anticline here, and the minor folds did not control the distribution of the oil, although the gas in this pool does tend to concentrate in arched or domed areas. If the dates of completion and of average declines in initial production are taken into consideration, in order to compensate for interference from adjacent producers, the wells in these anticlinal areas are perhaps a little above the average for the entire field, but this initial production is not higher than that of wells in adjoining synclinal areas.

On the other hand, it cannot be said that in this field there is no relation between geologic structure and the accumulation of oil, for structure includes both folds and faults, and the faults were probably influential in forming the pool. Nearly every area of high productivity in the oil-yielding belt here considered is traversed by one or more faults. A strip of richly productive territory does not border each fault, but here and there along almost every fault there is a spot of unusual richness.

How the Pool Was Formed

The Marlbrook marl is believed to be the source of the oil in this field, and the accumulation of enough oil in the Nacatoch above the Marlbrook to form a commercial field is probably due to a happy association of a source of oil, channels through which it could migrate, and a good reservoir bed. Oil was probably not formed everywhere in the Marlbrook, at least not in great volume, but in favored spots where it was laid down in shallow water and possibly raised above the sea from time to time, the conditions were right for the deposition and preservation of oil-forming matter. In any event, in some places the Marlbrook appears to have supplied large amounts of oil to the overlying Nacatoch sand, and in others, where the structure is seemingly quite as favorable, it has supplied little or none. At El Dorado the zone of faults crossed a productive area in the marl. The oil moved up along the fault planes and accumulated in the upper part of the Nacatoch sand. Pronounced anticlinal folding and faulting and a rich spot in the Marlbrook together would have produced ideal conditions for the accumulation of oil, and under such conditions the water trouble that has been the curse of the El Dorado field would not have appeared. The beds of sandstone lie so flat, however, that the oil they contain does not saturate them to any great thickness; but, instead, it is found in thin layers at the tops of several beds in the upper part of the Nacatoch, and the remaining parts of these beds are filled with salt water. The gas, being more mobile than the oil, has migrated to the more prominent domes and has excluded most of the oil and the water from certain thin beds of sandstone under the arched areas.

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*Abstracted from Report of U. S. Geological Survey.

If the formations just above the Nacatoch had contained porous sandstones, the oil, as it moved upward along the fault planes, would probably have formed small pools in them, for the faults are not limited to the beds below the top of the Nacatoch, but certainly cut the Arkadelphia clays, although these beds contain few sands. The faults may cut also the Midway beds, although this supposition cannot be definitely verified by the well records, but no evidence was found to indicate that they cut the Wilcox.

SOURCE MAY HAVE BEEN LOWER CRETACEOUS BEDS

Instead of originating in the Marlbrook, the oil possibly may come from a much deeper formation, such as the Brownstown marl, the Eagle Ford shale, or the Lower Cretaceous beds. The depth of these formations below the Nacatoch is no obstacle to the migration of the oil, for the faulting that cuts the Marlbrook must also cut them, and if it could furnish channels for upward migration from the Marlbrook to the Nacatoch it could almost as easily furnish channels for migration from the deeper beds. If the oil came from the Brownstown marl, there may be chances of finding oil-reservoir beds in this formation or adjacent to it, and if it came from the Eagle Ford shale there is a good chance of obtaining it from the Blossom and Woodbine sands.

If the oil came from the Marlbrook marl, however, the chances of obtaining it from underlying formations are not exceptionally good, although these lower formations should not be utterly condemned. The records of other fields that draw oil from Upper Cretaceous formations prohibit such a blanket condemnation, for practically all fields that have yielded either oil or gas in notable amounts from the Nacatoch sand have yielded much greater amounts from either the Blossom or the Woodbine sands, or both. The lack of anticlinal structure at El Dorado, however, offsets this favorable feature. Where oil has been found in the Blossom or the Woodbine there is either pronounced regional uplift or strong anticlinal folding. In the Caddo and De Soto-Red River districts there are both. In the El Dorado district there is neither. The conditions that are associated with oil pools in northern Louisiana, and to which the formation of those pools is presumably due, are therefore lacking here, and production from the deep beds cannot be expected. Nevertheless, the deep sands should be tested.

A few wells in the El Dorado field have reported "showings" of oil or gas in beds in the Midway formation. The few reports that traces of oil have been found in these beds might be discredited, for enough oil to give a rainbow-colored film on the drilling water might accidentally get into a well, but showings of gas could not be thus explained, and it therefore seems evident that at least one bed in the Midway formation carries some oil and gas. This bed may lie about 1,150 ft. below the surface over most of the field, or about 970 ft. above the Nacatoch sand. Reported showings of oil or of gas in a number of wells that have been drilled within a radius of 40 miles of the El Dorado field suggest that an oil-bearing sand may lie at the base of the Midway formation, which in the El Dorado field is from 575 to 625 ft. above the Nacatoch. No careful tests of these shallow beds seem to have been made in the field, in spite of apparent advisability of such tests. Small water-free wells that would draw oil from a bed not more than 1,200 ft. below the surface would probably yield greater net profits than the more spectacular but less reliable wells that get oil from the underlying Nacatoch sand. Tests of shallow sands should be made carefully, for the gas in them is evidently under low pressure, and it would be easy for one to drill through a thin oil or gas-bearing sand without suspecting its presence.

POSSIBLE EXTENSIONS OF THE FIELD

A number of test wells should be drilled west of the gas-bearing area, for oil-bearing beds may possibly border the gas-bearing beds on the west and south as they do on the north and east. The extension of the field to the south of its present limits is to be expected, and determined prospecting to discover a northward extension is also justified by the peculiar type of structure. Operators should not accept a single dry hole as limiting the field in these directions. The producing territory at the present north margin of the field can probably be extended westward.

Parallel belts of faults separated by areas almost unfaulted may occur in southern Arkansas as they do elsewhere in the mid-Continent region, notably in northern Oklahoma and southern Kansas. If such a belt exists within a few miles of El Dorado, the other favorable conditions that combined to produce the El Dorado pool probably also exist there and a field much like the El Dorado field may be developed. Because of this probability the following suggestions are made:

1. If gas in volume is encountered in a wildcat well, the search for oil should be continued by wells drilled east, northeast, or southeast of the gasser.
2. If oil is encountered in a wildcat well, the extension of the oil-yielding area should be sought by other wells drilled either north or south of the discovery well.
3. Gas pressure should be conserved by shutting in gas wells. The maintenance of high gas pressure will help to promote a greater extraction of oil and to prevent water trouble.

The chances for finding new fields are not limited to zones of faulting, for there are probably anticlines in southern Arkansas fully as strongly developed as those on which the Homer and Bellevue fields of Louisiana are located. Even if some of the conclusions here presented may be questioned, other oil fields will no doubt sooner or later be discovered in southern Arkansas, for in view of the showings of oil obtained in widely scattered wells in this broad region it would be unreasonable to believe that there is only one place in it where the conditions are favorable to the formation of an oil pool.

Petroleum Statistics for March Show Large Increase in Stocks

According to the American Petroleum Institute's analysis of complete official petroleum statistics for March, 1922, there was an excess of domestic production and imports over indicated total consumption, including exports, amounting to 15,710,058 bbl. for the month, or at an annual rate of 184,973,240 bbl. This compares with an excess production for the previous month of 12,326,491 bbl., or at an annual rate of 160,684,680 bbl., and an excess production for March, 1921, of 8,369,921 bbl., or at an annual rate of 98,548,905 bbl. The analysis which takes into consideration changes in pipe-line and tank-farm crude stocks, in crude and liquid refined stocks held at refineries, and in stocks of Mexican oil held in the United States, follows:

STATISTICS OF PRODUCTION AND CONSUMPTION OF PETROLEUM

Figures in Barrels of 42 Gallons

	February, 1922	March, 1922	March, 1921
Domestic crude-oil production	40,814,000	46,916,000	40,905,000
Imports, all oil	12,428,075	14,315,176	12,701,019
Total production and imports	53,242,075	61,231,176	53,606,019
Annual rate of domestic production and imports	694,048,595	720,947,635	631,167,490
Increase of pipe-line and tank-farm crude stocks	10,487,000	10,045,000	7,041,000
Increase of crude and liquid refined stocks at refineries	296,309(a)	4,428,058	1,072,921
Increase of Mexican stocks in United States	2,136,000	1,237,000	256,000
Net increase of all stocks	12,326,491	15,710,058	8,369,921
Indicated consumption	40,915,584	45,521,118	45,236,098
Annual rate of consumption	533,363,915	535,974,395	532,618,585
Excess of production	12,326,491	15,710,058	8,369,921
Annual rate of excess of production	160,684,680	184,973,240	98,548,905

(a) Decrease.

The annual rate of excess production over consumption of petroleum east of the Rockies was 169,575,350 bbl. in March, compared with 137,276,500 bbl. for the previous month, and 74,729,005 bbl. for March, 1921. Exports of all petroleum to foreign countries and to non-contiguous territories of the United States totaled 6,568,966 bbl. in March, 4,920,831 bbl. in February, and 5,666,440 bbl. in March, 1921. The indicated domestic consumption of petroleum and liquid products was 36,332,129 bbl. in March, as compared with 33,572,004 bbl. in February, and 37,106,837 bbl. in March, 1921. The excess of domestic production over indicated domestic consumption was 10,583,871 bbl. in March, compared with 7,241,996 bbl. in February, and 3,798,163 bbl. in March, 1921.

PRODUCTION INCREASED IN MARCH

Domestic production of crude oil totaled 46,916,000 bbl., a daily average of 1,513,419 bbl. in March, compared with 40,905,000 bbl., a daily average of 1,319,516 bbl., in March, 1921. There were 1,322 producing oil wells completed in March, against 1,143 in February and 1,450 in March, 1921. Producing oil wells completed east of the Rockies in March totaled 1,264, against 1,098 in February and 1,384 in March, 1921.

Imports of all oil into the United States in March totaled 14,315,176 bbl., a daily average of 461,780 bbl.; in February, 12,428,075 bbl., a daily average of 443,860 bbl.; and in March, 1921, 12,701,019 bbl., a daily average of 409,710 bbl. Pipe-line and tank-farm crude stocks as of March 31 totaled 201,516,000 bbl., an increase of 10,045,000 bbl. over stocks at the end of February. February stocks increased 10,487,000 bbl. over those of the preceding month.

Little Was Accomplished at the Recent Oil Conference in Mexico

Special Correspondence from Mexico City

Petroleum conditions in Mexico are very much "up in the air." Though the exports for April reached 17,000,000 bbl., or an increase of 700,000 bbl. over March, the fact remains that in the last four months not a well of importance has been brought in, and the production depends almost entirely on the Toteca and Cerro Azul fields, and everybody knows that these fields are, under present methods and rate of production, approaching exhaustion.

Notwithstanding optimistic reports given out after the recent conference here, between heads of the important companies in the United States and the Secretary of the Treasury—they were notably vague and lacking in details—the impression prevails that nothing of great importance was accomplished. The oil men agreed to pay the export tax every ten days instead of monthly, and the government, it is believed, agreed to be "easy" on the oil men. As to the efforts of the oil men to nail the government down to something tangible that might indicate what operators may expect in the future, nothing was accomplished.

A sword of Damocles, in the form of a special commission to examine into all titles of oil lands, is still hanging over the producers, with a presumed gentlemen's agreement that the commission will not get immediately or offensively busy, in the performance of its official functions.

In the meantime there is considerable activity in securing wildcat lands in the extreme southern part of the country. Most of the purchases or options are taken by large oil concerns already operating here. In Tabasco, Chiapas, and on the west coast of Guerrero actual drilling is going on in an attempt to prove some of the territory.

Standard Oil Co. of California Active in Montana Oil Fields

Strike of a big flow of gas in the No. 2 well of the Standard Oil Co. of California, drilling jointly with the Transcontinental Oil Co. near Armells, Fergus County Mont., has again turned active interest toward that section of the state. According to reports the flow of gas was estimated at 10,000,000 cu.ft. The gas was encountered in the Kootenai sands 300 ft. above the Ellis sands. The Ellis formation carries oil at Kevin. The Standard of California and the Transcontinental control leases in excess of 30,000 acres in this wildcat and largely unexplored structure.

In No. 1 well the company encountered gas at 1,250 ft., although the flow was not as large as that in No. 2 well. Almost coincidental with the report of the discovery at Armells was the announcement that the California company had opened offices in Great Falls from which its operations in the Montana fields would be directed.

From Great Falls also comes the report that the Standard has acquired five tracts in the Kevin-Sunburst district, largely in the southern end of the new field. On the Gas Ridge anticline the California company has about 2,000 acres blocked up. It is reported to be paying cash for all leases that it is acquiring in the prospective campaign of exploration.

Geologists of Note

HORACE V. WINCHELL

HORACE V. WINCHELL is naturally a geologist, both his father, Newton H. Winchell, and his uncle, Alexander Winchell, being distinguished and devoted geologists. Under these family instructors Horace studied earth science, graduating from the University of Michigan, where Alexander Winchell was professor of geology, in 1889. As his father was State Geologist of Minnesota, it naturally came about that Horace made his first field studies as assistant geologist on the Minnesota Geological and Natural History Survey in 1889-91. This is a distinction Mr. Winchell shares in common with the editor of this journal, who got his first field experience on the same survey in 1893, being initiated into this work by Professor N. H. Winchell and Horace Winchell. The result of Horace Winchell's first field work was the publication, in collaboration with his father, of the report on "Iron Ores of Minnesota," published in 1890, and in 1892 he published the first reconnaissance report on the Mesabi Range. The term "taconite," used widely in Minnesota to apply to the iron-bearing rocks, was proposed by the Winchells. A natural inclination toward business soon led Mr. Winchell into the field of commercially applied geology, and in 1892-93 he was in charge of explorations for iron on the Mesabi for the Minnesota Iron Co. From 1893 to 1898 he was in general consulting practice, with headquarters at Minneapolis. He then went to Butte as geologist for the Anaconda Copper Mining Co. and remained there eight years, till 1906. There he devised and initiated the system of careful and methodical mapping and painstaking recording of data for which the geological staff of the Anaconda is noteworthy to this day. He also was attracted by the problem of the origin of the rich copper sulphides, such as chalcocite, and, together with Dr. C. F. Tolman, now professor of geology at Stanford University, he succeeded in producing chalcocite by laboratory experiments, under such conditions as to indicate the secondary origin of this sulphide. It was largely that work that opened the eyes of other visiting geologists to the importance of secondary copper sulphides as a result of the alteration of lean primary sulphides by surface waters, and at nearly the same time Emmons, Weed, and Van Hise published the outlines of the now famous explanation. In 1906 Mr. Winchell left Butte and became geologist for the Great Northern Ry. Co., in which capacity he continued for two years. Since 1906 he has been in general consulting practice as an economic geologist. During that period he has specialized particularly in the geological and legal interpretation of the obscure problem of the law of the apex, and scarcely a great legal contest on this score between two mining companies has occurred for years without Mr. Winchell's services being requisitioned, usually as the chief expert on one side or the other. While he has thus become a redoubtable specialist both in the geology and the law of these cases, he is one of the staunchest opponents of the law, and has done more than any other man toward its repeal and its substitution by some more reasonable measure. He is one of the members of the committee which drafted the proposed new mining law, now under consideration by the Mines and Mining Committee of the House of Representatives. He gives freely of his time to technical and scientific societies, and in recognition of his qualities was elected president of the American Institute of Mining and Metallurgical Engineers in 1919, where he served most acceptably. He has the ability to deliver a forceful and throughtful address.

HORACE V. WINCHELL

When *Economic Geology* was founded by a group of American economic geologists, at the suggestion of J. E. Spurr, Mr. Winchell became one of the founding group. The *American Geologist* had long been edited by his father, Professor N. H. Winchell, and one of Horace Winchell's contributions to the new journal of *Economic Geology* was to turn over to it the *American Geologist*, with its traditions, good will, and subscribers, thus giving it at the outset an unusual start.

A firm believer in what he believes in; a good friend; an outspoken opponent; a public-spirited citizen, is Horace V. Winchell.

SOCIETIES, ADDRESSES, AND REPORTS

The Technical Side of Our Natural Resources*

The volume and extensiveness of the natural resources of the United States are probably not equaled in any country in the world. The component parts of everything used in our industrial life comes from the ground or grows upon its surface.

If we would analyze the bringing together of natural resources used in the structure we are now in, we should probably find that the timber came from Florida, the stone from Bedford, Indiana, the iron from the iron mines along Lake Superior, and the glass from silica deposits of Illinois.

All of the wealth represented by all of the building of cities, villages, railroads, steamships and industries comes under one deduction, which has given engineers, economists, accountants, geologists, and law makers so much trouble. That deduction on an income-tax return is depletion.

Innumerable positions have been taken by both the Government and the various industries since the imposition of the excise tax law of 1909. I cannot tell you why no depletion was allowed mining and oil operations under that act, though timber companies were allowed it, except that the Supreme Court in the famous Sargeant Land Co. case said the law did not provide for it. Under the 1913 income-tax law, the same industries were again treated differently, the mining companies being limited on their deduction for wasting assets to 5 per cent of the gross value at the mouth of the mine or well, though no such limitation was provided for regarding timber operations. We are not concerned with these limitations except that it is sometimes hard to explain to the taxpayer why we will not let him have depletion when it will help him and then make him take it for invested capital purposes in a year when it again hurts. The law under which we are now operating says a reasonable amount shall be deducted for depletion.

As practically all mining property was acquired prior to March 1, 1913, we are confronted mainly with the problem of establishing the value of the mine on that date and perhaps in a considerable number of cases with the clause relating to discovery since that date.

The revenue law provides three ways of determining the value of a mining property: (1) The cost of purchased property on March 1, 1913, or later; (2) the fair market value if purchased earlier than March 1, 1913; (3) revaluation in either of the other cases proved since March 1, 1913, or since purchased, subsequent to that date new discovery in unproven ground results in a value disproportionate to the value prior to discovery.

Practically all mines require a value as at acquisition, for the reason that seldom are any mines purchased with cash, nearly all being acquired by an issue of stock. There probably could not be money enough got together by a group of men to purchase the Utah Copper Co. or the Chile Copper Co.

By using strictly engineering methods it is possible for two sets of valuations to arrive at approximately the same results; i.e. by starting with the same facts there need be no great disparity in the result, because practically all great natural-resource companies carry an engineering department.

To give you an idea of the success of this branch of the Natural Resources Division, I do not believe that a single case has gone to court on strictly a difference of opinion regarding the value of property turned in for stock or a value as of March 1, 1913, for depletion purposes. It is possible much more accurately to gage values by transfers of near-by or similar properties in certain cases of oil and coal lands, as these in recent years have been subject to rather frequent changes of ownership, but these methods, except in occasional instances, do not yield a safe basis for valuation of metal mining properties. Stock-market quotations may, under some circumstances, afford a rough check for valuations arrived at by more direct methods, but in themselves can ordinarily be given little weight, for a variety of reasons. For instance, the asset value of United States Steel is about $235 per share, but it can be bought in any quantity today around $100 per share. The anticipation of things which are likely to happen or not to happen causes wide fluctuations in a stock market, but has nothing to do with real value. The attitude of the department in the past has been largely, what would a willing seller take for a property?

Inasmuch as the inception of valuation in the complex metals relies on factors such as tonnages and yield of ores which are necessarily estimates and approximations at best, it might seem natural to conclude that all subsequent steps could with just as much permission be of only about the same accuracy. Such an impression, if one exists, is erroneous, for after the basis is established the answer is purely one of mathematics.

I wish to call your attention to a phase of our taxation problem peculiar to all cases audited in the Natural Resources Division, which has long been recognized by economists and mining engineers but not in our revenue laws until recently: i.e., the principle of wasting assets. The apparent income for a given year's operations is part profit and part return of capital. The operator who sells his metal or his coal is selling not only his product but at the same time a part of his mine. The gross receipts must cover both. From my observation, the failure to provide for this feature has led to almost disastrous results.

The amount allowed as a deduction for Federal tax purposes has varied in almost every law. Under the present statutes, this provision for wasting assets we will find on the liability side of our balance sheet, under the name of reserve for depletion, which may be set up on various basic dates, including a reserve on cost, March 1, 1913, value, and probably a discovery value. In a case of this kind this reserve account must be analyzed to distinguish what part is a real reserve and what part takes on the status of surplus and becomes capital.

The large exploration companies are offered hundreds of prospects for every one taken up. The report of a large mining company tells of 3,000 investigations, and only one property examined and proved worth buying. Each prospector thinks he has discovered a mine of untold wealth, but its wealth usually remains untold and this suggests a prevalent error to regard a mine as a mint and the ore as coin, whereas the truth is mining is a branch of manufacture and the ore is only the raw material, and as such is subject to the uncertainties prevalent where it is situated, such as fuel and water, not only for sustaining life but for lights and power; the cost of living; the price of labor; the means of reduction, transportation; protection of law, and civilization generally.

Up to the present time, under all laws up to the act of February, 1919, depletion has not been allowed in arriving at taxable income on the March 1, 1913, value of a lease, but an amortization of any cost at time of purchase as development capitalized is allowed. This point is now being strongly urged in several cases, and one Federal court, in the Allworth Stevens case, ruled the deductibility of a March 1, 1913, value in the case of a sublessor.

By a special provision of the act of February, 1919, the depletion must be equitably prorated between the lessee and lessor on the March 1, 1913, value.

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*Abstract of a paper presented by H. L. Simcoe, assistant head of the Natural Resources Division, at a recent meeting of the Income Tax Unit.

Whether there is any realized appreciation to be added to surplus for [illegible] purposes depends on how it has been treated on the taxpayer's books. If depletion is based on cost and is deducted on cost, there is no unrealized appreciation to add to surplus, but the surplus account is correctly stated. It is automatically there.

If depletion is deducted on the taxpayer's books on a March 1 value or a discovery value in excess of cost, and thereby understates his net income to arrive at a taxable income which is reflected in a reduced surplus account, the difference between cost and deductible value is realized by sale, and the difference should be added to surplus, providing it has not been paid out in dividends and is still in the business.

It has been held an operating deficit cannot break down a surplus created by a realized appreciation, thereby giving it the status of a paid-in surplus instead of an earned surplus. However, I think this is a debatable subject, as it would appear that this is a surplus built up by non-taxable income realized by sale in the regular course of business.

There are some cases in which there is a depletion allowance even though no ore has been removed. This happens in the case of an advanced royalty, where the owner has leased a mineral property for a term of years, with a requirement in the lease that the lessee shall extract and pay for annually a specified number of tons, or other units of measurements agreed to, of such mineral, or shall pay annually a specified sum of money which shall be applied in payment of the purchase price, or a royalty per unit of such mineral whenever the same shall be extracted and removed from the leased premises; the value in the ground to the lessor, for purposes of depletion, of the number of units so paid for in advance of extraction, will constitute an allowable deduction from income of the year in which such payments are made. No deduction for depletion by the lessor shall be allowed in any subsequent year on account of the extraction or removal in such year of any material so paid for in advance and for which deduction has once been made.

If for any reason a mineral lease is terminated where advance payments have been made and depletion has been allowed the lessor, the amount allowed becomes income in the year the lease is surrendered. Since this is a provision of the later regulations and is not mentioned in the previous issues, we have had several contested cases falling under this provision.

In conclusion, let me say, taking it for granted I have shown you there is no formula which can be used indiscriminately, that there is no place you can turn to get the correct answer, but that in the last analysis many valuations are questions of judgment which must be left to men who are familiar with the industry and the field. Such men are attached to the Natural Resource Division grouped in industries, so let us leave the shoemaker to his last, the miner to the mine, and the bookkeeper to his books, and thus give us a division of labor, and each will speak the language in which he is trained.

Hopeful Elements in the European Situation

"The European industrial situation is by far the most outstanding single factor in our foreign trade," according to Dr. Julius Klein, director of the U. S. Bureau of Foreign and Domestic Commerce of the Department of Commerce. Speaking on May 22 before the First National Convention of American Importers and Exporters at the Pennsylvania Hotel, New York City, he declared that "it is by all odds the most conspicuous beacon on our commercial horizon by which our overseas efforts are to be guided. On the one hand it shows the way to those markets across the Atlantic which buy every year nearly 60 per cent of all our exports. On the other, it indicates the possible menace of European competition with American goods in other markets such as the Far East and Latin America. "The Continent as a whole," said Dr. Klein, "and especially the United Kingdom, which is by far our best customer, is getting back to normal production of foodstuffs and, unless a new drought or crop failure occurs, this season will import reduced quantities of edible necessities.

"The various European countries are gradually returning to a saner political outlook and to a more complete recognition of their own economic situation. France is gradually realizing that her budget must be balanced out of current revenues, and that she cannot rely on German reparations. Italy has been able to effect cuts in government expenditures and is weathering the crisis caused by the Ansaldo and Banca di Sconto troubles.

"In Belgium the boom of 1921 proved to have been rather artificial, and due to temporary causes, chiefly the decline of German competition. The encouraging movement was checked after Christmas by the rise in French exchange and British competition in coal, iron and steel. Coal production has held up fairly well, however, and iron and steel production has increased since January.

"German industrial production and general business are stagnant. Labor costs are rising, larger proportions of raw materials must be imported and the production of fuel is decreasing slightly. The productivity of German labor is less by 20 per cent or 25 per cent than before the war, on account of the lowering of the standard of living. All these and other factors have, apparently, brought present German production in general down to about 60 per cent of the pre-war standard.

"In general, it may be noted that the process of normalizing the industrial situation is proceeding slowly but steadily.

Research Fellowships in the School of Mines, University of Alabama

The School of Mines of the College of Engineering of the University of Alabama offers five fellowships in mining and metallurgical research in co-operation with the U. S. Bureau of Mines. The fellowships are open to graduates of universities and engineering schools who have proper qualifications to undertake research investigation. The value of each fellowship is $540 per year of nine months, beginning Sept. 1. Fellowship holders will be required to register as graduate students and to become candidates for the degree of Master of Science unless an equivalent degree has previously been received. The fellowships have been established for the purpose of undertaking the solution of mining and metallurgical problems of special importance to the State of Alabama and the Southern States.

The following problems have been selected for the year 1922-1923:

1. Beneficiation of iron ores.
2. The preparation, treatment and uses of non-metallic minerals, such as clay and barite, in the industries other than the ceramic and chemical industries.
3. Metallurgical coke.

Fellows will be exempt from all laboratory and non-resident fees and will be required to pay only the following: (a) Matriculation fee of $10; (b) student activities fee of $13.50 per year, which includes subscription to student publications and admission to all athletic contests; and (c) a diploma fee of $15.

Applicants should send a copy of their collegiate records from the registrar's office of the institution where they have graduated. They should also state their professional experience and give the names and addresses of at least three persons who are familiar with the training and ability of the applicant. Applications are due not later than July 15 and should be addressed to H. D. Pallister, Professor of Mining Engineering, School of Mines, University of Alabama, University, Ala.

Salt Lake City To Protest Cut in Government Appropriation

The possible curtailment for the coming fiscal year of the Federal appropriation to the Salt Lake Station of the U. S. Bureau of Mines (which is under the joint direction of the Bureau and the University of Utah School of Mines) as announced by Dorsey A. Lyon, director of the Bureau, will be protested by the Mining Committee of the Salt Lake City Commercial Club. Co-operation is promised by other local mining men and the Utah Chapter of the American Mining Congress. The work of the local station was carried on by funds furnished jointly by the Government and the State of Utah. The Salt Lake City Station was the first to be established in the Far West.

MEN YOU SHOULD KNOW ABOUT

Harry L. Day has moved from Berkeley, Cal., to Portland, Ore.

H. Foster Bain sailed from Seattle for Juneau. Alaska, on May 17.

C. W. Knight, associate provincial geologist of Ontario, will investigate the South Lorrain silver area.

Gordon Murray, of Murray brothers, the discoverers of the gold-bearing area of Elbow Lake, Manitoba, is in Montreal.

W. H. Blackburn, general manager of the Tonopah Mining Co., has returned from a business trip of several months to Nicaragua.

Arthur W. Jenks has gone to the northern part of the Province of Quebec to examine mining property for New York interests.

C. Colcock Jones is registered at the American Club, Mexico City, and expects to be at that address until the middle of June.

Prof. Russell D. George, state geologist of Colorado, has received the degree of LL.D. from McMaster University, Toronto.

John G. Kirchen, general manager of the Tonopah Extension Mining Co., left Tonopah on May 12 on a business trip to Eastern points.

Walter Douglas, president of the Phelps Dodge Corporation, is making a general inspection of the corporation's southwestern holdings.

D. C. Jackling last week visited Ray and Hayden, Ariz., in connection with details of arrangements for resumption of work on the Ray mine and mill.

M. R. Campbell is studying the geology and physiography of that part of the Shenandoah Valley in which the newly discovered caverns are situated.

A. G. Burrows, of the Ontario Department of Mines, will make an examination of the Porcupine gold area, including the underground workings of the mines.

Charles Camsell, Canadian Deputy Minister of Mines, and **Prof. S. F. Kirkpatrick** have been accorded the honorary degree of LL.D. by Queens University, Kingston, Ont.

W. C. Alden is in Montana to continue his studies of the Tertiary and Pleistocene bench gravels and glacial phenomena in the plains of eastern Montana and western North Dakota.

C. M. Weld, of Weld & Liddell, will return to New York about June 1 after a month's absence in West Virginia, Tennessee, and Alabama on examination work, principally on coal properties.

R. H. Sargent is in charge of a party which is en route to Alaska to make topographic and geologic surveys in the Cold Bay oil region. Mr. Sargent will be assisted in the topographic work by R. K. Lynt. The geologic work will be done by **A. A. Baker** and **W. R. Smith.**

J. E. White, is engaged in making an examination of the Uvada mine and milling equipment. This mine is an old silver property in the Cold Spring district, fifteen miles north of Modena, on the Salt Lake R. R.

David B. Kushmore, chief engineer of the Power and Mining Department of the General Electric Co., has recently been appointed to the staff of consulting engineers of the company. He will be succeeded by **K. A. Pauly**, formerly head of the steel mill section of the power and mining department.

H. W. Hardinge has left for a tour throughout the West. The purpose of this trip is to make a general survey of conditions in both the mining and industrial fields.

Major A. W. Davis has been appointed resident mining engineer of Mineral Survey District No. 3, British Columbia. His headquarters will be the town of Kamloops. He assumed the duties of his new office on May 15. Major Davis succeeds the late **R. W. Thomson**, who died some months ago.

F. W. McNair, president of the Michigan College of Mines, at Houghton, has been appointed a member of a joint committee representing the Society for the Promotion of Engineering Education and the National Industrial Conference Board.

C. E. Siebenthal, of the U. S. Bureau of Mines, has arrived in the Tri-State field for a stay of probably three months, during which time he will complete his study of the geology of the Oklahoma and Kansas sections of the field, a work started by him before the war. He will make his headquarters at the Miami Hotel, at Miami, Okla.

C. W. Merrill gave a luncheon for **B. C. Yates**, general manager, and **W. J. Sharwood**, metallurgist, of the Homestake Mining Co., at the Pacific Union Club, San Francisco, on May 16. Those present were **C. W. Merrill, F. W. Bradley, A. C. Lawson, Edmund Juessen, Charles Janin, E. A. Julian, E. Higgins, F. L. Sizer, E. H. Benjamin, Frank G. Baum, Frank H. Probert**, and **C. T. Hutchinson.**

Louis S. Cates, for a number of years assistant general manager of the Utah Copper Co., and consulting director of the Ray Consolidated Mining Co., has been made general manager, director, and assistant secretary of the Utah Copper Co., to succeed **Robert C. Gemmell**, who becomes assistant managing director of the Jackling group of porphyries, including the Ray, Chino, Utah Copper and Nevada Consolidated properties. Mr. Cates had charge of the construction work at the Boston Consolidated as his first experience in the camp of Bingham. This property later became a part of the Utah Copper holdings. As general manager of the Ray Consolidated, Mr. Cates developed a system which made it economically possible to mine low-grade porphyry by underground methods.

Mining engineers who recently visited San Francisco, Cal., included **F. Searles**, of Grass Valley, Cal.; **D. S. McAfee**, of New York City; **R. A. F. Penrose**, of Philadelphia, Pa.; and **Horace V. Winchell**, of Los Angeles.

Mining and metallurgical engineers visiting New York City last week included: **R. K. Neill**, of Spokane, Wash.; **E. S. Moore**, of State College, Pa.; **T. Antisell**, of Washington, D. C.; **William McCullough**, of Cleveland, Ohio, and **R. V. Whitman**, of Ebensburg, Pa.

OBITUARY

Pierre Tetreault, of Tetreaultville, Que., died suddenly on May 14 at the age of sixty-four years. He was a pioneer zinc miner of Butte, Mont., where he discovered the Arius mine. Returning to Quebec, he founded the village that bears his name. Mr. Tetreault was the owner of several mines in Quebec province.

Alva P. Thomas died in Aztec, N. M., April 10, at the age of forty. Mr. Thomas had been engaged in mining in the west for twenty years, having held important positions with the Anaconda Copper Mining Co., the Goldfield Consolidated, and the Goodrich-Lockhart Co. In 1915, Mr. Thomas went to Peru to take charge of some mining properties for the Backus and Johnston Co. Upon his return, he re-entered the employ of the Anaconda Copper Mining Co. At the time of his death Mr. Thomas was in partnership with his brother-in-law in the cattle-raising business near Blanco, N. M.

Henry Marion Howe, one of the leading metallurgists in the United States, and for many years professor of metallurgy at Columbia, died on May 13 at his home in Bedford Hills, N. J. Born in Boston seventy-four years ago, he was graduated from Harvard in 1869 and in 1871 from the Massachusetts Institute of Technology, later receiving the degree of LL.D. from Harvard and Lafayette. He was a son of the late Julia Ward Howe. He received his degree of bachelor of arts from Harvard in 1869, and his degree from the institute after two years' study. After his graduation from the institute he went into practical work in the steel industry at Troy, N. Y. From there he was called to Joliet, Ill., to become manager of the great Bessemer steel works. Everywhere his genius and attainments in his chosen career brought him honors. Among them were a knight of the order of St. Stanislaus by Emperor Nicholas of Russia, the Elliott-Cresson medal of the Franklin Institute, and the gold medal of Verien Beforderung des Gewerbfleiss of Germany. He was made a chevalier of the Legion of Honor in 1901, and was president of the jury of awards on mining and metallurgy at the Columbian Exposition and at the Paris Exposition.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

THE REPORT of the Evans Committee on its investigation of the American Smelting & Refining Co. has been issued to the stockholders. The management is taking steps to insure the continuance of its control at the annual meeting next month.

Debate on the tariff bill is becoming marked with bitterness. Little progress is being made.

Public test of the Hawksworth removable drill bit was made by the Anaconda company at the St. Lawrence mine recently, with excellent results.

The Tennessee Copper & Chemical Corporation has begun the erection of a flotation plant.

United Verde is experimenting with heap leaching under the direction of Joseph Irving.

Federal Tax Claim Against Consolidated Arizona Compromised

Consent to the disposal of the property of the Consolidated Arizona Smelting Co. to John I. McNeil for $1,000,000 was given in the United States Court on May 17. It was stated that a compromise had been effected of the Government's claim for about $600,000 for excess-profits taxes. It is understood that this clears the way for the operation of the Humboldt smelter early in June.

Tennessee Copper Building Flotation Plant

Licenses from Minerals Separation have been taken out by the Miami Copper Co. and the Tennessee Copper & Chemical Corporation. Construction of a flotation plant has been started by the Tennessee company, to treat its fines, hitherto largely stocked. The capacity of the initial installation will be sufficient to increase by 50 per cent the copper output of the company, which is normally about 10,000,000 or 12,000,000 lb. annually. The ultimate capacity planned has not been divulged.

Tennessee Copper's ore has always been smelted directly, sulphuric acid being manufactured from the furnace gases. The output of copper has consequently been directly affected by the demand for acid. Erection of the flotation plant is expected to remedy this situation to some extent. The additional copper so produced will thus be made at a lower cost.

Granby May Build Mill

The Granby Consolidated Mining, Smelting & Power Co. is thinking of building a concentrator of about 1,000 tons' capacity to handle low-grade siliceous ores from the Hidden Creek mine, in British Columbia. No decision has been reached as yet by the management.

Evans Committee Reports on Investigation of American Smelting & Refining Co.

Majority Criticises Management on Certain Points—Elihu Root Holds Findings Unjust—Minority Upholds Guggenheims —Call for Proxies Out

WHILE conceding that the business management of the American Smelting & Refining Co. has been successful and that a highly efficient organization for the conduct of its business has been built up, the majority report of the Evans committee of stockholders nevertheless sets forth certain transactions wherein officers and directors of the company are, in the committee's opinion, subject to criticism in their dealings with other corporations in which also they were interested. It also condemns "the policy of paying large dividends during the years of very profitable business without making sufficient additions to capital reserves."

The report is signed by Henry Evans, Clarence H. Kelsey, Henry K. Pomroy, and Willis D. Wood, four of the committee's seven members. The three members dissenting are E. C. Jameson, Lyman Candee, and Wilfred Shore, who were elected directors at the last annual meeting on April 6, 1921. A minority report defending the management of the company is signed by them. They had been added to the membership of the committee at the company's request and as its representatives.

The Evans committee was organized on March 24, 1921, to investigate the management and affairs of the company, as a result of the charges of mismanagement made by Karl Eilers during his campaign to oust the Guggenheims from control. As then agreed, the committee was to conduct the investigation through its own agents and report its own conclusions, but the report, before distribution to stockholders, was to be submitted to the company to be examined by William H. Taft, on behalf of the company, if the latter wished. Later it was understood that Elihu Root would act in place of Mr. Taft. George W. Wickersham acted as counsel to the committee and concurred in the finding of the majority.

At the time of the merger of M. Guggenheim's Sons with the American Smelting & Refining Co., states the majority report, the latter company acquired from the Guggenheims properties worth $14,713,000, giving in exchange stock having a market value of $34,804,000 and which was later disposed of for $37,411,720. Regarding this transaction, the report says:

"The statement made by S. R. Guggenheim to the stockholders in 1921, that at the time of the merger the business of M. Guggenheim's Sons was earning over $4,000,000 a year, appears, from all the facts ascertained in connection with this investigation, to be very greatly exaggerated."

Ten pages of the report are devoted to a discussion of the company's relations with the Federal Mining & Smelting Co. The fall of the Federal company from its position in 1907, when its common stock paid 18 per cent and sold at $196, to that at the present, when its deficit is placed at $10,000,000 by the committee, is shown. The report says:

"In 1908 the failure of the Federal company may be said to have begun. From the beginning of the fiscal year 1905 to the beginning of the fiscal year 1908, the dividends paid on preferred stock amounted to $2,342,033.71, and the dividends paid on common stock amounted to $2,372,009.10, together amounting to $4,714,042.81. During the same three year period the total deduction from earnings for overhead, construction, exploration, development, depreciation, and ore depletion (i. e., for all purposes except operating expenses) amounted to less than $650,000, of which less than one-half was deducted for ore depletion.

"There was only half as much common stock as preferred stock, yet during the three-year period preceding the decline of the company the amount paid in dividends on common stock exceeded the amount paid in dividends on preferred stock.

"The earnings used for dividends amounted to more than 26 per cent of the company's total capital, while the earnings used for ore depletion amounted to less than 2 per cent of such capital."

In connection with the transactions with other companies which the committee considers subject to criticism, particular reference is made to the organization and issuance of various stocks by the American Smelters Securities Co., guarantees of such stocks and purchases by the Smelting company, and the sale by the Guggenheim Exploration Co. to the Smelting company in 1911 of substantially half of the common stock of the Securities company. Reference is also specifically made to the transfer to Guggenheim Brothers in 1921 of the copper-selling agency which the Smelting company had conducted for ten years.

Election of a board of directors of whom a majority would be independent of the present management has been advocated by the majority members of the committee in a statement to stockholders.

A call for proxies has likewise been sent out by the management.

Elihu Root Comments on Report of Majority

Elihu Root, who examined the majority report for the company in place of Mr. Taft, cites the dividend record, showing that the stockholders in twenty years have had returned to them the entire cash investment, plus 6 per cent per annum, plus $23,000,000 in excess of the entire cash investment and annual interest thereon, and that they now have behind their stock practically a clear value of more than $128,000,000, equivalent to par for both common and preferred stock and $17,000,000 surplus.

Taking up the points of criticism referred to by the committee in its report, Mr. Root says:

"The consideration moving from the Smelting company for its half of the Smelters Exploration Co. common stock was its guaranty of $7,500,000 of the Smelters Exploration Co. preferred stock. It is objected that the properties conveyed to the Smelters Exploration Co. under this arrangement were not such as to justify an expectation that the profits from their operation would pay the dividends on the preferred stock and leave any margin for the common stock. It is unnecessary to discuss this objection, because the actual operation of the properties has proved the contrary."

Referring to the organization of the American Smelters Securities Co., Mr. Root says that the criticism is that the American Smelting & Refining Co. should have financed the new copper smelting development itself alone, taking all the profits itself, instead of bringing in the Smelters Exploration Co. to take part in financing and carrying on the enterprise and in the profits. Defending the management against this, Mr. Root says in summarizing:

"The gist of the matter was that the Smelting company was not in a financial position to raise the money for the new enterprise without taking Mr. Schiff and his associates into a virtual partnership with them in the enterprise. That was the conclusion reached, and accordingly the issue of Preferred B stock with the guaranty of the Smelting company was increased from $7,500,000 to $30,000,000 and the stock was taken by an underwriting syndicate formed by Kuhn, Loeb & Co. and very largely made up of Mr. Schiff's associates and customers."

As to the transfer of the copper-selling agency, Mr. Root summarizes thus:

"The so-called transfer of the selling agency comes down to this: That the agency was brought to the company through the influence of Messrs. Guggenheim in the producing copper companies; that it remained with the Smelting company so long as it was beneficial and productive of great profits to the company and until the company was forced to discontinue the agency because they could not continue it without ruin; that upon the happening of that event, the Guggenheims, in discharge of their obligation to the stockholders of the copper producing companies, entered into a new arrangement for the sale of their copper, not for profit, but for the best interests of all concerned, the Smelting company included."

Mr. Root concludes that the management is not subject to just criticism upon either point, but is "entitled to high credit for its devotion to the interests of the company and the fairness and integrity of the management." He also says that the report and annexed material contain no charge or suggestion of graft or dishonesty or peculation in the management, or in the multitude of employees of the company.

Minority Upheld Management

In giving their reasons for disagreeing with the majority, the minority state, in part:

"The Messrs. Guggenheim are entitled to a very large share of the credit for the company's prosperity, not alone by reason of their participation in building up the 'valuable organization' which now operates the business, but primarily by reason of the fact that they have consistently brought to the company the ores of the mines in which they have been interested.

"There can be no question but that the good offices of the Messrs. Guggenheim enabled this company to procure the business of the Utah Copper Co, the Kennecott Copper Corporation, the Nevada Consolidated Copper Co., the Braden Copper Co. and a number of other important companies.

"The profits accruing in the past twenty years from the contracts and business which have been thus brought to the company have been very great. The contracts with these companies have been as favorable to the Smelting company as the contracts with other companies in which the Messrs. Guggenheim have had no interest whatever.

"Much is said in the report concerning the profits of the Copper Sales Agency, which was terminated in 1920. The Sales Agency could not have been retained without causing serious embarrassment and loss to the company, and it has since been demonstrated that its earnings, even if it had been retained, would be comparatively unimportant.

"But the majority report makes no mention of the fact that the Messrs. Guggenheim are entitled to the credit of having brought to the company in the first instance this agency and the profits it yielded prior to the period of war readjustment and consequent financial crisis, which necessitated its termination.

"In our opinion, the 1905 transactions, about which so much is said in the report, are transactions in which the Guggenheims' personal interest lay with the American Smelting & Refining Co. as against the Guggenheim Exploration Co.; and viewed in this light, we think the 1905 transactions cannot properly be criticized, especially as they turned out to be highly profitable to the Smelting company."

Appeal in McDougall vs. Oliver Iron Mining Co. May 30

On May 30 the appeal of Alexander McDougall from the decision of Judge Wilbur F. Booth, in the case of Alexander McDougall vs. Oliver Iron Mining Co., will come up in the U. S. Circuit Court of Appeals in St. Paul, according to schedule. McDougall sued the Oliver company for alleged infringement of ore concentrating machinery.

Gold Ore Discovered in Java

By Cable from Reuters to "Engineering and Mining Journal-Press"

Batavia, May 5—A discovery of gold ore is reported in the Soekaboemi district of Java.

Ice Breaking Up on Yukon

The ice began to break up on the Yukon River on May 14, and the event was celebrated at Dawson, Y. T., in the usual manner. An influx of miners and prospectors is expected in the Mayo district during the present summer. The White Pass Railway Co., which for many years has run an excursion from Vancouver to see the midnight sun, has had to suspend it this year because it has such a heavy booking of ordinary traffic.

A large amount of building supplies has been assembled at Whitehead for shipment to Mayo Landing as soon as navigation opens. The Yukon Gold Co. has 3,300 tons of high-grade ore at Mayo Landing, ready to be shipped south.

News from Washington

By PAUL WOOTON
Special Correspondent

Bitterness Marks Tariff Debate

Proposal to Increase Rate on Barytes Causes Argument—Walsh Explains Position on Manganese.

Indications of the acrimony that [illegible] of the debate certain to take place in the Senate when the metal schedule is reached were in evidence during the consideration of the committee amendments to the chemical schedule of the tariff bill. Several items in that schedule are of immediate interest to the mining industry. In addition to the economic cleavage between members as to the advisability of a duty on cyanide, a political element has been injected into the discussion. To an already taut situation there has been added outbursts of partisan bitterness.

While the paragraphs dealing with lead pigments and salts of zinc were approved as amended by the Finance Committee, the discussion foreshadowed what may be expected when the lead and zinc paragraphs are reached.

The committee's proposal to increase the rates on barytes ore to $10 per ton and on *blanc fixe* to 1¼c. per lb. precipitated extended debate, and the paragraph went over for later consideration. Senator Walsh, of Montana, sees no reason for a heavy duty on barytes when manganese is put on the free list. His position with regard to a duty on manganese is set forth in a letter to one of his constituents, as well as by his remarks on the floor.

"I intend to see that the facts upon which the people of Philipsburg insist upon a duty on manganese are fully presented to the Senate and their right to it on the theories of those supporting the bill is vindicated," the Senator says in a letter to W. W. Williams, manager of the Moonlight Mining Co., of Philipsburg, Mont. "If there is to be a heavy duty on barytes, for instance, there is no reason why there should not be a duty on manganese, the fact that the latter is consumed by the great steel companies, while the former goes into products of less prodigious manufacturers, being no very sound reason. I shall vote against the proposal of the Finance Committee to transfer manganese to the free list. What I meant by saying that I should not vote for a duty on manganese is that I shall not vote for the bill in order to get a duty on manganese or because it carries a duty on that commodity."

The Senator has pointed out on the floor of the Senate that to get a duty on manganese he must not only vote for the bill but must vote for a multitude of indefensible duties. Though he would like to see the manganese mines at Butte and Philipsburg at work, he does not want to pursue a policy likely to shut down the copper mines in Butte to attain that end, he stated.

The lead pigments and litharge duties were passed over until the Senate passed on the lead duty, which was subjected to much criticism. Senator Jones, of New Mexico, opposed increasing the lead content of ore duty 100 per cent and the pigment duties 215 per cent. He stated that although the duty was imposed for the benefit of producers of lead ore, the imports of lead ores are from Mexico and are controlled by the same concerns which smelt the product in this country. Senator Smoot said the duty was to cover the smelter charges on which there were losses, and also the extra cost of materials in smelting as compared with smelter costs in foreign countries. Senators Jones, of New Mexico, and Walsh, of Massachusetts, argued that the duty would not protect the American lead producers, as lead would be brought in free contained in copper matte. Two thousand tons of lead in copper mattes it is proposed to admit free.

Senator Jones, of New Mexico. opposed the duty on lead, saying there was no necessity for placing a tariff on lead except the ore itself. Under existing circumstances, he said it was all right to levy a duty on the lead ores which may be imported. He argued that the lead-bearing ore producers are at the mercy of the smelters, as they are required to sell their ore to the smelters, and the benefit to the actual producer of ore is uncertain. He stated that lead-bearing ores can be produced in Mexico for less than in the United States, owing to the formation in which the lead appears and the labor situation.

Senator Caraway, of Arkansas. said the importation of 2,000 tons of lead ore in copper matte was a "present of $60,000 a year to the smelting companies."

Senator Smoot, of Utah, defended the duties, pointing out that as it did not pay to take the lead out of the copper matte the companies smelting the ores should not be penalized by a duty on the copper matte containing lead that they cannot recover at the market price. He said the Colorado smelters had been closed and the plants of the American Smelting & Refining Co. transferred to Mexico because of the transportation charges in this country. Senator Smoot said the business of three smelters had been transferred to Mexico. Senator Jones said the Western smelters had an advantage in smelting dry metallic ores. He did not think the lead industry was in such a depressed condition, and said the reason the Colorado smelters were closed was because of depression in the gold and silver industries.

Government's Silver Purchases

Purchases of silver by the Bureau of the Mint during the week ended May 20 amounted to 289,400 fine ounces. This brings the total purchases under the Pittman Act to 110,373,756 fine ounces.

War Minerals Relief Commission Continues Work

Numerous Claims Allowed—Disallowances in Fifteen Cases

Among the awards recommended by the War Minerals Relief Commission are the following: E. A. Garrison, Forest Hill, Cal., $1,540.75; Fred Kohlmeyer, Deming, N. M., $1,414.71; Green, Mattos and Volonte, Castella, Cal., $806.64; August Dupzyk, Hornbrook, Cal., $187; C. H. Hawkins, San Francisco, $824.76; Caldwell and Albrecht, San Francisco, $1,428.85; Albrecht, San Francisco, $1,428.85; Smith, Starr, and Grunnell, Grants Pass, Ore., $270; Alex E. Hook, Stockton, Cal., $888.70; Continental Mining & Royalty Co., Mena, Ark., $395.78; Allen-Odea Ore Co., Birmingham, Ala., $993.85; C. H. Hawkins, San Francisco, $867.51; Willis A. Sharp, Grants Pass, Ore., $1,085.82; estate of Frank L. Shelby, Brookdale, Cal., $2,361.85; estate of Charles Sisson, Boulder, Col., $285; James W. Duckworth, Sumpter, Ore., $466.17; Joe Meadows, Sumter, Ore., $466.17; Frank Rose, Talent, Ore., $593.24; George J. Sherman, Salt Lake City, $162.63; F. A. Emerald, Salt Lake City, $233.63; and C. A. Kirkland, Salt Lake City, $222.63.

Disallowances have been recommended in the following cases: Robert Brown, Elko, Nev.; Mrs. Dorothy Moffitt, Gillette, Wyo.; J. A. Faucher and A. S. Hughes, Oakland, Cal.; Robert E kelman, Custer county, Col.; O. G. Avery, Fresno, Cal.; Paramount Metals Co., Cleveland, Tenn.; H. Sordy and C. E. Noble, Grants Pass, Ore.; A. E. Hanenkrat, Prairie City, Ore.; V. E. Gillette, Prairie City, Ore.; P. F. Renfroe, Cartersville, Ga.; John Buchanan, Prairie City, Ore.; Vindicator Consolidated Gold Mining Co., Denver; Mines Efficiency Co., Duluth, Minn.; Southern Sulphur Ore Co., Nashville; Thorkildson and Miller, Los Angeles.

Ewert's Title to Indian Lands Void, Supreme Court Holds

Titles to lead and zinc lands acquired by Paul A. Ewert from Oklahoma Indians in 1909 are invalid because Ewert was at the time employed by the Government as a Special Assistant Attorney General in Indian land matters, according to a decision of the U. S. Supreme Court rendered on May 15 by Justice Clarke. The court sustained the Circuit Court of Appeals for the Eighth Circuit, which invalidated Ewert's acquisition of the lands under a law of Congress forbidding persons employed in Indian affairs from having any interest or concern in any trade with the Indians except on account of the Government.

In one of the two cases decided by the court, it was held that not only did Ewert's acquisition of lands from Indian minors come within this prohibition but also lands acquired from Indian adults. In the second case decided the court held that the Indian from whom Ewert obtained the lands was incompetent to handle his affairs. The Supreme Court did not accept Ewert's defense that he purchased the lands at public sale by the Interior Department and that he had such a right as any other citizen.

Railroad Rate Reduction Now a Political Issue?

The President's dinner at which the railroad executives were guests is conclusive evidence to many traffic men that railroad rate reduction is now a political issue. It is believed generally in Washington that the President called in the railroad executives after he had learned that the Interstate Commerce Commission could not at this time reach a conclusion to order substantial reductions in freight rates.

There is a tendency to criticize the commission for its failure, after more than five months of consideration, to get together on a definite finding, rather than to create a situation where the President practically has been forced to take a hand in rate making.

Action on "Blue-Sky" Bill This Session Unlikely

The Senate Committee on Interstate Commerce plans to give hearings on the Denison "Blue-Sky" bill at a later date, in response to numerous requests from various parts of the country. Action on the bill will probably not be taken, however, this session, because of the desire of Congressional leaders to adjourn after the tariff bill reaches final disposition.

Child Labor Bill Introduced

A bill making it unlawful to place in interstate commerce the product of any mine or manufactured article in the production of which the labor of children under fourteen years of age has been used, without notice of such fact being conspicuously placed thereon, by tag, marker or other means, has been introduced in the House by Representative Huddleston, of Alabama. Administration of the law would be under jurisdiction of the Interstate Commerce Commission.

Coal Price Conference May 31 at Washington

To make effective a plan intended to prevent a runaway market in coal, a general coal price conference has been called by the Secretary of Commerce to be held in Washington on May 31. This announcement by Secretary Hoover followed a preliminary conference on May 18 at which fifty operators, representative of all the non-union fields, voted to use the Garfield schedule of prices of Oct. 29, 1917, as a basis for fixing fair prices of coal.

News by Mining Districts

London Letter

Aid for Cornish Tin Mining—Government Gold Mining Areas Consolidated Shows Profit of £1,803,486

By W. A. Doman

London, May 9—Though down on their luck, owing to the low price of tin, Cornish miners have ever looked forward to a revival of the ancient and main industry of the Duchy. They have experienced bad times, and, much to their disappointment, have been compelled to accept doles. Money has been subscribed to enable these unfortunate miners to live, but the fund is rapidly becoming exhausted. The outlook now is rather more hopeful, for after long negotiations the Trade Facilities Committee has decided to assist the South Crofty to the extent of £30,000. This will enable work to be carried on for considerable time, and will give a fair amount of employment. It is expected, too, that the Trade Facilities Committee will decide to give assistance to the Levant mine, which works under the Atlantic. Even this is not all, for William Hosking, the president of the Institute of Mining Engineers, has brought forward a proposal for an amalgamation of the mines in the Camborne district. The negotiations have proceeded so far that a London syndicate is prepared, on conditions, to put up £500,000 to resume operations.

There are, of course, pessimists still in existence, and one of the largest firms in the tin business talks rather dolefully of the prospects. The stocks of the metal are reported to be about 35,000 tons, in itself not excessive, except for the fact that trade is bad. If the tin-plate industry could get going, there would be no difficulty in disposing of this quantity, and then prices might improve.

The Government Gold Mining Areas (Modderfontein) Consolidated still maintains its reputation as one of the big mines of the Witwatersrand. During the last calendar year it crushed 1,625,500 tons of ore, for a revenue of £2,828,220, with gold at standard price; but taking £5 5s. 9d. per fine oz., which was realized, and adding sundry revenue, the total income was £3,561,397. Working expenses took £1,757,911, leaving a working profit of £1,803,486. Of the profit, the Union Government took 49 per cent, or £896,211, and, in addition, the company paid in taxes £17,051. Shareholders received in dividends £770,000, or 55 per cent on the capital, which is £126,000 less than the government share. This is explained by the fact that instead of the company paying for mining rights, the government gets a percentage of the profits. Working expenses per ton were just under 21s. 8d., a reduction of about 6d. per ton, due partly to an increase of 110,000 tons crushed and partly to a reduction in white wages, and the working profit was 13s. 2d., in comparison with 11s. 8d. The amount received for gold above the standard price was £692,181. Considering the conditions, working costs were low, though if the government would reduce railway rates the figure might be brought down to a round sovereign per ton. The revenue per ton at standard price was nearly 34s. 10d., an increase of about 1s., due to a larger percentage of waste sorted out, and to the quantity of ore obtained from reclamation work.

As regards development, a lower footage was done on the reef, 16,352 ft., against 19,905 ft., and the proportion payable was 59.6 per cent, against 66.1 per cent, the average value being 13.5 dwt. over 57 in., in contrast with 14.6 dwt. over 55 in. Although such a large tonnage was extracted, the ore reserves remain at practically the same figure as a year earlier—namely, 10,232,000 tons, of an average value of 8.5 dwt. over a stoping width of 77 in., the gold content being higher by 0.3 dwt. As these reserves include ore of a value of 4 dwt. and over, it is evident that some of it is, for the Rand, distinctly rich. All the development to the west of the mine has been good, but in the opposite direction it was not so satisfactory. A circular shaft with an inside diameter of 22 ft. is to be sunk to a depth of 3,500 ft.

BURMA

Burma Corporation Reports April Production

Namtu—In April, 15,842 tons of ore was milled by the Burma Corporation, producing 9,695 tons of lead concentrate; 10,420 tons of lead-bearing material was smelted in the blast furnaces, producing 3,361 tons of hard lead for treatment in the refinery. Refinery products were 3,029 tons of refined lead and 320,767 ozs. of refined silver.

Coronation Syndicate Reports Gold Discovery

Capetown, May 19—The Coronation Syndicate's report on the Luipaards Vlei Estate & Gold Mining Co. says that a Randfontein leader three and one-half inches wide has been cut at a depth of 785 ft., assaying 11¼ dwt. over a width of 48 in.

Would Revive Mining Industry in New South Wales

By Cable from Reuters to "Engineering and Mining Journal-Press"

Melbourne, May 17—In view of the serious mining depression in New South Wales, the Minister of Mines has invited various interested bodies to submit plans to restore the industry.

Johannesburg Letter

Two Green Diamonds Found—Coronation Syndicate Holds Meeting—Gold Output for First Quarter Less Than for Normal Month

By John Watson

Johannesburg, April 18—The gold output of the Transvaal for the three months ended March 31 was declared on April 12 by the Chamber of Mines. The total for the three months is from 70,000 to 80,000 oz. less than the average for a normal month. The figures were: Witwatersrand, 594,788 fine oz.; outside districts, 44,940 fine oz; Transvaal total equaled 639,728 fine oz. Owing to the long duration of the strike, no comparison is made with previous months, nor is the value given of the output, owing to the difficulty of arriving at an average price for the gold produced over the period of three months. The largest producers were: Government Areas, 56,004 oz.; Crown Mines, 53,104; and New Modderfontein, 40,406 oz.

The following figures, given by the Minister of Mines, show to what extent work on the gold mines is being resumed. Since the strike was declared off and to March 31, approximately 7,500 Europeans had been re-employed, whereas about 6,500 had applied for work without success. The number of natives who had returned to work was 2,116. The total numbers employed on March 31 (including officials and those who have worked on essential service) was 12,639 Europeans and 123,526 natives. Permission to reopen recruiting of natives was wired to Union native areas on March 18 and to Mozambique on March 27.

Two discoveries of green diamonds have recently been reported. The first, found in the Bloemhof district, was a 5½ carat stone, black and opaque, which, on cutting, yielded a jewel of 1½ carats of an emerald-green shade. It has been valued by London experts at about £5,000, or about 100 times the price of a water-white diamond. The second green diamond was washed out at Parys a short time ago, and was of 10 carats weight. It has been sent to a government valuator at Cape Town. One of the most celebrated green diamonds is the "Dresden Green," in the Saxon Crown jewels, which weighs about 40 carat and is apple-green in color.

At a special meeting of shareholders of the Coronation Syndicate, Ltd., held in Johannesburg on April 6, it was stated that a number of influential firms in London and Paris had agreed to underwrite an issue of £100,000 cash, which will be offered to shareholders for subscription. Coronation Syndicate shares are now selling at about 5s. The company holds 1,000 claims near Balfour, where reefs have been proved in two shafts. It holds nearly 16,000 shares in the Afrikander Proprietary Gold Mines, Ltd., in the Klerksdorp district. It has an interest in the Machavie Gold Mining Co., Ltd., and it owns a freehold farm, Zonnestraal, ([illegible] morgen) in the Heidelberg district. It holds an option to take over the mining lease on Luipaard's Vlei, No. 10, on the West Rand, where two bore holes (out of three sunk) have disclosed the Randfontein series of reefs.

The Union Corporation, Ltd. (formerly Ad. Goerz & Co.) accounts for the year 1921 show a realized net profit of £179,517. The directors have decided to add £30,000 to the reserve account and have declared a dividend of 16 per cent (2s. per share), involving an amount of £140,000 and leaving the sum of nearly £78,000 to be carried forward.

The newly formed Mining Industry Commission proposes to begin its sittings in Johannesburg on April 24, at the New Law Courts.

CANADA

British Columbia

Iron-Ore Resources of Province To Be Surveyed This Summer

Victoria—A survey of the iron-ore resources of British Columbia is to be started this summer. The Canadian Geological Survey Branch has agreed to undertake this work, in co-operation with the Provincial Department of Mines. The object is to obtain information as to the ability of British Columbia to support an iron and steel plant of large capacity. Dr. G. A. Young will begin the field investigations within a few weeks.

The Cedar Creek placer gold discoveries are taking hundreds of men from Victoria, Vancouver, Seattle, and other Pacific Coast cities. Though the snow has not entirely disappeared, work has begun on some of the claims. Platt and Lyne, owners of Discovery, state that their property is not for sale and that it will be developed this season.

Ontario

Coniagas Gets Control of Newray—Dome Directors May Propose $2 Capital Repayment

Cobalt — Under an agreement between Newray Mines, of Porcupine, and Coniagas Mines, of Cobalt, which was ratified by Newray shareholders at a special meeting May 16, Coniagas has secured control of Newray and an option on the balance of the treasury shares. The option covers the total of 1,530,000 shares in the treasury, at 35c. a share. Coniagas contracts to spend at least $4,000 a month. The shaft is now down 400 ft. Work will be started within two weeks. F. D. Reid, manager of the Coniagas, will be in charge of operations.

F. L. Culver, of the Beaver Consolidated, says that though the Beaver will soon be in good condition for resuming mining and milling operations, no definite date has been set.

The Temiskaming directors want to see silver solidly at 80c. an ounce before talking of reopening.

Operations at the Castle-Trethewey, of Gowganda, continue satisfactorily, and it is said that the mine is now on a self-sustaining basis. Sufficient high-grade ore is being bagged from work on the new vein at the 260 level to pay all operating charges. Considerable mill rock is also being developed.

La Rose may appeal to the Privy Council in connection with the recent judgment in the dispute regarding the Violet and O'Brien boundaries, which gave the main Violet shaft to the O'Brien.

Kirkland Lake — New York capital has secured control of the Munro-Kirkland company, buying out some of the larger interests and securing options on smaller holdings. It is proposed to complete the assessment work on some claims not yet patented. The company owns about ten claims. After this work is completed, it is proposed to do some diamond drilling in an effort to prove continuation of the veins found on the Lebel lode, which lies to the west.

Porcupine — According to present plans of the Kerr Lake management, sinking at the Goldale property, near the McIntyre, will start June 1. The shaft will be sunk to the 500 level before lateral work will be undertaken.

It is said that the policy of the directors of the McIntyre is to spend a considerable sum on the development of the mine's ore possibilities and a continuation of the intensive campaign of the last two years rather than to increase the dividends.

According to a current report, at an early meeting of the Dome directors it will be proposed that Dome's second repayment of capital, which is to be made this year, be $2 a share, instead of the expected $1. The production figures for the last four months are as follows: January, $300,000; February, $307,000; March, $312,000; and April, $377,000. These official figures clearly show that the company has been realizing net profits at the rate of over $200,000 a month since the beginning of the year, or at the rate of over $5 on each issued share.

Port Colborne—Operations at the nickel refinery of the International Nickel Co. of Canada at Port Colborne are being increased, and the directors have ordered an additional furnace to be started. Numerous orders are being received, and the output is to be increased to about 1,000,000 lb. per month. President J. L. Agnew stated in answer to inquiries as to when work would be resumed at the smelter at Copper Cliff that the company expected to have it in operation early in the fall, but the date had not been decided.

Goudreau—The country surrounding the original gold discovery now being developed by the Goudreau Gold Mines, Ltd., has been widely staked, over 1,600 claims having been recorded during the last eight months. The staked area covers about 360 square miles, the belt being thirty miles long and twelve broad. About ten syndicates have been formed.

MEXICO

Government to Study Mining Industry in Order to Rectify Abuses—No New Titles Until Old Have Been Annuled

Mexico City—The Secretary of Commerce and Labor is preparing to appoint a series of committees, in different parts of the country, for the purpose of making a careful study of the mining industry, with a view to getting recommendations that will enable the government to rectify certain abuses which are complained of, and to assist in building up the industry.

Two questions of vital importance will be given special attention: (1) The tendency on the part of certain state authorities to pass laws, under the pretense of benefiting labor, that threaten completely to paralyze the industry locally; (2) to bring pressure on the railway managements for a more equitable traffic rates. At present, a few of the larger corporations do enjoy large reductions, but the smaller concerns and the individual miners are seriously handicapped, and in many instances prevented from doing development work and conducting exploitation operations by excessive freight charges. In fact, in many instances they are placed entirely at the mercy of the smelters.

It is also intended to recommend a reasonable tariff reduction on many of the articles of prime necessity which are used in the development of the mines, and which of a necessity must come from abroad.

The department has expressed its sympathy with the reform work, and appears to be anxious to encourage miners to get to work.

A commission from Chihuahua has been in the city several days attempting to get a hearing from the federal authorities so as to explain its objections to several clauses of the new labor laws of Chihuahua, which it is claimed will paralyze mining operations in general. Efforts to get a suspension of the law from the governor of the state have been ineffectual. As a result of the governor's attitude, it is reported that several properties have suspended work. The Chihuahua Chamber of Commerce has made a vigorous protest.

Mexico still leads the world in silver production. The Department of Industry has given out the March production as being 209.346 kg., against 181,183 kg. produced in February. The gold output for March was 2,091 kg. and for February 1,778 kg.

To eliminate the difficulties hitherto encountered by owners of mines in redeeming their titles, ordered canceled by the Finance Department in view of taxes due and unpaid, the Secretary of the Treasury has ordered that in the future no new titles will be issued by the Department of Commerce unless that department is notified by the Secretary of Finance to annul the old titles. Until recently it has been the practice of the Department of Commerce to annul old titles and issue new ones as soon as it was advised by the Finance Minister that taxes were delinquent. Owners have often found their titles in dispute without notice having been given them previously of cancellation of titles.

NICARAGUA

Matagalpa—J. A. Willey has taken over the Las Enemas claims in the Segovia district.

The San Albin mine, about 15 miles away, is owned by Charles Butters, who is erecting a plant, consisting of sixty-ton mill, and a small smelter. This is the first of the kind in Nicaragua.

CALIFORNIA

Use of Tule Lands for Disposing of Debris from Hydraulic Mining Advocated.

San Francisco Correspondence

San Francisco—Recently, at Grass Valley, W. H. Martin advocated Government aid in bringing about a resumption of hydraulic mining on a larger scale than at present. Mr. Martin suggests the use of existing river channels and the flooding of the waste tule lands with the debris. The plan is in opposition to the present system, which requires the construction of local restraining barriers. Owing to the stand of the farmers the suggested plan is not likely to be seriously considered, although it is held to be not without some merit.

Suit has been filed in the U. S. District Court by the Original Sixteen-to-One Company against the Mariposa Mining Co. which has acquired the Ophir mining property, in the Alleghany district. Two suits have been started, one to quiet title and the other for damages. Extralateral rights are the issue involved.

The opening of the highway down the Klamath River between Happy Camp and Orleans Bar makes the lower Klamath country more accessible and may result in additional lode mining.

The South Fork of the Feather mine, near Woodleaf, Yuba County, is again being worked.

The Gruss Mining Co. has taken over the Surcease mine, near Las Plumas.

Near Kelsey, El Dorado County, the Harlow North Star Gold Mining Co. is developing a quartz vein.

At Angels Camp, reports are in circulation to the effect that W. J. Loring will soon begin operations on the Chaparral Hill group.

At Jackson, the Amador Tunnel Mine & Milling Co. has withdrawn the demurrer in a suit to quiet title to certain mining property situated near Middle Bar and also the Mammoth Gold Quartz mine. Hydraulicking at the Elephant Deep Gravel mine is expected to be completed within a month, and other sections near Volcano will be attacked.

Randsburg—There are at present thirty-five shafts in active operation, sinking, developing, or producing.

A 5-in. rotary core drill is prospecting the Hard Cash claim of the Yellow Aster. The Kelly Rand mine has struck good ore at 250 ft. The Mizpah Montana encountered high grade at 100 ft. The North Rand is prospecting on the third and fourth levels, and has found some high-grade stringers. The Coyote (Randsburg Silver Mining Co.) is sinking three shafts on the ground recently bought. Grady is sinking two shafts, one of which is now 600 ft. deep.

About 500 men are employed in the district. Mines have been bonded by substantial companies, and there are indications that the known productive area is only a small part of the area that will eventually be productive.

The Yellow Aster is dropping twenty stamps and remodeling its screening plant.

NEVADA

Pioche Consolidated Stockholders Vote New Bond Issue—Conditions Normal at Tonopah

Rochester — Production in April of the Rochester Silver Corporation was 4,540 tons, with a gross value of $46,768, which is below normal. Profit was small, on account of extensive development work.

Peavine — The water struck during the latter part of April in the Standard Metals mine has been bulkheaded and development resumed.

Leadville—The Leadville Mines Co. resumed milling on May 6. The mill was not operated during the winter, on account of adverse weather, but development work was never stopped. The vein on the 400 level is 8 ft. wide, with 7 ft. of milling ore and 1 ft. of high grade on the hanging wall.

Tonopah—Conditions in this district are normal, with a daily production of about 1,300 tons. The Tonopah Belmont, which has a lease on the Buckeye Belmont ground, is preparing to sink the shaft below the 1,200 level to prospect a vein cut in the shaft near the 1,200. In addition, some development work is being done on upper levels.

The Tonopah Extension has resumed sinking the Victor shaft below the 1,880 level. It is planned to sink to the 2,100 level, with stations at the 2,000 and 2,100 levels. The oreshoots are exceptionally strong and rich on the 1,880, or lowest present level, with no indication of decrease with depth.

Goldfield—During 1921, the lessees at the Goldfield Consolidated shipped 2,400 tons of ore. To date this year, 1,500 tons of ore has been shipped, and the grade is considerably better than in 1921. Most of the recent ore shipped has come from the Silver Pick lease, in Red Top ground, although one leaser in other ground has shipped 67 tons which averaged 17 oz. gold per ton.

Pioche—Stockholders of the Prince Consolidated Mining Co. met in Salt Lake City, May 15 and voted to issue $150,000 of 8 per cent bonds or debenture notes, maturing three years after date. A bonus will also be given in stock.

MONTANA

Hawkesworth Removable Drill Bit Tested—Silver Dyke Incorporated in Montana—Davis-Daly May Resume June 1

Butte—At Butte, tests have been made with the new Hawkesworth drill point by the Anaconda company. The company is making arrangements to manufacture at Anaconda points for use in its mines. A demonstration was made recently for the benefit of the operating officials of other mining companies.

The Hawkesworth point weighs about four ounces and is made of vanadium steel. It is attached to the steel shank by a groove so made that the harder the point is driven into the rock the more firmly the point maintains its grip on the shank. When dulled, the bit can be displaced from the shank by a blow of the hammer, a sharp bit slipped into the shank groove and the drill started again with only a moment's loss of time.

The demonstration recently made took place at the St. Lawrence mine. An ordinary drill 1¾ in. in diameter was used. In two minutes the point penetrated the granite for 9½ in. One of the Hawkesworth points was substituted, and at the end of two minutes the drill had penetrated 20½ in. A second test of a point that had been ground down in resharpening to 1½ in. showed the rock penetrated for 22 in.

It was pointed out that, besides the advantages in drilling that the new drill point achieves a large saving can be effected in other ways. Starting on shift, all that a miner needs is to carry four shanks at the most, with a supply of sharpened points in his pocket. As fast as one point becomes dulled, another can be substituted. This makes unnecessary the hoisting of huge quantities of steel to the top every night to insure a fresh supply for the next day's operations.

Articles of incorporation of the Silver Dyke Mining Co., a subsidiary of the American Zinc Co., have been filed in Cascade County, giving the company authority to do business in Montana, it being a Maine corporation. The company owns thirteen mining claims in the Neihart district. According to recent reports from that district, the Silver Dyke has opened up a body of good milling ore.

Though no actual information has been received at the Butte offices, it is anticipated that the Davis-Daly mining company will resume work at the Colorado mine about June 1. It is expected that by then a new contract with the East Butte company for smelting Davis-Daly ores will have been ratified. It is understood that the new contract is advantageous to the operation of the Davis-Daly property.

Transvaal's Gold Output Reported

London, May 22 — The Transvaal Chamber of Mines advises that the total gold output in the Transvaal during April totalled 511,338 ozs.

UTAH

Utah Consolidated Increasing Scale of Operations—Tintic Standard to Locate Third Shaft

From Our Special Correspondent

Bingham — Operations are to be gradually increased by the Utah Consolidated. It is expected that the new treatment mill at Tooele will be working at capacity in June. Ore from the property at Bingham will be sent to the mill by aerial tramway, over a distance of four and a half miles. During the period of curtailment, improvements in equipment and operating arrangements were made. Exploration work on the lower levels of the mine was continued. On the 2,200 level east, the main oreshoot in the upper limestone was drifted on for 227 ft., averaging 2.7 per cent copper, .013 oz. gold, and .46 oz. silver. On the 2,400 level, the same oreshoot was followed 52 ft., and the assay was 2.2 per cent copper, .02 oz. gold, and 1.77 oz. silver.

Eureka — Shipments for the week ended May 13 amounted 173 cars. Shippers were: Tintic Standard, 56 cars; Chief Consolidated, 50; Grand Central, 15; Colorado, 14; Iron Blossom, 10; Eagle & Blue Bell, 9; Victoria, 7; Empire Mines, 4; Centennial-Eureka, 3; Sunbeam, 2; Bullion Beck, 2; Showers, 1.

The Tintic Standard has acquired a large rotary drill. This will be used in prospecting ground lying to the northeast of the No. 2 shaft, and will furnish data for the sinking of a third shaft.

Park City—Shipments for the week ended May 13 amounted to 2,119 tons of ore. Shippers were: Silver King Coalition, 855 tons; Park-Utah, 250; Ontario, 388; Judge, Daly, and Daly-West, 627.

COLORADO

Production in Boulder, Gilpin and Clear Creek Counties Increased—Conditions in Alma District Better

From Our Special Correspondent.

Denver—A survey that has recently been made by the Colorado Metal Mining Association to ascertain the present and probable future production of smelting ores in Boulder, Gilpin, and Clear Creek counties indicates a decided revival of mining activity throughout the district mentioned. The survey was made for the purpose of procuring dependable data to present to the head officials of the railroads and smelters as a basis on which to formulate a readjustment of transportation and treatment rates so as to encourage an increase of tonnage of ores from the northern mining counties.

The figures show that there has been an increase in production of over 100 per cent since Jan. 1 and that projects under development and construction will increase the output several fold within the next six months.

A material reduction in both smelting and freight rates is expected within a short time, and this will still further increase the shipment of smelting ores to the Leadville plant.

Coal production in Colorado for the month of April, according to the report of State Coal Mine Inspector Dalrymple, amounted to 400,963 tons, compared with 644,868 tons for the corresponding month last year and 980,000 tons for March, 1922. The total for the year is but 94,709 tons short of the amount mined during a like period last year. The strike appears to be practically ended in Colorado, and no trouble is experienced in any of the mining districts to procure miners where demands for the product justify the operation of the mines.

Alma—Mining conditions in the Alma district are improving with the disappearance of ice and snow from roads and trails. Much new development work has been planned.

ARIZONA

United Verde Experimenting With Heap Leaching—New Power Development Scheme

Jerome—United Verde has turned to heap leaching. Under charge of Joseph Irving, who installed the Dundee-Arizona experimental plant last year, there is being built up near the mouth of the Hopewell tunnel a 5,000-ton heap of sulphide ore containing 2 per cent or less of copper. The mine water, itself rich in copper, will be passed through the leach heaps before being conducted to the precipitation plant. June 1 is now set as the date for resumption of smelting at Clarkdale, with one reverberatory and one water jacket. The former is being warmed up. There is to be monthly production of 4,000,000 lb., about two-fifths the capacity of the works. About 300 men are being added to the company's force, to give a total strength of about 1,000. The ore consumption will approximate 1,400 tons a day. Steam shovel work is to be speeded up with a crew of 250 men.

United Verde Extension is maintaining a monthly copper production of about 3,000,000 lb., and employs nearly 600 men. Last month's output was 3,500,000 lb. The 1,700-level drift into Jerome Verde ground still has 100 ft. to go to get under the Maintop ore strike, but conditions on the way are reported favorable. By this drift a large addition was developed to the Extension's own ore reserves.

Globe—Old Dominion, Inspiration, and Miami are reported to have joined in the employment of Louis C. Hill as a consulting expert to check over plans that have been submitted by the Salt River Valley Water Users' Association, involving possible participation by the companies named in a power-development scheme that may cost $6,000,000. Mr. Hill was the builder of the Roosevelt dam, while an engineer of the U. S. Reclamation Service. The Roosevelt project, at Roosevelt and at several Salt River Valley points, now develops about 25,000 hp. It is proposed to add about 40,000 hp. by erection of a high dam across Salt River at Mormon Flat and by other hydro-electric installations on the stream.

MICHIGAN

The Copper Country

Ahmeek Makes Important Find of Mass Copper—Arcadian Continues in Rich Ground

By M. W. Youngs

Houghton—Mass copper of unusual size has been found in the Ahmeek's mass fissure vein on the nineteenth level of No. 2 shaft. One piece, weighing fourteen tons, has already been removed and brought to surface. It was cut from the main mass by means of twist drills of a special design and length. These rotary drills will accomplish in a few days what took weeks and months to do in former years when hand chisels were used.

At the Calumet mill of Calumet & Hecla, eight heads are being operated. Eight furnaces at the smelter are also in operation. Production is gradually increasing as shaft repairs progress and men can be employed in actual mining. Rock shipments now run about 2,500 tons daily.

Isle Royale continues on a production basis of less than half of normal, but the output can be increased easily whenever the market price for copper warrants. Meanwhile it is engaged in an extensive opening program. Approximately 70 per cent of the vein exposed in No. 5 shaft is available for stoping, and in No. 6 shaft almost 60 per cent of the ground can be mined. No. 5 shaft is the chief producer. Isle Royale rock runs better than 18 lb. to the ton, and last year, for the limited time the mine was operated, the yield was brought up to 21.37 lb.

Arcadian Consolidated continues in the rich ground opened in the south drift, 225 ft. from the shaft, at the 1,100 level of the New Baltic shaft. The miners are now into this rich area for a distance of 25 ft. from the point of contact and there is no diminution in values. The north drift from the bottom level also continues in good ground.

Menominee Range

Bristol and Monongahela Shut Down—Bates Miners Strike

Crystal Falls—Operations have been suspended at the Bristol mine of the Bristol Mining Co. and the Monongahela mine of the Hollister Mining Co. Large stocks of ore on hand are responsible.

Iron River—The Berkshire mine of the Brule Mining Co. has added a night shift, thus increasing the force by eighty-five. The Munro Mining Co. is shipping steadily from its Rogers mine, where there is 85,000 tons in stock. Shovels have also been at work at other mines of this company on the range.

The miners at the Bates mine of the Bates Iron Co. refused to go underground this week unless a higher wage scale was granted. The surface crew remained at work. Most of the mines of the range have increased wages to meet the scale being paid by the Oliver Iron Mining Co., and it is thought that the Bates miners will also be granted an increase.

Iron Mountain—The Oliver Iron Mining Co. is now operating its Chapin and Aragon mines on full time. The wage scale remains the same.

Gogebic Range

Tentative Valuations on Mines Lower Than Last Year

Ironwood — Although working full time the mines of the U. S. Steel Corporation have not yet begun to ship ore to the docks. A reduction in ore freight rates by rail and water is awaited, which it is thought will more than offset the additional cost of stocking ore at present. A few years ago this cost about 10c. per ton.

The hearings of the Michigan State Tax Commission in the several counties of the iron ranges were attended by representatives of most of the mining companies operating there, and many pleas for lower valuations on mining property were made. L. P. Barrett, state geologist, on whose examinations and reports the valuations are based, admitted that for several years the mines in Michigan had made an average profit of only about four per cent on their assessed valuation.

At Bessemer the commission announced tentative valuations on the mining properties in Gogebic County totaling $47,915,266, a decrease of $951,142 from last year's figures. The decrease was due principally to depletion, but the small profits of 1920 and 1921 also had an effect.

The real ground on which the mining companies feel they are justified in complaining is that their properties are valued at full cash value while other property is not. The commission argued that there should be a reduction in the expenditure of tax moneys by the cities and towns. They made the statement that of the total amount raised by taxation the cities spent 36.33 per cent, the county 10.68 per cent, the highway fund 12.04 per cent, the schools 32.46 per cent, and the state government only 8.49 per cent.

MINNESOTA

Cuyuna Range

Skilled Labor Becoming Scarcer—Armour No. 2, Mahnomen and Portsmouth Mines Resume

Crosby—With the resumption of mining at two of the largest mines in the district the Armour No. 2 (Inland Steel Co.) and the Mahnomen (Clement K. Quinn & Co.), the unemployment situation of the Cuyuna appears to have received a "knockout blow"; in fact, some operators even report difficulty in finding enough experienced men to fill their crews.

The Armour, the largest underground producer in the district, employing normally 200 men, has taken on full crews, and is rapidly getting into full swing with shaft shipments, as well as completing shipments from stockpile. Ore production is being pushed at the Mahnomen open pit, and it is expected that the property will be a steady producer throughout the season. Unwatering of the pit was recently completed.

Another promising move was the reopening of the Portsmouth mine by the Gordon Mining Co., a subsidiary of Coates & Tweed. The Portsmouth, an open pit reserve of both manganiferous and iron-ore grades, has been idle since the fall of 1920.

At the Hillcrest mine, at Ironton, the operators have just put into service the newly installed Pomona pump at the recently completed drainage shaft. This pump is now handling all pit drainage, and drifting has been resumed in the drainage drift cutting the orebody to the north. Daily steam-shovel shipments are being made from this property, and one shovel is engaged in extending the stripping limits.

Riverton—John A. Savage & Co. have awarded a contract to the American Bridge Co. for furnishing and erecting the structural steel in the new screening and drying plant of the Sagamore mine. Construction of the plant is expected to be completed about July 1, and machinery installed and in operation soon after. The plant as now designed is rated at 75,000 tons per month capacity. Most of the open-pit product which will be treated at this plant is a manganiferous iron ore.

Ironton—It is reported that plans are being considered for unwatering and reopening the Cuyuna-Mille Lacs mine, a manganiferous ore property of the American Manganese Manufacturing Co., which has been idle since 1919.

JOPLIN-MIAMI DISTRICT

Golden Rod Company to Open No. 4 Mine and Mill—Circle Mine Shut Down

By P. R. Coldren

Joplin—Preparations are being made by the Golden Rod Mining & Smelting Co. to reopen its No. 4 mine and mill about June 1. The property has been idle for more than a year. Numerous improvements are being installed preparatory to the reopening, including the addition of six or seven Boylan cones, and the installation of oil-incased bearings throughout. The mill will have a capacity of approximately 1,000 tons when started. The company has been operating only its No. 4 mill, which is one of the largest in the district.

Approximately half a hundred homes in Picher were moved recently as a result of the need of the Eagle-Picher Lead Co. for a new tailings pond for its Netta mill. Work has been started on the pond, which will be 700 ft. square, approximately, and is situated right in the heart of the town.

The Connecticut Zinc Corporation has closed down its Circle mine, at Oronogo, after a few months of operations, following idleness of more than a year. It is understood that the property was losing money steadily and that a shutdown was decided upon until zinc ore prices improve. The mill is the largest in the district.

THE MARKET REPORT

Daily Prices of Metals

May	Copper, N. Y., net refinery* Electrolytic	Tin		Lead		Zinc
		99 Per Cent	Straits	N. Y.	St. L.	St. L.
18	13.125@13.25	30.25	31.00	5.50	5.35	5.125
19	13.25	30.625	31.50	5.50@5.75	5.35@5.40	5.15
20	13.25@13.50	30.625	31.375	5.50@5.75	5.375@5.40	5.15
22	13.50	30.00	30.875	5.50@5.75	5.40	5.15
23	13.50	30.00	30.875	5.50@5.625	5.40@5.45	5.15@5.175
24	13.625	30.25	31.00	5.50@5.625	5.40@5.45	5.20

*These prices correspond to the following quotations for copper delivered: May 18th, [illegible]; 19th, 13.50c.; 20th, 13.50@13.75c.; 22d, 23d, 13.75c.; and 24th, [illegible].

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
18	61¾	62	67	150¼	151¾	24¼	23⅛	27⅛	27
19	62¼	62¼	67½	152½	154	24½	23⅛	27¼	27
20	....	....	....	....	....	...	...	...	...
22	61¾	62¼	68	150½	151⅞	24⅞	23⅜	27¼	27⅛
23	62¼	62½	68¼	149	151¼	25⅛	23½	27¼	27⅛
24	62¼	62¾	68½	151½	152	25¼	23½	27½	27⅜

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

May	Sterling Exchange "Checks"	Silver			May	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
18	444½	99⅝	73⅝	37	22	444½	99⅝	73¾	37⅜
19	444½	99⅝	71¾	36	23	444½	99⅝	72¾	36⅞
20	444½	99⅝	73¼	37⅛	24	444½	99⅝	72⅛	36½

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, May 24, 1922

Metal producers are decidedly optimistic over the general increase in metal prices. Improved business conditions at last seem to be reflected in the demand for the non-ferrous metals and minerals, and speculation is playing only a minor part in the business that has been done.

Copper

Copper has advanced more during the last week than for some time. The increase has been caused by a continued good consuming demand, though not exceptional, accompanied by a dearth of current supplies to meet it. Few producers have any May-June copper left, though it may be obtained at current prices from one or two sources. The demand has been general, though wire and rolling mills are the chief buyers. Brass makers are becoming more and more a factor in the market, however. Most of the copper sold has been for July-August delivery.

Saturday saw the last of the copper which was available at 13.50c. delivered. Today sales have been made as high as 14c. for small quantities, though one or two thousand tons could be picked up at 13¾c., for practically any delivery.

Export demand has been about the same as last week, at advancing prices. The quoted price of the Copper Export Association, c.i.f. European ports, is now 14c.

Lead

The American Smelting & Refining Co. raised its official contract price from 5.35c. to 5.50c. New York, on Thursday, May 18.

The lead market continues to be upset, with regular customers of the principal producers able to obtain their requirements at large concessions from the prices generally quoted in the open market. Lead has been sold in New York during the week as high as 5.75c., but this price was not maintained after Monday, when one of the principal producers began selling freely at 5.50c. Much the same conditions have obtained in the Middle West. An important consumer reports having bought lead at 5.25c., St. Louis, although he could have broken up the lot and immediately resold at a 15-point premium. Many inquiries for July shipment have been made, but producers continue to refuse this business except at average prices. The demand for lead from pipe manufacturers and mixed-metal manufacturers and dealers has been the feature of the last few weeks, orders from these sources being considerably greater than they have been for a long time. The cable companies have also been in the market for lead recently. With the resumption of activity by the strikers at Perth Amboy, and a liberal attitude as to the release of stocks by certain Western producers, there is little likelihood of any great pinch for lead being felt. The market is strong and may gradually go higher, but consumers should not be stampeded into paying fancy prices without a thorough investigation. An undue inflation will almost certainly be followed by a midsummer reaction.

The pronounced backwardation in the London market is considered an artificial condition, and indicates a scarcity of spot supplies on the London exchange rather than a feeling that lead prices are to weaken.

Zinc

Galvanizing demand has supported the market, and the tendency is still upward. There is also a good demand from brass manufacturers for the higher grades of zinc. Metal is now being sold for June at the prices herewith quoted, but July deliveries command about 2½ points premium. An order for 2,000 tons has contributed to the strength of the market in the last day or two, and today several other inquiries were made. Zinc has been sold for export to the Far East, but European prices are no longer attractive.

Tin

The tin market has been quiet, and tin platers show no inclination to lay in appreciable stocks. Reports that Straits shipments would approximate 7,000 tons for May have had a somewhat bearish effect on the market. Tin does not seem to have responded at all to the advances made by most of the other metals, the meager advance made in the first three weeks of April not having been maintained. Forward deliveries have been available at approximately the same prices as have been asked for spot.

Arrivals of tin, in long tons: May 17, Liverpool, 50; 18th, Straits, 800; 20th, Straits, 600; 22d, Singapore, 50; Liverpool, 100; 23d, Singapore, 50.

Gold

Gold in London: May 18th, 93s. 2d.; 19th, 92s. 11d.; 22d, 92s. 11d.; 23d, 93s. 2d.; 24th, 93s. 4d.

Foreign Exchange

No important features have marked the foreign exchange market during the last week. On Tuesday, May 23, francs were 9.035c.; lire, 5.125c.; marks, 0.335c.; and Canadian dollars, 99.125c.

Silver

New high prices for the year were established on May 22 at 37⅜d. in London and 73¾c. in New York. The latter figure was also ⅜c. higher than the top price in New York for 1921. During the last week the market has fluctuated violently, due to the abrupt changes of position of Chinese and Indian operators.

Mexican Dollars—May 18th, 56¼; 19th, 55; 20th, 56; 21st, 56⅜; 22d, 55⅝; 23d, 55.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17.50@18.50c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 5.40@5.50c. W.C.C., 6@6½c. Cookson's "C" grade, spot, 8.75@9c. Chinese needle antimony, lump, nominal, 3.5@4c. per lb. Standard powdered needle antimony (200 mesh) nominal at 5¾c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 6.75@7c.

Bismuth—$2@$2.10 per lb.

Cadmium—$1.15@$1.20 per lb.

Iridium—Nominal, $150@$170 per oz.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Small tonnages, spot, nominal at 30@33c.

Palladium—$55 per oz.

Platinum—$85 per oz.

Quicksilver—$55 per 75-lb. flask. San Francisco wires $54.70.

The prices of **Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of May 6.

Metallic Ores

Molybdenum Ore—50c. per lb. of MoS_2, for 85 per cent MoS_2 concentrates.

Tungsten Ore—Chinese, price advanced to $3.50@$3.75 per unit.

The prices of **Bauxite, Chrome, Manganese, Tantalum, Uranium, Vanadium, Titanium** and **Iron Ore, Zircon** and **Zirkite** are unchanged from the prices in the issue of May 6.

Zinc and Lead Ore Markets

Joplin, Mo., May 20—Zinc blende, per ton, high, $32.50; basis 60 per cent zinc, premium, $31; Prime Western, $29@$30; fines and slimes, $28@$27; average settling price, all grades of blende, $29.66. Calamine, 40 per cent zinc, average, $12.

Lead, high, $73.60; basis 80 per cent lead, $70; average settling price, all grades of lead, $70.44 per ton.

Shipments for the week: Blende, 10,661; calamine, 102; lead, 1,348 tons. Value, all ores the week, $413,680.

Reports have reached here that zinc smelters in Pennsylvania and West Virginia are closed owing to fuel shortage. No trouble is reported from the Illinois smelting region, and generally the gas situation will permit continued operations in Oklahoma. One Oklahoma smelter was closed last week by striking smeltermen. An advance of 5 per cent was accorded, and part of the works only was restarted. Buyers assumed that a lessened demand for ore would result from this situation and hoped to secure this week's tonnage on a $29 basis Prime Western, but many sellers declined to accept such offerings and purchases were 900 tons less than last week.

Platteville, Wis., May 20 — Blende, basis 60 per cent zinc, $31 per ton. Lead ore, basis 80 per cent lead, $72 per ton. Shipments for the week: Blende, 309; lead ore, 37 tons. Shipments for the year: Blende, 6,000; lead ore, 867 tons. Shipped during the week to separating plants, 750 tons blende.

Non-Metallic Minerals

Feldspar—One producer reports No. 1 pottery grade has recently been in good demand at a slight recession in price, $6.40 per ton, f.o.b. Eastern mines.

Talc—20 to 200 mesh, $7@$12 per ton, f.o.b. Vermont; $8@$10, f.o.b. Georgia; 200 mesh, $18, f.o.b. California; through No. 25 Swiss silk, $25, f.o.b. California. Market fair.

Prices are unchanged from those in the issue of May 6, on **Asbestos, Barytes, Borax, Chalk, China Clay, Emery, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica and Sulphur.**

Mineral Products

Arsenic Oxide—7c. per lb.

Copper Sulphate—Nominally 6c. per lb. Extremely scarce.

Sodium Nitrate—$2.70@$2.80 per 100 lb. ex-vessel Atlantic ports.

Sodium Sulphate—[illegible] per ton, New York.

The price of **Potassium Sulphate** is unchanged from that of May 6.

Ferro Alloys

Ferromanganese—Domestic, 78 to 82 per cent, $67@$69, f.o.b. furnace; English, $67.50; German, $66, both c.i.f. Atlantic seaports. Spiegeleisen, 19 to 21 per cent, scarce at $35 per gross ton, f.o.b. furnace; 16 to 19 per cent, $34.

Ferrotungsten—Domestic, 70 to 80 per cent W, 45@50c. per lb. of contained W, f.o.b. works.

Ferrotitanium, Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferro-uranium, and **Ferrovanadium** are unchanged from the prices published May 6.

Metal Products

Copper Sheets — New York base, 20.25c. per lb.; wire, 15c.

Nickel Silver—26.75c. per lb. for 18 per cent nickel Grade "A" sheets.

Yellow Metal — Dimension sheets, 17.50c.; rods, 14.50c.

Lead Sheets and **Zinc Sheets** are unchanged from the prices published May 6.

Refractories

Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick, and **Silica Brick** are unchanged from the prices quoted May 6.

The Iron Trade

Pittsburgh, May 23, 1922.

In freight cars, automobiles, and fabricated structural work the steel market has been and continues unusually active. Otherwise it is quieter than in March or April.

Automobile production is probably at record rate, with fully 200,000 passenger cars to be turned out this month. Freight car buying has averaged 15,000 cars a month thus far this year. Since April 1 fabricated steel lettings have been fully equal to capacity, against 53 per cent for the first quarter and 35 per cent in 1921. These three lines of consumption, however, hardly account for 25 per cent of current steel production, the rate of ingot production being somewhat over 37,000,000 tons a year against rates of about 35,000,000 tons on March 31 and 20,000,000 tons in December.

Steel prices are firm, with bars, shapes, and plates rarely going at under 1.60c., and occasional small sales at higher prices. Hoops are now quoted at 2.25c., or $5 a ton advance. In nearly all lines, however, mill shipments are largely against sales made at close to the bottom.

Pig Iron—The market is stagnant, prices being largely nominal at $26 for bessemer, $25 for basic, and $24 for foundry, f.o.b. Valley furnaces.

Coke

Connellsville Coke — Production is now increasing slightly, but the strike is still exercising a retarding influence. Furnace coke, $6.25@$6.50; foundry, $6.75, with turnover limited.

COMPANY REPORTS

Miami Copper Co.

A report of the operations of the Miami Copper Co. for [illegible] a net profit of $929,984.35 before depletion. Dividends of $1,494,228 were paid. Operating account follows:

	Per Pound	
[illegible]		
[illegible]	$0.0650220	$3,462,032.43
[illegible]	0.0134722	717,316.63
[illegible]	0.0071653	381,504.94
[illegible]	0.0174878	931,124.42
[illegible]	0.0030396	161,833.01
[illegible]	0.0045878	244,274.57
[illegible]	0.0029529	157,223.12
	$0.1137276	$6,055,309.12
[illegible]	0.0008831	47,021.67
	$0.1128445	$6,008,287.45
[illegible]		750,352.57
		$6,758,640.02
[illegible]		
[illegible]	$0.129909	$6,662,211.87
[illegible]		
[illegible]	0.123478	2,008,722.03
35,015,941		$4,653,489.84
[illegible] 1921		
[illegible]		
2,037,186 lb. @	$0.13651	$278,105.42
[illegible]		
[illegible]	0.1128445	1,827,044.76
53,243,945 lb.		$2,105,150.18
		$6,758,640.02

PROFIT-AND-LOSS ACCOUNT

[illegible]	$336,267.29
Balance carried to balance sheet	929,984.35
	$1,266,251.64
[illegible]	$750,352.57
[illegible]	200,764.73
[illegible] Dec. 31, 1921	315,134.34
	$1,266,251.64

Balance sheet as of Dec. 31, 1921, is given as follows:

ASSETS

[illegible]		
[illegible]	$26,196,728.52	
[illegible]	270,869.06	
		$26,467,597.58
[illegible]		
Mine development	$923,493.16	
[illegible]	274,678.46	
		1,198,171.62
[illegible]		3,564,838.06
[illegible]		2,135,059.66
[illegible]		826,809.00
Prepaid taxes and insurance		18,569.81
[illegible]		261,969.84
[illegible]able		212,881.87
Sundry investments and securities		4,282,061.42
		$38,967,958.86

LIABILITIES

[illegible]		
[illegible] 800,000 [illegible] @ $5		$4,000,000.00
[illegible] 747,114 [illegible] @ $5		3,735,570.00
[illegible]		1,425,908.68
[illegible]		14,228,977.89
[illegible]		
[illegible] Jan. 1, 1921	$22,047,562.99	
[illegible] 34 [illegible] 37	1,494,228.00	
	$20,553,334.99	
[illegible] Jan. 1, 1921	[illegible]	
[illegible] year 1921	[illegible]	
	$1,905,817.05	
[illegible]	929,984.35	
	[illegible]	$19,577,502.29
		$38,967,958.86

[illegible]

Ore reserves on Jan. 1, 1922, are estimated at 8,900,000 tons of 2.26 per cent copper ore; 6,000,000 tons of ? per cent copper ore; and 36,000,000 tons of 1.06 per cent copper ore.

Yukon Gold Co.

A report of the operations of the Yukon Gold Co. for 1921 shows a net deficit of $346,875.13, according to the following income statement:

	Production	Working Costs	Operating Gain
Dawson dredge	$222,813.15	$174,042.88	$48,770.27
Dawson hydraulics	269,632.90	172,504.45	97,128.45
California dredges	311,787.05	278,997.24	32,789.81
Murray dredge	149,821.02	90,686.16	59,134.86
Miscellaneous operations	16,868.92	556.01	16,312.91
Total operations	$970,923.04	$716,786.74	$254,136.30
Non-operating income			70,768.83
Total income			$324,905.13
Less			
Royalties paid		$35,192.79	
Interest, general expense, examinations		271,664.72	
Depletion		158,770.47	
Depreciation		206,152.28	
			671,780.26
Net deficit for 1921			$346,875.13

Balance sheets as of Dec. 31, 1921, and Dec. 31, 1920, follow:

ASSETS

	Dec. 31, 1921	Dec. 31, 1920
Properties and investments at cost	$15,619,246.65	$15,350,885.24
Less deductions for depletion and revaluation	13,299,232.25	13,140,461.78
Properties and investments as revalued	$2,320,014.40	$2,210,423.46
Equipment	$9,394,615.56	$8,912,455.82
Less deductions for depreciation	6,960,308.41	6,754,156.13
Equipment as revalued	$2,434,307.15	$2,158,299.69
Deferred charges	$169,537.10	$193,921.20
Advance royalties	10,000.00	10,000.00
Materials and supplies	451,445.28	465,804.23
Notes receivable—subsidiary companies	2,032,441.94	1,924,290.31
Accounts collectible	137,846.03	350,636.36
U. S. and Canadian government bonds	707,674.00	249,000.00
Bullion in transit	15,710.77	20,046.73
Cash	72,801.24	250,570.65
	$8,351,777.91	$7,832,992.63

LIABILITIES

	Dec. 31, 1921	Dec. 31, 1920
Yukon-Alaska Trust notes	$5,462,695.71	$4,375,000.00
Yukon-Alaska Trust advances		200,000.00
Bills and accounts payable	294,790.59	160,137.04
Letters of credit pending payment—not due	148,036.68	298,585.13
Reserve for replacements	39,461.79	45,602.19
	$5,944,984.77	$5,079,324.36
Capital stock—par value issued for cash or properties	$17,500,000.00	$17,500,000.00
Net amount realized from operations	15,024,443.80	15,006,396.18
	$32,524,443.80	$32,506,396.18
Distributed to stockholders	$9,858,110.00	$9,858,110.00
Deductions due to depletion	5,342,226.84	5,183,456.37
Deductions due to revaluation	7,957,005.41	7,957,005.41
Deductions due to depreciation	6,960,308.41	6,754,156.13
	$30,117,650.66	$29,752,727.91
Balance representing excess of assets over liabilities, including properties owned at March 1st, 1913, on the basis of their fair value and including properties subsequently acquired at their cost	$2,406,793.14	$2,753,668.27
	$8,351,777.91	$7,832,992.63

Operations are summarized as follows:

	Production	Average Yield per Unit Value	Cost Per Unit
Dawson dredging, cu yd.	556,957	40.01c.	31.25c (a)
California dredging, cu.yd	3,988,340	7.817c.	6.995c (a)
Idaho dredging, cu.yd.	1,540,446	9.726c.	5.887c (a)
Dawson hydraulics, cu.yd	1,069,468	25.21c	16.13(a)
Nevada lode, tons	38,129	$14.91	$6.64(a)
Mayo silver-lead, tons	2,110(b)	$179.16	$13.03
Malay tin, cu yd	185,600(c)	. . . .	

(a) Exclusive of depreciation.

(b) Assay value, 195.8 oz. silver and 62.2 per cent lead, giving net profit of $104.246.

(c) Producing 44,964 lb. of concentrates, or 32,192 lb. of tin.

Tonopah Belmont Development Co.

A report of the operations of the Tonopah Belmont Development Co. for 1921 shows a net profit of $388,780.40 (dividend payments totaled $150,000), according to the following comparative account:

	Year Ended Dec. 31, 1921	Year Ended Dec. 31, 1920
Gross value of production	$1,793,660.17	$1,796,141.51
Losses in treatment	147,701.62	141,338.28
Net values realized	$1,645,958.55	$1,654,803.23
Operating expenses	1,153,964.49	1,252,395.55
Net earnings mine and Tonopah mill	$491,994.06	$402,407.68
Net earnings of other plants	23,856.99	55,418.81
Total net earnings	$515,851.05	$457,826.49
Other income	(a) 56,149.58	(a) 204,531.74
Gross income	$572,000.63	$662,358.23
Administration, exploration and taxes	(b) 183,220.23	59,211.51
Net profit	$388,780.40	$603,146.72

(a) Includes dividends from Belmont Surf Inlet Mines, Ltd.

(b) Includes $130,750.29 expenses and losses occasioned by labor strike.

Balance sheet as of Dec. 31, 1921, follows:

ASSETS

Property		
Mines and mining claims (revalued as of March 1, 1913, at $5,000,000) after writing off $3,192,804.22 depletion	$1,807,195.78	
Shafts, buildings and machinery, after writing off $414,006.12 depreciation	43,192.96	
Millers mill, after writing off $491,090.09 depreciation	65,051.22	
Tonopah mill, after writing off $428,566.76 depreciation	91,942.97	
Re-treatment plant for sweepings, after writing off $4,660.75 depreciation	10,000.00	
		$2,017,382.93
Investments		
Belmont Surf Inlet Mines, Ltd.	$1,292,352.94	
Belmont Shawmut Mining Co.	792,450.83	
Belmont Wagner Mining Co.	853,575.13	
Esmeralda Power Co.	6,206.25	
Tonopah Divide Mercantile Co.	10,650.00	
Tonopah Mines Hospital Association	1,325.00	
		2,956,560.15
Secured loan to Jim Butler Tonopah Mining Co.		40,763.14
Available assets		
Materials and supplies for operation	$157,171.80	
Ore stock on hand	48,354.24	
Insurance premiums paid in advance	5,603.32	
Accounts receivable	261,458.34	
U. S. Government certificates of indebtedness	100,000.00	
Cash in bank	207,895.55	
		780,483.25
		$5,795,189.47

LIABILITIES

Capital stock			
1,500,000 shares of $1 each fully issued			$1,500,000.00
Current liabilities			126,583.61
Property reserve account arising in respect of the revaluation of mines and mining claims as of March 1, 1913			2,989,040.84
Surplus			
Balance of undivided profits up to Dec. 31, 1920 (last report)		$1,284,884.22	
Net income for year ended Dec. 31, 1921		388,780.40	
		$1,673,664.62	
Deduct			
Charge for depletion of ore, 1921	$344,099.60		
Dividends paid to shareholders	150,000.00		
		494,099.60	
			1,179,565.02
			$5,795,189.47

Production of the Belmont mill amounted to 18,073 oz. of gold and 1,747,950 oz. of silver. A total of 138,031 tons was milled at a cost of $3.317 per ton. Mining costs were $5.296 per ton.

Winona Copper Co.

The report of the directors of the Winona Copper Co., with head office at Boston and mining properties at Winona, Mich., states that no mining operations have been carried on since May, 1920. Expenses of the Boston office during the year were $5,229.96, and net expenses at Winona, after sale of supplies and income from rentals, $1,124.42. The company is carrying 130,546 lb. of copper on inventory, and has $7,221.88 in cash.

The president states that he believes the cross valleys of the Sleeping River and its branches mark a mineralized shear-zone south of No. 2 King Philip shaft, and that the property should not be condemned until further exploration has been made.

Mexican Silver To Supply the Orient?

The Mexican consul in Hongkong, China, writes his government at Mexico City:

"The large banking houses in the Far East are taking an active interest in the recent declaration of the Mexican Monetary Commission that it is now in a position to make extensive and regular shipments of silver bars to China.

"The Bank of Canton states that it has already been receiving certain quantities of Mexican silver bullion through its San Francisco correspondents and considers the quality equal to American exports.

"Bigger, manager of the Asia Banking Corporation, has expressed a desire to get in touch with the Mexican Monetary Commission, and states that his institution could use 500,000 oz. monthly. The Banque De L'Indo-China also desires 200,000 oz. monthly and requests that shipments begin the first of July."

The consul adds that the Americans at present control the silver market, but suggests to his government an excellent opportunity to put Mexican silver not only in Canton, Shanghai, Pekin and other Chinese ports, but believes they can invade Saigon, Singapore, and Colombo.

In view of these representations, the Mexican government has under consideration a plan for subsidizing one or more Chinese steamship lines in order to get direct communication from west coast Mexican ports to Asiatic ports.

United States Lead Production

The following is a comparative table of domestic lead production prepared by C. E. Siebenthal and A. Stoll, of the U. S. Geological Survey:

	1919 Short Tons	1920 Short Tons	1921 Short Tons
Domestic desilverized lead	208,751	220,327	187,962
Domestic soft lead	147,744	189,854	157,513
Domestic desilverized soft lead	67,938	66,668	52,747
	424,433	476,849	398,222
Foreign desilverized lead	57,787	52,808	50,367
Total refined primary lead	482,220	529,657	448,589
Antimonial lead	13,874	12,535	10,064

APPARENT CONSUMPTION OF REFINED PRIMARY LEAD IN THE UNITED STATES

(Refinery Stocks Disregarded)

	1919	1920	1921
Supply			
Stock in bonded warehouse Jan. 1	472	234	1,322
Imports of pigs, bars, and old	5,107	35,719	31,301
Production	482,220	529,657	448,589
	487,799	565,610	481,212
Withdrawals			
Exports of foreign lead—			
From warehouse	40,976	17,363	25,000
In manufactures, with benefit of drawback	1,936	6,175	9,369
Exports of domestic lead	10,510	2,730	1,624
Stock in bonded warehouse Dec. 31	234	1,322	347
	53,656	27,590	36,340
Apparent consumption	434,143	538,020	444,872
Lead content of ore and bullion in bonded warehouse Dec. 31 (a)	45,476	51,220	98,186
Average selling price in cents per pound	5.3	8.0	4.5

(a) Some part of this may have been smelted and refined and thus be included in the quantities given above as "Foreign desilverized lead."

Mining Dividends for May, 1922

The following dividends were paid by mining and metallurgical companies during May, 1922:

Companies in the United States:	Situation	Per Share	Total
Chief Consolidated, s.l.	Utah	$0.05Q	$44,201
Colorado Fuel & Iron pfd.	Col., N. M., Wyo.	2.00Q	40,000
General Development Co.	Various states	0.25	30,000
Homestake Mining, g	S. D.	0.25M	62,790
International Nickel pfd.	N. J., Ont.	1.50Q	133,689
Miami Copper	Arizona	0.50Q	373,557
New Cornelia Copper	Ariz.	0.25Q	450,000
New Jersey Zinc	New Jersey	2.00Q	909,328
United Verde Extension, c	Ariz.	0.25Q	262,500
Companies in other countries:			
Amparo Mining, g s	Mex.	0.03Q	60,000
Cie. Aramayo de Mines en Bolivie, t, s, c	Bolivia	1.25fr.	750,000fr.
Hollinger Gold	Ontario	$0.05 4 wks.	$246,000
McIntyre Porcupine Gold	Ontario	0.05	182,014

Q, quarterly; M, monthly; g, gold; s, silver; c, copper; l, lead; t, tin.

The General Development Co. paid its first dividend since August, 1920.

MINING STOCKS

Week Ended May 20, 1922

Stock	Exch.	High	Low	Last	Last Div.	
COPPER						
Ahmeek	Boston	65	60	65	Sept. '20, Q	$1.00
Alaska-Br. Col.	N. Y. Curb	½	⅜	⅜		
Allouez	Boston	29	26½	28½	Mar. '19	1.00
Anaconda	New York	53¾	52	53¼	Nov. '20, Q	1.00
Arcadian Consol.	Boston	4¼	3¾	4¼		
Ariz. Com'l.	Boston	11	9¾	10	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*28	*18	*21		
Bingham Mines	Boston	15½	15	15¾	Sept. '19, Q	0.25
Calumet & Arizona	Boston	63½	59	62¼	Mar. '22, Q	0.50
Calumet & Hecla	Boston	286	265	285	June '20, Q	5.00
Canada Copper	N. Y. Curb	*50	*41	*49		
Centennial	Boston	10¾	10½	10¾	Dec. '18, SA	1.00
Cerro de Pasco	New York	39¾	37⅛	39¾	Mar. '21, Q	0.50
Chile Copper	New York	23	19⅞	22⅞		
Chino	New York	32¼	28	31¾	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*28	*27	*27		
Consol. Arizona	N. Y. Curb	*5	*3	*5	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	2	1¾	1¾		
Copper Range	Boston	44½	41¼	44¼	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1¼	1⅛	1⅜		
Davis-Daly	Boston	9	8½	8½	Mar. '20, Q	0.25
East Butte	Boston	11¼	10	11½	Dec. '19, A	0.50
First National	Boston Curb	*90	*67	*70	Feb. '19, SA	0.15
Franklin	Boston	2¼	2¼	2½		
Gadsden Copper	Boston Curb	1¼	1	1¼		
Granby Consol.	New York	32½	28	32⅜	May '19, Q	1.25
Greene Cananea	New York	34	31	33½	Nov. '20, Q	0.50
Hancock	Boston	3½	3	3¼		
Howe Sound	N. Y. Curb	3½	3⅛	3¼	Jan. '21, Q	0.05
Inspiration Consol...	New York	45	40¾	42½	Oct. '20, Q	1.00
Iron Cap	Boston Curb	8	7	8½	Sept. '20, K	0.25
Isle Royale	Boston	26	23	25½	Sept. '19, SA	0.50
Kennecott	New York	39⅜	33½	38¼	Dec. '20, Q	0.50
Keweenaw	Boston	3	2¼	3		
Lake Copper	Boston	5	4⅝	5		
La Salle	Boston	1¹¹⁄₁₆	1	1½		
Magma Copper	N. Y. Curb	1¼	*75	1¼	Jan. '19, Q	0.50
Majestic	Boston Curb	*10	*10	*10		
Mason Valley	Boston	2½	2	2¼		
Mass Consolidated	Boston	4½	3	3½	Nov. '17, Q	1.00
Miami Copper	New York	31	28¼	30¼	May '22, Q	0.50
Michigan	Boston	3	2	2½		
Mohawk	Boston	63	56	63	Feb. '22, Q	1.00
Mother Lode Coa...	N. Y. Curb	10¼	9½	10⅜		
Nevada Consol.	New York	18⅞	16¼	18½	Sept. '20, Q	0.25
New Cornelia	Boston	19¼	17½	19½	Feb. '22, K	0.25
North Butte	Boston	13	12¼	13½	Oct. '18, Q	0.25
North Lake	Boston			*40		
Ohio Copper	N. Y. Curb	*10	*9	*10		
Old Dominion	Boston	26	23	26½	Dec. '18, Q	1.00
Osceola	Boston	37¼	35	36¼	June '20, Q	0.50
Phelps Dodge	Open Mar.	†180	†170	.	Apr. '22, Q	1.00
Quincy	Boston	47	44	47¼	Mar. '20, Q	1.00
Ray Consolidated	New York	18⅜	16⅜	18	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	1¼	1½	1½		
St. Mary's Min. Ld.	Boston	48	45	46½	Apr. '22, K	2.00
Seneca Copper	Boston	14	13½	14		
Shannon............	Boston	1½	*95	1¼	Nov. '17, Q	0.25
Shattuck Arizona	New York	11	8½	10½	Jan. '20, Q	0.25
South Lake	Boston	1¼	1¼	1¼		
Superior & Boston...	Boston	1¼	1¼	1¼		
Tenn. C. & C. cfs.	New York	12½	11	12⅞	May '18, I	1.00
Tuolumne	Boston	*90	*69	*90	May '13	0.10
United Verde Ex.	Boston Curb	31	28	31	Mar. '22, Q	0.25
Utah Consol.	Boston	3	2½	3	Sept. '18,	0.25
Utah Copper	New York	68½	64	67½	Mar. '22, Q	0.50
Utah Metal & T.	Boston	1½	¾	1½	Dec. '17,	0.30
Victoria	Boston	2	1½	2		
Winona	Boston	2	1½	1¾		
Wolverine	Boston	15	13	15		
NICKEL-COPPER						
Internat. Nickel	New York	18¼	17⅛	18	Mar. '19,	0.50
Internat. Nickel, pfd.	New York	82½	82	82	Feb. '22, Q	1.50
LEAD						
National Lead	New York	96½	92	94½	Mar. '22, Q	1.50
National Lead, pfd.	New York	110	109¾	110	Mar. '22, Q	1.75
St. Joseph Lead	New York	15½	15¼	15½	Mar. '22, Q	0.25
QUICKSILVER						
New Idria	Boston	2	1	1½		...
ZINC						
Am. Z. L. & S.	New York	20⅞	18	20	May '20,	1.00
Am. Z. L. & S. pfd.	New York	48¼	44	48	Nov. '20, Q	1.50
Butte C. & Z.	New York	8¼	6¾	7	June '18,	0.50
Butte & Superior	New York	33¼	30¼	33	Sept. '20	1.25
Callahan Zn-Ld.	New York	9¾	8	9	Dec. '20, Q	0.50
New Jersey Zn.	N. Y. Curb	145½	144	144	May '22, Q	2.00
Yellow Pine	Los Angeles	*52	*50	*51	Sept. '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

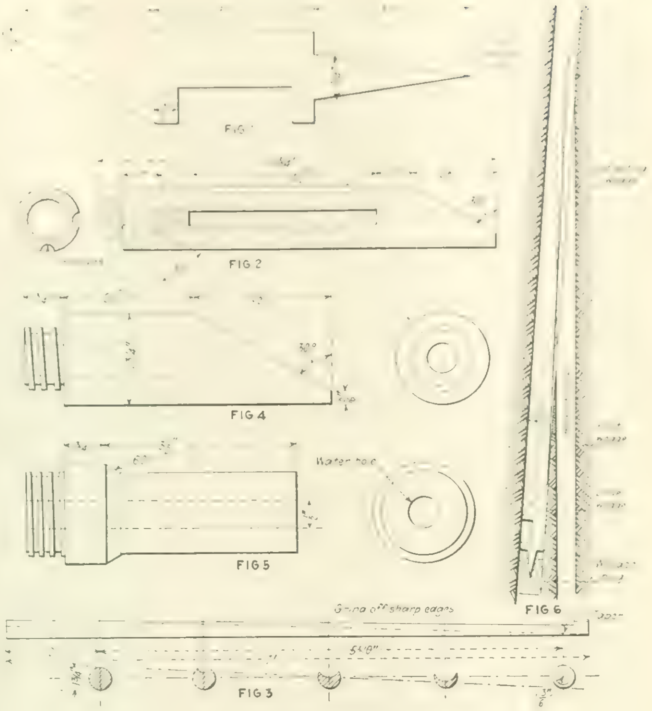
Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs, The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.	
GOLD						
Alaska Gold	New York	⅜	⅜	⅜	....	
Alaska Juneau	New York	2	1	1⅞	.....	
Carson Hill	New York	14½	14¼	14½		
Cresson Consol. G.	N. Y. Curb	2½	2¹¹⁄₁₆	2¼	Apr. '22, Q, X	$0.10
Dome Extension	Toronto	1	1	1	....	
Dome Mines	New York	28½	27¾	28¼	Apr. '22, Q	1.00
Florence Goldfield	N. Y. Curb	*23	*18	*23		
Golden Cycle	Colo. Springs	*77	*77	*77	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*7	*7	*7	Dec. '19,	0.05
Hollinger Consol.	Toronto	9.70	9.55	9.60	May '22,	0.05
Homestake Mining	New York	72	70	72	Apr. '22, M	0.25
Kirkland Lake	Toronto	*45	*45	*45		
Lake Shore	Toronto	2.39	2.25	2.35	Nov. '21, K	0.02
McIntyre-Porcupine.	Toronto	19.25	17.70	18.00	May '22, K	0.05
Porcupine Crown	Toronto	*28½	*26	*28½	July '17,	0.03
Porcupine V. N. T.	Toronto	*37	*32	*32		
Portland	Colo. Springs	*27	*25	*27	Oct. '20, Q	0.01
Schumacher	Toronto	*57½	*55	*56	....	....
Silver Pick	N. Y. Curb	*17	*13	*16	....	....
Teck Hughes	Toronto	*54	*52	*53	... ...	..
Tom Reed	Los Angeles	*75	*73	*74	Dec. '19,	0.02
United Eastern	N. Y. Curb	1³⁄₁₆	1⅛	1¼	Apr. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*10	*8	*10	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*8	*4	*8	...	..
Wright-Hargreaves	Toronto	3.01	2.70	3.00	Apr. '22,	0.02½
Yukon Gold	N. Y. Curb	1⅛	*90	1	June '18,	0.02½
SILVER						
Batopilas Mining	New York	1⅛	1	1	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*34½	*30	*32	May '20, K	0.03
Coniagas	Toronto	1.25	1.20	1.25	May '21, Q	0.12½
Crown Reserve	Toronto	*19	*16½	*18	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3¾	3½	3½	Apr. '22, Q	0.12½
La Rose	Toronto	*37	*31	*35½	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*29½	*28	*28½	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.15	1.00	1.05	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅜	6	6¼	Apr. '22, Q, X	0.30
Ontario Silver	New York	8⅞	7¾	8½	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	.		*12	Jan. '12,	0.10
Temiskaming	Toronto	*35	*30	*30½	Jan. '20, K	0.04
Trethewey	Toronto	*5	*4	*4½	Jan. '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*26	*20	*22	....	....
Cash Boy	N. Y. Curb	*5	*5	*5	....	...
Dolores Esperanza...	N. Y. Curb	2¾	2⅜	2½	....	...
El Salvador	N. Y. Curb	*6	*6	*6	......	
Jim Butler	N. Y. Curb			*8	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb			*5	June '16,	0.05
MacNamara M. & M.	N. Y. Curb	*9	*9	*9	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1¹¹⁄₁₆	1⅝	1¹¹⁄₁₆	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*76	*74	*76	.....	
Tonopah Extension	N. Y. Curb	1⁹⁄₁₆	1½	1⁹⁄₁₆	Apr. '22, Q	0.05
Tonopah Mining....	N. Y. Curb	1⅞	1¾	1¹³⁄₁₆	Apr. '22, SA, X	0.07½
West End Consol.	N. Y. Curb	1	*97	1	Dec. '19, SA	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*7	*6	*7	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*95	*93	*95	Dec. '20,	0.15
Chief Consol.	Boston Curb	5	4¼	4¾	May '22, Q	0.05
Consol. M. & S.	Montreal	23	22¼	23	Oct. '20, Q	0.62½
Daly Mining.........	Salt Lake	†3.00	†1.40		July '20, Q	0.10
Daly-West	Boston	†2½	†2	2	Dec. '20, Q	0.25
Eagle & Blue Bell...	Boston Curb	†3	†2½	2½	Apr. '21, K	0.05
Electric Point	Spokane	*6	*6	*6	May '20, SA	0.03
Federal M. & S.	New York	16½	13½	15	Jan. '09,	1.50
Federal M. & S. pfd.	New York	53¾	44	52⅝	Mar. '22, Q	1.00
Florence Silver	Spokane	*22½	*22	*22	Apr. '19,	0.01½
Grand Central	Salt Lake	†*63	†*60	*75	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	6⅝	6⅛	6⅜	Mar. '22, Q	0.15
Iron Blossom Con...	N. Y. Curb	*23	*23	*23	Apr. '22, Q	0.02½
Judge M. & S.......	Salt Lake	†2.50	†2.30	2.60	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*21	*19	*21	June '21, I	0.02
Prince Consol.	Salt Lake	*7	*3¼	*7	Nov. '17,	0.02½
Rambler-Cariboo....	Spokane	*6½	*5	*5	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*11	*8	*10	... .	.
South Hecla	Salt Lake	†*60	†*35		Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*22	*20	*21	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*11	*9	*10	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.45	2.45	2.45	Jan. '21, K	0.04
Tintic Standard.....	Salt Lake	2.20	2.00	2.02½	Dec. '21, Q	0.05
Utah Apex	Boston	3½	3	3½	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	....	....	*2	Nov. '17,	0.01
VANADIUM						
Vanadium Corp.....	New York	52¼	47¼	50⅞	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	56	56	56	Apr. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	75½	75	75½	Apr. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	22¼	19½	21⅜	Nov. '19, Q	1.00
Texas Gulf	New York	48⅝	43	46⅞	Mar. '22, QX	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	67½	58	65⅜	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	98½	96¼	98½	Mar. '22, Q	1.75
Am. Sm. Sec. pf. A..	New York	92⅝	92¼	92⅝	Apr. '22, Q	1.50
U. S. Sm. R. & M...	New York	45½	41	44¼	Jan. '21, Q	0.50
U.S. Sm.R.& M. pf..	New York	46½	45¼	46½	Apr. '22, Q	1.75

NEW MACHINERY AND INVENTIONS

The Use of Deflecting Wedges in Diamond-Drill Holes

Method That Makes Possible The Drilling of Vertical Bores and That Overcomes Many Disadvantages of Ordinary Diamond Drilling



Parts of Hall-Rowe wedging device
Fig. 6 shows wedge placed in drill hole

ONE of the main limitations of diamond-drill work has been the inability to drill a straight hole. To depths of 1,000 ft. the deflection is often not large, but over this depth the hole tends to take a somewhat erratic course. As a means of overcoming this difficulty there has been developed the "Hall-Rowe" wedging method and device for controlling the direction of drill holes, which are the result of a long series of experiments. After the invention and perfection of this wedging method and device, holes were successfully bored to 3,000 ft. with practically no deflection. The method has become standard for all deep drilling and in all short holes where the formation deviates the rods.

In addition to controlling a hole and furnishing definite information there is supplied a simple and accurate method of making any number of branches to a hole and of securing a series of samples of ore discovered.

To wedge a diamond-drill hole at any point a dry, turned wooden plug, grooved to allow water to pass, is pushed down with the rods to the point where it is desired to branch the hole, and allowed to swell. A drive wedge, Fig. 1, is then dropped into the hole and driven into the wooden plug, using a blank bit for driving. The drive wedge, being cut out below the face, usually falls with the face of the wedge in the direction of dip, but in every case its position is surveyed carefully by using the special clinometer, Fig. 2.

Lines are cut on the inside of the clinometer parallel to and in the plane of the long axis of the 30 deg. beveled part of the clinometer. Lines indicating this plane are marked on the sides of a glass test tube with a small carbon, the low point of the bevel face being indicated. The glass tube is filled to a height of about two inches with hydrofluoric acid diluted with two parts water; a cork is put in, gummed paper placed over the cork and fastened to the sides of the tube, and the plane marked across the paper so that it fits the clinometer snugly. When lowered into the clinometer the marks coincide. The clinometer is lowered into the hole and allowed to set thirty minutes to take the etching. It is then pulled up, the tube cleaned and dried and the low and high point of the etching marked when the tube is held vertical. The relative direction of the face of the drive wedge and the dip of the hole are indicated. If the two low points coincide they are the same, and it is only necessary to set the face of the deflecting wedge (Fig. 4) in the same direction and lower them.

If the two low marks do not coincide, it is necessary to determine the angle between them and to rotate the pilot wedge (Fig. 4) with regard to the deflection wedge, to bring the deflection wedge, when in place, in a direct opposite to the dip of the hole. Strips of paper wound around the test tube and wedge allow marking and measuring the arc determining the angle. If the dip is small, a standard dip protractor or the transit and protractor may be necessary to determine the low point of the etching.

A ring is left at the top of the deflecting wedge to lower it. The pilot wedge and deflecting wedge, properly orientated, are lowered by riveting a special plug threaded into a blank "A" bit to the ring with a copper rivet. Neither the 30-deg. face of the drive wedge nor the face of the pilot wedge is brought to a thin point, but an end ¼ in. thick is left. This provides a surface for driving the drive wedge; also, in one position the point of the pilot wedge will rest on the point of the drive wedge, and on being rotated 180 deg. the pilot wedge will drop 2 in. into its place, indicating when the two are in their proper relation. Shearing of the copper rivet gives a further drop of 3 in. The amount of stretch in the rods must also be taken into account in working at depth; 1,500 ft. of "A" rods have about 2.5 in. of slack.

When the deflecting wedge is in place an "E" bit and core barrel are used and an "E" hole is drilled to a point 3 or 4 ft. below the wedge. The curved face of the deflecting wedge is "E" size, so the "E" bit follows the wedge without cutting into it. After the "E" drilling, the wedge and deflected hole are reamed out with the special reaming bit, Fig. 5.

The small part of this is "E" size and acts as a pivot. Diamonds are set in the beveled part to ream the wedge and hole out to "A" size. After doing this the regular "A" rods and "A" bit are used, but reaming with the "A" bit is started at the top of wedge to make sure there is ample clearance for passing up and down. The "A" hole is continued as an "A" hole below the wedge.

The average correction per wedge is 2 deg., and thus a hole should be wedged before it deflects much more than this. Experience has shown that it requires about five shifts to place a wedge properly.

The following are some of the economic uses of the Hall-Rowe wedge:

(a) A bore hole started vertically is prevented from deflecting more than 2 deg. and therefore accuracy is assured; also, a given ore zone will not be mined. (b) A second core from an orebody can be obtained without redrilling the entire hole. (c) Mines must have structure accurately determined, so that shafts, drifts, and crosscuts can be laid out to cost the minimum amount. (d) A hole lost due to some obstruction in the bottom could be continued with little loss of footage.

The exclusive rights to the Hall-Rowe wedging method are controlled by the Smith & Travers Co., Ltd., Sudbury, Ont.

Collar of Thermit Weld Permits Groove Inspection

The one fact that has been more responsible than any other for retarding the progress of welding, according to a statement by the Metal & Thermit Corporation, New York, is that when a weld is made it is impossible to determine without destroying it what strength is definitely assured and safe to allow. An examination of the surface of welds does not reveal this.

A Thermit weld, however, by reason of its collar, is the only method which allows a careful inspection and permits the drawing of proper conclusions as to the strength of welds. In Thermit welding it is impossible to have such defects as lack of fusion (if the proper amount of Thermit has been used and instructions have been carefully followed), or oxide inclusions, such as those formed during the adding of metal in other methods. Unclean surfaces, oxide inclusions (due, for example, to failure properly to clean scale from wrought-iron sections before welding) have always resulted in Thermit welding in only one type of defect—i. e., blow holes. This defect, due to the natural tendency of the gases to rise in the molten mass, if present at all, will always be present in the Thermit steel collars, and an examination internally of the collar can be made without affecting the strength of the weld.

In practice, this examination is made by gouging deep grooves in the Thermit steel collars parallel with the axis of the piece, these grooves reaching almost to the original section itself. Two such grooves on the four sides of a Thermit weld have been found to be sufficient. If these grooves are observed to be free and clean from blow-hole defects, the inspector may be absolutely assured that the weld itself is sound.

Motor Operated Gate Valves

The necessity of a reliable, efficient and expeditious method of valve control for steam lines, particularly in event of rupture of the main lines, is evident from a safety standpoint, the old method of direct manual operation being not only a slow procedure but frequently one of great danger.

Until the tests conducted by the Public Service Electric Co. at Newark, N. J., on Jan. 28, 1922, under the auspices of the National Electric Light Association, considerable doubt existed as to the possibility of closing a gate valve under the extreme velocity conditions occasioned by a ruptured steam line, but the test proved beyond question that a valve properly constructed would operate effectively.

The valve made by the Lukenheimer Co. of Cincinnati, Ohio, and used on the above test was a 10-in. cast steel, monel mounted, "Victor" gate, equipped with a Dean electric control. It successfully closed in less than thirty seconds against a boiler steam pressure of 225 lb. superheated 150 deg. F. The discharge end of the valve was open to the atmosphere, and the steam was permitted to escape for one minute and a half before the valve was closed.

Afterwards the seat and disk rings were carefully examined to ascertain the effect of this severe test and it was found that they were in perfect condition, and showed no marks, such as would be occasioned by the disk dragging across the seats in valves wherein the disk is not properly guided.

These motor-operated gate valves are procurable in either iron body bronze mounted or cast steel monel mounted patterns in sizes 6 in. and larger.

TRADE CATALOGS

Pumps.—We are in receipt of a folder containing several data sheets issued by the Aldrich Pump Co., of Allentown, Pa. This company builds power pumps for mine drainage, oil pipe lines, reduction and cyanide plants, and other industrial service. The engineering tables included in Pump Data No. 50 constitute a most valuable work and one which will be of the greatest use to the mine operator or the engineer who has to do with the purchasing, installation, repair or operation of pumps. Several useful diagrams are included.

Pump Data 27 illustrates and describes selective fittings which will be found essential to pump construction or operation. These include the following: Gearing, pinions, gear guards, stairway, platforms, connecting rods, couplings, oiling systems, plungers, linings, stuffing boxes, valves and seats, shock absorbers and alleviators, check and bypass valves, relief valves, and pressure and vacuum gages.

The pumps illustrated in Pump Data No. 32 are a part of a group which have been termed "divided water-end type," so called from the fact that the working barrels and valve chambers are contained in separate castings—a divided water-end. This feature of design naturally confines the application to comparatively large quantities against lifts up to 350 ft. These pumps are suitable for general pumping requirements such as would be met at mills, mines, and quarries. The range of operation is from 350 to 1,800 gal. per minute for a maximum working lift of 100 ft., or 43 lb.; from 350 to 1,600 gal. per minute for 175 ft., or 76 lb.; from 350 to 850 gal. per minute for 350 ft., or 150 lb., and from 1,000 to 1,200 gal. for a maximum working lift of 300 ft., or 130 lb.

"Solid water-end types," those pumps in which the working barrels and valve chambers are contained in a single casting, are illustrated in Pump Data No. 34. These pumps are horizontal triplex power pumps, single-acting and with outside-packed plunger. When required, they can be mounted on trucks, which facilitates moving them about the mine. Range of operation is from 25 to 350 gal. per minute for a maximum lift of 100 ft.; 25 to 350 gal. for 175 ft., and 25 to 350 gal. for 350 ft.

Vertical quintuplex power pumps, of the so-called "pot-chamber water-end" type, are illustrated and detailed in Pump Data No. 35. In these pumps the valves are contained in separate and interchangeable pots, which feature of design makes the pumps especially applicable for handling large quantities against lifts up to and including 1,000 ft., and is suited particularly for conditions where the liquid pumped has a corrosive action on the metal because the individual pots can be replaced readily at small expense and without loss of time.

Pump Data No. 44 relate to an electric triplex sinking pump of the solid water-end type. This pump is entirely sectional—the standards, main journals, cradles, crossheads, water-end, and motor base are all separate. A special sling facilitates raising and lowering, and, when desired, the pump can be fitted with telescopic discharge, permitting raising or lowering without disconnecting and lengthening the discharge line.

The single-acting, outside-packed plunger, vertical triplex power pumps described in Pump Data 48 have a range of operation from 500 to 2,000 gal. per minute for a maximum working lift of 500 ft., or 216 lb.; from 400 to 1,600 gal. for a lift of 700 ft., or 303 lb., and 300 to 1,200 gal. for 1,000 ft., or 434 lb.

Chilled iron plungers and patented metallic packing, suitable to horizontal, vertical, power or steam pumps, are detailed in Pump Data 53.

Data that illustrate the Aldrich horizontal, higher-speed pumps, which are specially designed with extra large valves and water passages for higher pump speed with low water velocity, are given in Pump Data No. 58. The range of operation of these horizontal triplex power pumps is from 50 to 250 gal. per minute, for lifts of 100 ft. and from 50 to 250 gal. per minute for 175 ft.

Single-acting, outside-packed plunger, vertical triplex power pumps are described in Pump Data No. 60. Specifications are given for 4-in., 6-in., 7-in., 8-in., 9-in. and 10-in. stroke pumps.

In Pump Data Nos. 80 and 81 are included information concerning Aldrich "Utility" vertical triplex power pumps. These pumps have a wide range of utility, and their descriptions will no doubt be interesting to those who are familiar with the larger units.

T. A. RICKARD
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Volume 113 New York, June 3, 1922 Number 22

Deep Veins

IT WAS POINTED OUT in an editorial last week that the rich shallow-formed Tertiary ores of the "bonanza" type have an always determinable limited vertical range, below which will be found barren veins or even barren fissures; nevertheless, other vein types, which have formed at greater depths, have greater original vertical range, and hence greater possibilities (though not certainties) for deep mining. Near this opposite end of the classification, perhaps, stand gold-bearing veins of the deep type, associated with granitic, monzonitic, or sometimes dioritic intrusions. Such are the gold-quartz veins of California and of Ontario, for example. They represent older types of veins—in California, post-Jurassic; in Ontario, pre-Cambrian—and have been exposed through deep erosion. In California, at Grass Valley and on the Mother Lode, these veins are ore-bearing for thousands of feet—over a mile on the dip at the Kennedy mine; and there is as yet no indication where the lower limits of ore-deposition will be reached. The orebodies are naturally not continuous in these veins, any more than they are in the Tertiary veins; but beneath an exhausted orebody on the Mother Lode, deep exploration has repeatedly discovered other orebodies. Thence arose the unwarranted theory of the "barren zone." There is no certainty that new orebodies will be discovered in depth; there exists only the opportunity that may be afforded by an excellent prospecting chance.

The lower limit of ore-deposition, and of the total original vertical range, has not been determined. Whereas, the maximum possibility in the Tertiary veins appears to be perhaps three thousand feet, the corresponding possibility in the deep gold-quartz veins may well be double that amount, or more. It is this geologic condition that renders gold-mining still hopeful and attractive in California, and which offers hope for long life of gold mining in Ontario, as at Porcupine. Lack of perception of these differences in different types of veins, however, leads to unnecessary risks in exploration in depth: as, for example, in the case of such mines as El Oro, in Mexico, and the Camp Bird, in Colorado, and the Gold Roads, in Arizona—all of which properties may be considered as being of the Tertiary bonanza type.

It is, however, to be remarked that the deep quartz veins often degenerate, as in the Appalachian belt, and also at many places in the Canadian region, into a string of lenses, due to their deep origin. A lens opened up at the surface pinches at a little depth; and deeper exploration becomes speculative on account of the physical conditions. The chances of other ore-bearing lenses at greater depth are excellent; but whether it will pay to search for these, with the amount of dead-work entailed by the separation of the lenses, is a problem of mine management which obviously will depend on various factors that must be given consideration by those in charge of the enterprise.

Mineral Wealth and Self-Determination

THE DISCOVERY and development of mineral resources in an otherwise unproductive region seldom fails to result in an increasing evidence of patriotic fervor on the part of the inhabitants. In some instances the newly acquired love of native soil leads to a desire for independence, which may be embarrassing to others. Thus we learn that the preliminary discussion at Washington between representatives of Chile and Peru anent the Tacna-Arica controversy is likely to be rudely disturbed by the presence at the national capital of a delegation of gentlemen who call themselves native Tarapacans, and who intend to petition President Harding that the Treaty of Ancon, by which the Province of Tarapacá was ceded to Chile in 1881, be canceled.

The intervention, if taken seriously, introduces a new element into a controversy that has taxed the reasoning powers of all impartial observers. To appreciate the situation it is necessary to recall the fact that the nitrate deposits in South America were first exploited, developed, and financed in the (then) Peruvian province of Tarapacá by Chileans. The War of the Pacific arose in consequence of alleged illegalities on the part of Bolivia, particularly toward the Cia. de Salitres y Ferrocarril de Antofagasta, a Chilean company with headquarters in the coastal town of Antofagasta, which at that time belonged to Bolivia. Peru joined forces with Bolivia, and both were defeated. The Treaty of Ancon resulted in the permanent cession of all the valuable nitrate deposits to Chile, together with the temporary cession of Tacna and Arica, pending the result of a plebiscite to be held after ten years to determine the wishes of the inhabitants.

It is claimed that a few Peruvians, resident in Tarapacá immediately prior to the war, opposed the treaty. As to which side is to blame for the failure to hold the plebiscite, no one can speak with assurance unless he be a Chilean or a Peruvian. Suffice to say that Chile wants to retain hold of the buffer states, for they serve as a protection against sudden attack to regain the valuable nitrate deposits farther south. Peru, on the other hand, makes no secret of her desire to regain possession not only of the buffer states but also of Tarapacá and other nitrate districts.

To settle what for many years has been known as the Tacna-Arica controversy, a meeting of delegates of Chile and Peru was convened at Washington. Prospects of a settlement are hopeful, but the situation is now complicated by the news of the arrival of the natives of Tarapacá—the district that is the *casus belli* of the whole trouble. From press reports it would seem that these gentlemen apparently expect recognition as a separate group.

Tarapacá is one of the centers of the nitrate industry. The province is immensely rich in potential reserves of nitrate. Its wealth, absorbed by the Chilean government in the form of an export tax, has flowed in a steady stream to the capital at Santiago, far to the south. There it has served to bolster the finances of the government to an extent that has permitted Chile to copy the German army and the British navy, and with remarkable success. Those directly concerned with development of the nitrate industry in the arid regions to the north have mourned the loss of so much good revenue to the national capital. This sentiment has now found an outlet by the so-called Tarapacans—they may be Chileans or they may be Peruvians—who appear to be under the impression that they may yet make Tarapacá and its revenues their own particular concern, with that simple and innocent and philosophic attitude that characterizes so many Latin Americans when the resources of their country have been developed by outside capital.

Chile, however, has no intention of relinquishing Tarapacá, The money received from the nitrate export was essential to the financial stability of the country. The Tarapacans must feel annoyed that a considerable portion of the wealth from the pampa has gone to build up a military establishment that serves as an insurance against secession or a return of the land to Peru.

It is to be hoped that an amicable agreement in regard to the Tacna-Arica controversy is imminent; the ending of the squabble will serve to draw further attention to Washington as the world's center for the burying of the hatchet. But we have good reason to believe that the native Tarapacans, whoever they are, are wasting their time. The United States can and will offer hospitality and good advice to disputants, but we predict that the President will be silent on so absurd a demand as one asking for the cancelation of a treaty made between two foreign countries in the early 80's.

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What We Publish—A Straw Vote

WE HAVE HAD many individual opinions about our publication. We are this and that; the opinions are scattered, contradictory, and confusing. Journalism is service; but our clientele is very large. To get a representative straw vote, we sent out a questionnaire to about 300 subscribers, selected as representing a cross-section of the whole group. More than one in four responded; and we are very thankful for their trouble. It has enabled us to have a more representative mass of opinion, a helpful index of sentiment.

We first asked, "Have we the right proportion of technical articles?" There were 71 decided answers; 61 held that we had the right proportion; 6 held that we had too many; 4 that we had too few. We must conclude that our policy regarding the proportion of technical articles is fully approved.

Our second question was, "Have we the right proportion of descriptive articles?" Our correspondents voted thus: Forty-nine said the proportion was right; 11 held that we had too few; 2 that we had too many. We conclude that we can go even a little further with good descriptive articles without glutting the market.

Our third question was, "Have we the right proportion of articles on mining geology?" And 44 said we had the right proportion; but 19 said we had too few; only 2 said we had too many. Clearly, there is a certain appetite for good articles on practical mining geology not yet satisfied.

Fourth, we asked, "Do you approve of articles on economic subjects connected with mining?" The vote in the affirmative was practically unanimous; Yes, 64; No, 1. The economic phases of the mining industry are vital.

Well, there were a lot of other questions, and we may refer to the vote on them later. Enough for the present. We had also a lot of pleasant praise; and a very few jolts, all of which we consider attentively.

"In a general way I heartily approve of the general lay-out, and I am confident that it meets a great need in an excellent way." "I think the *Journal* in its present form is extremely satisfactory." "There is no need of my going over your questions singly, for I approve of each and every one of your departments individually and collectively." "I consider the *Journal* well-balanced in the subject-matter it publishes."

Our questionnaire, it may be explained, was necessarily based upon policy prior to the consolidation into the present *Journal-Press*.

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Alchemy and the Transmutation of Elements

ALCHEMY, the dictionary tells us, was a medieval science, the principal objects of which were to transmute base metals into gold and to find a panacea and a means of prolonging life indefinitely. The word is of doubtful origin, but it is probable that it was used first to designate the art of extracting juices from herbs, in the manufacture of medicines. Later, as an authority has said, it represented "the sickly but imaginative infancy through which chemistry had to pass before it attained its majority"; it was shrouded with humbug and secrecy—two features that distinguish it from the real science of today.

In early times alchemy was intertwined with religion. Thus in the fourth century, A. D., Nemesium, Bishop of Emesa, is reported to have said that the Creator, in order to prevent the destruction of elements, had wisely ordained that they be capable of transmutation, the one into the other, or into their component parts, or that the component parts could be resolved into the original elements. "Thus," he said, "the perpetuity of things is secured by the continued succession of their respective generation."

It is probable that the first workers in this phase of chemistry began their investigations with honest motives; but an ignorance of the fundamentals of science soon forced them to stoop to trickery and fraud. One of the earliest experiments may have been to turn a piece of lead to an oxide ash, possessing none of the physical characteristics of the original metal. The ash might then be mixed with charcoal and heated in a crucible, and lead would again be produced. Such an experiment, to the credulous, would prove the transmutability of metals into other substances, or the transmutability of other substances into metals. Having thus gained, as an investigator of superior intelligence, the support of the people, the alchemist, to save his reputation, was obliged to tackle the insistent problem of the transmutation of a base metal into gold; and this was when the humbug began.

The fiction advanced at that time was that gold was the acme of purity, and that other substances could be transformed into it by merely removing the dross. Because of the fact that fire lent itself to the secrecy with which all such work was performed, it was adopted as the principal agent for the removal of the "impurities" and the production of the coveted lucre. The heat necessary prevented a close examination by the onlookers of the details and progress of the experiment. Much cunning was shown by the alchemist; his "transmutations" would convince many at the present time were it not for the healthy influence of a science that knows no chicanery, and a recognition of the fact that science is truth.

The majority of the alchemists were entirely unscrupulous. They demonstrated that it was possible to change charcoal into silver by burning it; all that was needed was to soak the charcoal beforehand in a solution of some silver compound. To change charcoal into gold the alchemist would bore a small hole in the charcoal, fill it with gold dust and then plug the mouth of cavity so that it was impossible to detect that it had been tampered with. It was then smelted in a crucible; the charcoal was burnt, and a button of gold remained.

Another favorite experiment was designed to prove to the credulous that lead could be converted into gold by heat. The lead was melted in a crucible and stirred with an iron rod. This rod had previously been hollowed out for a short distance from the end, the cavity being filled with gold dust and plugged with paper. As soon as the rod came in contact with the molten lead, the paper burned and the precious metal mixed with the lead. The alloy would then be kept hot in a strong draft of air until all the lead had been oxidized, after which a button of gold would be found.

But, strange to relate, many a fiction serves to herald the truth; and now we learn that the element helium can be produced from the element radium, and that both uranium and thorium undergo slow change, with lead as the final product. Discoveries such as these revive hopes among the get-rich-quick section of the community that gold may be made artificially, and by human intervention, from lead or other base metal.

The gold-mining industry is no more likely to be affected by the progress of scientific research in the matter of the transmutation of metals than it was by the chicanery of the alchemists.

Developing the Would-Be Engineer

PRESIDENT JOHN GRIER HIBBEN of Princeton University, in discussing recently the education of an engineer, said that a man who is highly developed mentally but who lacks character is a menace to the community. On the other hand, one who has character without mind, he said, comes to grief in the contests and the conflicts of life. Future success and conspicuous leadership necessitate an early grasp of fundamental principles, rather than the mental acquisition of indigestible facts; the sciences must be mastered by every student of engineering.

These comments suggest a connection between character and science, which will become apparent on closer analysis; for character, essentially, is sincerity and truth. Science, on the other hand, is verity and thoroughness. The "early grasp of fundamental principles" necessitates something more than mere acquisitiveness; it demands the full use of reasoning power; it tasks the entire resources of the mind; it stimulates thought. Too small an amount of individual thinking is required of the average engineering student; little attempt is made usually to quicken and encourage the imagination. The full-fledged graduate emerges from his *Alma Mater* equipped with a university diploma, evidence of acceptance in the ranks of a so-called professional organization, and a number of facts and formulæ. If he forgets the facts or mislays the formulæ he is indeed lost, for his "education" has been handed to him in tabloid form, and he knows but little of the why and the wherefore. If he be wise he will make an early attempt to remedy a state of affairs that finds daily encouragement in so many of our schools of learning. He will admit, at the beginning, that he is not an engineer, whichever interpretation of the term be accepted. He will start to show a real acquisitiveness for the knowledge, not found in textbooks, that shows what others have done, on which to base his research, and by which he may add at least one small brick of originality to the edifice of knowledge. This will stimulate his imaginative powers; it will create an inventive spirit, by which the future will be opened as a vista of unbounded possibilities. Thus will he become an engineer, showing initiative and creative spirit, with which he can achieve what to the mediocrity appears impossible or impracticable.

Potential Energy, or Gold as a Backing for Paper Money

WE HAVE HEARD much of late about the "commodity dollar." The sequel to this is the proposal by Henry Ford that the undeveloped water-power resources of the South shall serve as a backing for paper currency to be issued to meet the cost of development. This comes as an alternative to the printing of fiat money, with no promise of redemption in any form; but whatever the zeal and sincerity that would-be economic reformers put behind proposals such as this, it is evident that the world knows full well the necessity for backing paper currency with something of tangible worth—something that will buy anything and everything in any mart in the world. Such backing may be in the form of specie in the vaults of the national banks, or it may exist in the mines, unrecovered but determinable as to approximate amount and purchasing power.

The argument that the United States is not in reality on a gold basis, because it could not at any one time redeem all the paper money in circulation, is specious, for it ignores the lack of necessity for such provision. The retention of so much gold, away from national and international circulation and use, would be an unjustifiable waste of resources. The fact that no unreasonable advantage is taken of the Government's promise to redeem in gold is an evidence of national stability and individual prosperity. It demonstrates the wisdom of existing provision in this respect.

Recent European history has shown that the nations which have issued paper money *ad libitum,* with no backing of real and international-trading value, are in the throes of economic and financial chaos, or they are slipping toward national bankruptcy. Some standard of value, some indication of financial stability, is necessary. To back paper currency on something so intangible as undeveloped water-power resources would presage a riot of irresponsible promotion. It would be as airy a scheme as the issuing of bonds against the atmosphere, the nitrogen content of which Mr. Ford hopes to utilize for the manufacture of fertilizer.

Conditions on the Rand

BY T. A. RICKARD

SINCE the ending of the strike that interrupted mining operations on the Rand and threatened a revolutionary war, the various forces that were engaged in that conflict are now correcting the disorder caused by the disturbance of normal economic health. The Government has shown vigor in prosecuting the smaller offenders, many of whom have been convicted by due process of law, whereas the leaders and those who murdered a group of employees at the Brakpan mine are being held under arrest, pending the collection of further evidence. The Chamber of Mines has announced its new policy and specified the conditions under which the trade-unions will be recognized in future. The most stringent conditions are that (1) the union must be truly representative; (2) provision for a secret ballot of members, before striking, must be made, (3) the members of the union must not refuse to work with non-union men, and (4) the unions must not be represented by persons recently associated with the South African Industrial Federation, or 'council of action', which, as will be recalled, was the organization primarily responsible for the recent outbreak of anarchistic violence, euphemistically termed a strike. The unions themselves—now pleading, defensive, and ashamed—are endeavoring wildly to test and to recover their strength after their recent costly failure, and after seeing the complete defeat of their allies, the communists and revolutionary nationalists.

The mine managers are rehabilitating their white-labor forces, to bring them into proportion with the number of native laborers remaining on the mines. During the strike 50,000 natives were repatriated, so the mines are much under-manned, but the managers are enjoying a free hand and a power to discriminate between white workers such as they have not found practicable for several years. American readers, who may have seen only the scanty accounts appearing in the daily press on the subject of the Rand strike and its sequel of revolution, may have had difficulty in gauging the magnitude of the economic and political upheaval, in comparison with similar disorders in our Western camps. In my recent article on the subject (in the issue of May 6) I tried to make clear how serious an event it was, so that my readers will know whether to measure it with a micrometer or a two-foot rule. The following statement of casualties, incurred chiefly at the Far East Rand mines and in the district immediately west of Johannesburg, is eloquent: government forces, killed 50, wounded 237; civilians (revolutionists and peaceful citizens), killed 136, wounded 287; colored persons, killed 31, wounded 67, total, killed 217, wounded 591.

The strikers originally involved numbered 22,000, of whom it may be estimated that 10,000 were voluntary and 12,000 involuntary participants in the affair. The majority of the men were afraid to vote against the strike or to assert themselves against the extremists. This is the story of most outbreaks of a similar kind; the quiet and conservative men are harried by the violent and radical members of the unions. The open vote plays into the hands of the extremists by intimidating those who are good citizens. If the Chamber of Mines can use the prestige acquired recently, in consequence of the defeat of the unions, to force them to use the secret ballot at their meetings, it will be a step toward giving strength to the better element in the unions. The idea of insisting that the unions be "truly representative" is good also, for the system of collective bargaining cannot be effective unless both sides are thoroughly representative. The system breaks down when the larger part of the employees decline to unionize, and especially if, as happens usually, the married men and the more orderly individuals stay out of the union, which then consists of the less responsible and more radical elements, to whom the system of collective bargaining, as expressed by unionization, becomes a means of making industrial trouble. The working-man's hatred of the 'scab'—the non-union man that accepts employment during a strike—is intelligible enough; and although non-union labor may serve as a convenient tool for breaking organized labor when it becomes tyrannical, it is evident to an onlooker that the system of collective bargaining must fail even during a peaceful period so long as it excludes a large number of those whose welfare it affects.

A committee has been appointed by the Minister of the Interior to investigate claims arising from damage done during the strike and to make compensation for injury to the person and property of peaceful citizens and of those who assisted the Government in suppressing the disturbance. General Smuts, during the debate on this subject in the Assembly, said that the commission to investigate recent strikes was "more necessary than ever, because, owing to the mine-owners' victory, there was danger that the employers would refuse to take into account the voice of organized labor". He stated also that the Government "could not countenance tyranny by either side". It is evident that the Premier is living up to his reputation for fairness and sagacity. Nevertheless the Opposition, headed by General Herzog, an irreconcilable Boer of the old type, has endeavored to exploit sundry incidents of the strike, more especially the declaration of martial law, against the Government. Public opinion, however, inside and outside the South African parliament supports the Premier in his efforts to resolve a difficult situation.

To the shareholders of the mining companies operating on the Rand the question of the moment is how far the demoralization of the mining industry during recent years is to be checked; to what degree the subordination of managerial authority and technical efficiency to the dictates of labor policies is to be corrected; and whether these sinister influences are now to prevent a speedy re-establishing of mining operations on a sound economic basis despite the decreasing assistance of the currency premium. The return to the mines of the Kaffirs that were repatriated will be a slow business, and when they re-start to work they may show signs of demoralization, owing to the interval of idleness, but, with pluck and sagacity in the right quarters, there should be no delay in restoring the technical efficiency and industrial vitality of the Rand.

DISCUSSION

Assisting Development of Prospects

Attempts to Increase Asking Price After Negotiations Have Been Initiated Often Result to Disadvantage of All Concerned—An Equitable Method of Reaching an Agreement

THE EDITOR:

Sir—The finding and development of prospects is our pressing need. The physical factors which influence the value of a prospect, such as geology and possible methods of mining and treatment of the ore, have been thoroughly discussed, but one of the most important phases of the question, and the least likely to receive a solution, is the human element entering in the development of prospects.

Usually our friend the prospector does a lot of work and endures many hardships without financial help. Eventually he needs someone to help him equip his property with machinery for further work or to extract the metals from the ore. When his funds are out and no one seems to want his property the valuation he sets on it is extremely low. But as soon as an outsider shows the slightest interest in his claim it is surprising to note the tremendous increase in its value.

No doubt others have had similar experiences as the following: Mr. X wanted some money to help develop his claim and offered a friend of mine a one-half interest for $3,500. I was asked to look up this prospect. The state and U. S. Geological surveys' reports regarding the district being favorable, I wrote Mr. X telling him that his claim seemed promising and that we wished to investigate it further. This was a fatal mistake, for in his next letter Mr. X wanted $10,000 cash for the same one-half interest. After a little correspondence Mr. X admitted that there had been no new discovery on his ground or any new excitement in the district since his original offer to sell. The fact that we showed an interest in his property was justification for his boosting of the price almost three times what he thought it was worth when he was trying to market it himself. As far as we were concerned the skyrocketting of the selling price by Mr. X ended the negotiations. I did not dare to think of the price had we shown enough interest to inspect the property.

This trait of getting all the traffic will bear is not inherent to the man who wants to sell his claim but also to the man who wants to finance further development and wants to "hog" the whole project or freeze out the original owners. The prospector is certainly entitled to a good share in the profits of the mine brought to life by his efforts, yet he should also consider that there are many other businesses in which a man can invest his money, and that the only thing which makes him willing to help the claim owner is the possibility of making a large profit.

During his work, day in and day out, and constantly pondering over his daily problems, our prospector is apt to become visionary. He feels sure that "she gets richer the further down you go." The thought of enormous wealth just ahead of his drift spurs him on. Consciously or not, he may stretch the value of his mineral in sight.

Briefly, Mr. Y's small mine had been closed some time for lack of funds. The most important part of the mine, the sulphide zone, has been allowed to fill with water. Mr. Y assured me that the dump, which he had carefully sampled and which represented his last work, averaged $7.50 per ton in gold. Being unable to sample the mine on account of water, we decided to sample the dump, and told Mr. Y to select for us his own sample of what he considered ore. Instead of the expected $7.50, later assays by a reliable assayer gave for our own sample $1.04 and Mr. Y's sample $0.54. Leaving aside the difficulty of getting a true sample of a dump, Mr. Y, although familiar with the district and this particular property, could not tell ore from country rock.

The point I wish to emphasize by this recital is the lack of precise information which many men seem to have concerning their property. This does not apply generally, of course, but a number seem to be afraid of knowing definitely the assay value, and prefer to rely entirely on their judgment and guess.

Mr. Z showed me some samples of copper ore. He knew he had copper because the water coming out of his tunnel would copper plate a shovel if left in long enough. Mr. Z had spent all summer working on his claims until driven off by the winter snows. He carried these specimens with him, and when asked how much copper they contained the answer was that he did not dare have assays made for fear of spoiling his mine.

The indefinite permits the mind to conjure dreams and fancies, but a successful mine is built on the hard foundation of metallic content of the ore.

But two things can be determined with some accuracy—the value of the exposed faces and their position on a map. Every engineer realizes the importance of even a rough assay map of the mine, kept right up to the minute during the development period. To know positively what you have and where it is gives the basis for further intelligent work. This map becomes of great value when the earlier workings have caved and become inaccessible, for verbal information regarding old workings becomes most unreliable and scarce as time goes on.

The two points I have tried to make are: First: That numerous worthy prospects would be developed if the financier and the prospector met on a reasonable basis and if each were willing to let the other have a fair share of the expected profits: Second, that a number of prospects and small mines as well can be developed more quickly and cheaply by substituting more exact technical methods for the "guess system."

Oakland, Cal. LOUIS J. BRUNEL.

Mining Industry's Share of the Government Burden

THE EDITOR:

Sir—The communication of C. B. Holmes in the April [illegible] issue, dealing with the problem of depletion, was most timely. All such communications for the last six years have been timely, and quite likely will be for the next decade unless some such measures as he proposes are adopted. Depletion is the *monstrum horrendum informe, ingens* which has been stalking the industry for the past half decade. It is at present the Great Unknown in the puzzled mind of the investor or engineer who still clings to the business of mining.

The unsettled claims for several years still outnumber those settled, in the files of the Revenue Bureau. Those that have been cleared away have been resolved by a compromise guess between the Natural Resources Bureau and the taxpayer. Company treasuries and the bank accounts of mining investors are still the repositories of inert funds which should be hunting out new orebodies and building new mills. The Government can do one thing, at least, while claiming that its paramount interest is the revival of industry, and that is to straighten out long-due settlements. The problem does not admit, though, quite such a dramatic and sweeping solution as Mr. Holmes advances—a uniform depletion factor for each product. It savors somewhat of emptying all the bottles on a laboratory shelf into a beaker to get a certain reagent.

All cases are different and must be separately considered, but as quickly as possible. More power to the appraisers (among whom are fortunately a few engineers), less tolerance of windy "agents" in Washington, and no consideration of involved and suspiciously refined accounting methods. These measures, vigorously applied, ought to clear out the files in a reasonable time.

Some such plan must be adopted for immediate relief. But the industry ought not to let it go at that. Corporation income taxes and depletion ought to be divorced. They ought never to have been joined. An income tax should levy upon wealth created by the energies of man, and it does in every other business but mining or a natural-resource development. The state has had, since the beginning of history, the power and the right to command the services of its people for war or public works. It allowed, later, the substitution of goods, and then money. Theoretically, the state, which has almost universally alienated its ownership of the soil, has the right to say—to collect its tithe of human energy—"so much of your wealth comes from the ground, and so much from your labor. Our slice comes from the latter."

In practice, as we have learned in the past six years, such an attempt is so complicated as to be absurd. Least of all minds is the collective lawyer-mind of Congress capable of doing this. What it can do, pretty well, is to arrange it so that mining bears its proportionate share, neither more nor less, of the burden of government, in comparison with the other industries. A lawyer, whose training and mental habit would make him the inferior of an engineer in working out the complex applications of depletion, is often the latter's superior as an arbitrator and adjustor. The mining industry must, of course, present its side vigorously and clearly, with emphasis on the inherently hazardous nature of the pursuit.

Depletion, moreover, is a matter which might well concern not the impersonal corporation but the stockholder as an individual. It is simply a device to guide him in keeping his possessions intact, although his mine is decreasing in value, by careful reinvestment. Before this application to the tax law arose, it was recognized as such. Mr. Holmes says: "In years prior to 1913 no one had ever seen a depletion account on mining books." This was because a stockholder was supposed to look after his own re-investments. The reports of the companies were his sources of information as to how fast his capital was disappearing. Although he did not see, perhaps, the problem in all its details, he went out and looked for a new mine, or bought some bonds. The income-tax law took this matter out of his hands, where it belonged.

The analytical appraisal method, based on money rates, was applied to mining in the early days of the Rand. In 1897 a paper in the *Transactions* of the Institution of Mining and Metallurgy dealt with it exhaustively. Once applied to determine the fair purchase price, it was dropped; the investor could use it or not, as he wished, in splitting his dividends into income and return of principal. I hope, of course, that the reader has in mind the distinction between depreciation charges (amortization) which are proper on the books of the corporation, and depletion.

All of which, the whole of this letter, might have been expressed succinctly by: "Behold the Canadian mining tax laws." In Ontario there is a flat exemption for small earnings, a flat rate for earnings between certain limits, a higher fixed rate between higher limits, and so on, and no "depletion" deductions allowed. The dominion and the provinces thus determine the mining industry's proportion of the government burden. If it has been excessive or unfair, you will have a hard time explaining the northward flow of American capital. The need of the United States is for such a measure, and the scrapping of present regulations and procedure.

New York City. RUSSELL H. BENNETT.

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Efficiency in the Use of Safety Fuse

THE EDITOR:

Sir—It was with considerable interest that I read Mr. Tillson's article, "Promoting Efficiency in Drilling and Blasting," which appeared in the March 18 issue of *Engineering and Mining Journal;* but I do feel that in justice to the men who have to use safety fuse in the mines, it would be well to call their attention to certain errors that unwittingly have crept into Mr. Tillson's paper.

Mr. Tillson will probably acknowledge that through error he has stated the opposite to what he intended when he says, "Fuse burns slower when the gases of combustion are confined." The statement should read, "Fuse burns faster when the gases of combustion are confined." This is obvious when one considers the reason. If the gases generated by burning cannot escape readily, they build up a pressure within the fuse which forces the flame ahead faster. A simple test to illustrate the point can be conducted by burning a piece of fuse while holding it tight in the jaws of a vise. It seems to me, therefore, that Mr. Tillson's statement is misleading, and dangerous to miners if they act on his theory.

Certain field investigation on complaints regarding safety fuse have led to one or two interesting and well-established facts. It has been found that the reason why fuse fired holes out of rotation was that some holes in a round were tamped and some were not. The average miner, when loading a round of holes in development work, and realizing that the lifters are the last holes to shoot, usually places the primer in these holes reasonably close to the point of the hole, and tamps these holes exceptionally well, in order to exclude water and to protect the powder in these particular holes from the water that seeps in while the rest of the round is being shot.

It has been found that the lifting hole was usually the hole in which the fuse burned with the greatest rapidity when this method of loading was followed. The lifters in this case fired very much out of rotation and lessened the efficiency of the round to a marked degree. It has been found through careful investigation that the reason the fuse burned so much more rapidly in these holes than it did in the other holes in the same round was the fact that a greater length of fuse in the lifter was exposed to pressure. In other words, fuse on which pressure is exerted burns more rapidly than fuse which is untamped.

The same theory holds true regarding fuse burned at a considerable elevation above sea level, but under these conditions there is a relief of pressure and a slowing down in speed. The factory with which I am connected manufacturers fuse at an elevation of approximately 500 ft. above sea level. Fuse which burned at approximately forty seconds per foot in the open air, unconfined, at this elevation, when taken to an elevation of 7,000 ft. burned in the open, unconfined, at approximately fifty-six to sixty seconds per foot, and when returned to the point of manufacture burned at the original speed which it had when tested prior to leaving the plant. This is further illustrated by the following tests made with a certain brand of fuse in South America:

Place	Elevation, in Feet Above Sea Level	Burning Speed of Fuse, Seconds Per Yard
Lima, Peru	500	127
Chosica, Peru	2,800	136
San Bartolome, Peru	5,000	136
Matucana, Peru	7,800	141
Caspalca, Peru	13,600	158
Cerro de Pasco, Peru	14,200	158
Morococha, Peru	15,000	158
Ticlio, Peru	15,600	160

This feature of the effect of pressure on fuse was gone into thoroughly some years ago by two engineers at the testing station of the Bureau of Mines, Pittsburgh, Pa. The department issued an interesting pamphlet as a result of its work. (See Technical Paper No. 6, by Snelling and Cope.)

So far as I know, the requirements of governments, both in Europe and America, permit a variation of 10 per cent in speed either way from standard. These limits, which may at first consideration seem rather wide, are given the manufacturers not because it is impossible to make fuse which, within a given unit of manufacture, will burn at much closer limits, but because it is realized that fuse in commercial use is manufactured over an extended period and so under varying weather conditions; and it is, therefore, impracticable to establish closer factory limits without materially increasing the price at which the fuse reaches the consumer. The fuse manufacturers, however, realize full well the work which their product is supposed to perform, and throw around the manufacturing process of their fuse such practical and technical safeguards as will insure its burning as near the standard of their factories as possible. As an evidence of this care, it has been found, by a careful tabulation made by some of the largest copper mining companies in the West, that it is not an unusual thing for their records to show a total of less than 0.5 per cent of missed holes from all causes over a period of many months, and they do not consider such a record as being at all unusual.

In conclusion, my experience of twelve years of investigating fuse complaints has led me to the belief that safety fuse fails to perform the function for which it is manufactured much more often as a result of abuse in transportation, storage, and handling than it does from any defect in manufacture.

Livermore, Cal. GRANT H. TOD.

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Recognition of Mexico

THE EDITOR:

Sir—Your editorial in the issue of April 15 was timely and of great interest. Regarding Article 27 of the Constitution of 1917, perhaps too much stress is laid on its application to the petroleum industry, and too little to its being a subject of concern to Americans who have invested their savings in ranch lands here and in mortgage bank bonds secured by loans on ranch lands.

I refer to ranch lands acquired from their legitimate owners prior to 1917. As you know, mining men hanker to own a farm (where there is no work to do!), and some of us have used that method of investing for "an old-age stake." "PRO BONO AMERICANO."

Mexico.

Differential Flotation in Tasmania

The Electrolytic Zinc Co. has recently been carrying on some successful flotation experiments on the Read-Rosebery ores at Zeehan, Tasmania, according to *Chemical Engineering and Mining Review*.

A standard one-box Minerals Separation machine is used, and 200 to 300 lb. of ore is treated in one shift. The charge is fed in by buckets, after having been broken in a crusher and ground in a ball mill. The water is kept at a temperature of 120 deg. F. Sulphuric acid is introduced in sufficient amount to keep the liquid slightly acid—0.06 per cent. Wood tar oil with a little eucalyptus oil is added intermittently. Sulphur dioxide is introduced through the same pipe as the oil, from a small burner, keeping the solution saturated with the gas at a temperature of 120 deg. F. In this stage, a pyrite galena float is obtained. The sulphur dioxide has the effect of allowing the particles of blende to be wetted, and consequently they sink with the gangue.

When this float is finished, the temperature is raised to 140 deg. F., and the sulphur dioxide turned off. A mixture of coal tar and creosote, with a little eucalyptus oil, is added, and more acid from time to time to keep the liquid at 0.06 per cent throughout the run. When the sulphur dioxide has been expelled, the zinc sulphide froth rises and overflows.

The average metal content of the different products shows the result of the experiments to be:

	Zinc [illegible]	Lead [illegible]	Iron [illegible]
Feed	[illegible]	[illegible]	[illegible]
Pyrite-galena float	[illegible]	[illegible]	[illegible]
Zinc concentrate float	[illegible]	[illegible]	[illegible]
Tailing or reject	[illegible]	[illegible]	[illegible]

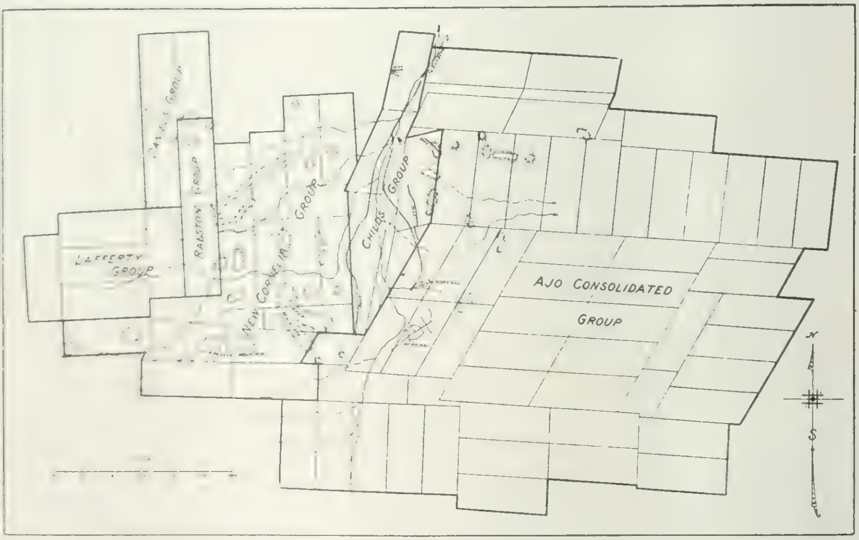
A recovery of 85 per cent is obtained.

Ajo Enterprise of the New Cornelia Copper Co.—I

Ore Deposit First Opened by Spaniards in Eighteenth Century—Several Metallurgical Processes Proved Failures—Water Supply and Other Public Improvements Necessary—Ore Occurs as a Large Laccolith of Monzonite—Porphyry Oxidized Above Present Water Level

By A. W. Allen
Assistant Editor, *Engineering and Mining Journal-Press*

"WEST of the Santa Cruz, and south of the valley of the Gila, to the Colorado River, the territory is generally an irreclaimable desert. Its mountains abound in the precious metals, and a sufficiency of water for mining operations can be usually obtained without exorbitant expense. The celebrated Ajo mine, now known as the Arizona Copper Mine, is in this district. Mr. E. Dunbar . . . was formerly the director of this mine, and the first, I believe, to demonstrate the fact that water could be obtained . . . The Arizona mine will one day prove of immense value; like the rest of the mining companies, it needs the outlet on the Gulf of California."



Map showing position of original claims at Ajo, Arizona

So spoke one Sylvester Mowry before the American Geographical and Statistical Society in New York on Feb. 3, 1859. His prediction as to the future of the Ajo mine has been fulfilled, although the goal was reached only after many vicissitudes, in which personality and conviction, and the influence of such characteristics on others, played no small part.

Mines First Worked by Spaniards

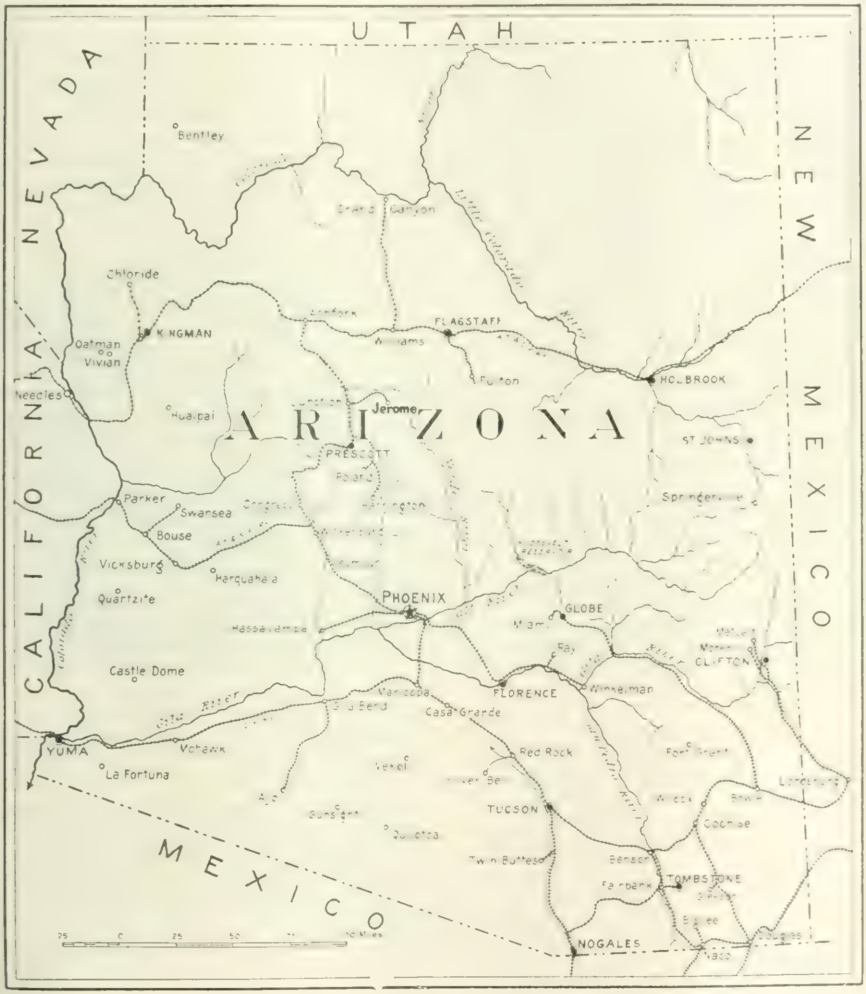
The quotation shows that the district was looked upon with favor sixty years ago; in addition, it had something of a history even at that date, for the mines were said to have been opened by the Mexicans and the Spaniards a hundred years before.

Soon after the Gadsden Purchase, when that part of Mexico became United States territory in 1852, Arizona's first copper smelter, made of adobe brick, was built at Ajo, being operated by P. R. Brady and associates, who together formed a group of adventurers known as the Arizona Mining & Trading Co., with headquarters at Los Angeles. It is known that ore was shipped to San Francisco and to Swansea about that time, but the cost of production and the difficulties of transportation were such that the venture soon came to an ignominious end.

Exploitation Resumed in 1906

The district remained more or less dormant until early in the present century. A stamp mill and concentrating tables were in operation in 1906, some mines being held at that time under bond and lease by the promoters of a San Francisco enterprise known as the Ajo Copper Mountain Mines Co. Numerous reorganizations about that time resulted in the formation of two other companies, the Rendall Ore Reduction Co. and the Cornelia Copper Co. This original Cornelia company attempted to treat the ore by a fantastic patent process, in the

McGahan vacuum smelter, as it was called. The experiment, although sponsored by well-meaning individuals, was doomed to failure. The plant at Ajo cost about $30,000 and proved, as might be expected, a fizzle. The Anderson process of leaching with hydrofluosilicic acid was tried afterward and abandoned by the same company, whose estimate of ore reserves, it is interesting to note, was 25,000,000 tons containing an average of 10 per cent copper. Contemporaneously, the Ore Reduction company adopted the so-called Rendall process, by which, according to a contemporary record, could be treated with equal facility all classes of copper ores, at a cost of $1 per ton and with an extraction of 95 to 98 per cent. This venture, also doomed to metallurgic failure, was followed by another period of depressing quiescence, which was terminated when the General Development Co. purchased sufficient shares in the original New Cornelia Copper Co. to obtain an option for control of the property. This option was abandoned after a campaign of diamond drilling and exploration.



Map of Arizona, showing Ajo near the Mexican border

About the same time the property adjoining and belonging to the Rendall Ore Reduction Co. was being examined for an influential group of capitalists, but the results were considered disappointing and the option was allowed to lapse. In 1911 the Calumet & Arizona Mining Co. took an interest in the New Cornelia property, and an option on 76 per cent of the company's stock was acquired. From that time until the present the history of Ajo has been one of continued success, economic as well as metallurgic; and this has been due, in no small measure, to the sterling character and the technical ability of the men at the head of affairs, of

Railway station at Ajo

whom Dr. L. D. Ricketts and Captain (afterward Colonel and now General) John C. Greenway have been prominent.

Recent Development of the Ajo Deposit

A vigorous campaign of diamond drilling disclosed a large body of low-grade copper ore. Concurrently, the property owned by the Rendall Ore Reduction Co. was being examined by a group of engineers and capitalists, operating as the Ajo Consolidated Copper Co. Between the Ajo Consolidated claims and the New Cornelia claims lay the holdings that were known as the Childs group. This property was examined by engineers representing the U. S. Smelting, Refining & Mining Co., the option obtained, however, being forfeited soon afterward. In the meantime the Ajo Consolidated Co. had acquired the Rendall property and had progressed in developing the mine, which was then taken over by the New Cornelia Copper Co., as the Calumet & Arizona subsidiary was named, in 1917. This company, which replaced the Cornelia Copper Co., was incorporated in [illegible] with a capital of $9,000,000, in $5 shares, of which the parent company controlled 1,229,741.

In 1915 the company increased its capital by an issue of $[illegible],000, in 6 per cent twelve-year, sinking-fund gold bonds, convertible into stock at $10 per share, of which the Calumet & Arizona company subscribed for $[illegible]0,000 at par. An initial dividend of 25c. per share was paid in November, 1918, amounting to $450,000, followed by others that totaled $900,000 in 1920. Since then the state of the copper market and excessive taxation have militated against regular disbursements of a similar nature, but these doubtless will be resumed when general economic conditions are normal. The property of the company now consists of sixty-two patented and ninety unpatented claims, and one patented millsite and fourteen unpatented millsites, covering an area of 2,854 acres.

Geographic Position of the Property

Ajo is situated in Pima County, Ariz., about forty-three miles from Gila Bend, a station on the Southern Pacific, and about midway between Tucson and Yuma. The Mexican border is but thirty miles distant; and rail connection with the Gulf of California, ninety-seven miles to the west, will provide an outlet to the sea. This, in conjunction with the provision of an adequate supply of power at reasonable rates—by utilizing the water-power of the Colorado River—will do much toward furthering the general prosperity of the Southwest. The branch railway from Gila Bend to Ajo, known as the Tucson, Cornelia & Gila Bend R.R., was completed in February, 1916. This was an enterprise that was undertaken jointly by the New Cornelia Copper Co. and the El Paso & Southwestern R.R.

Ajo is a veritable oasis in the desert; it has none of the undesirable characteristics of most Western mining towns. The climate for the greater part of the year is unusually pleasant and bracing; the rainfall in the district is among the lowest in the United States; cloudy days are rare. An annual precipitation of only a few inches is usual, so that vegetation is scanty, and the surroundings therefore are not altogether pleasing to the eye. However, the limitation of natural provision in this respect was appreciated early, and steps were taken to insure a water supply that would permit mining and metallurgical operations on an ambitious scale, would provide for the enormous evaporation from the surface of immense leaching vats, and would secure for the town and its inhabitants that supply of good water which is so essential to modern progress and comfort. The nearest supply in quantity is found in the Gila River, about fifty miles away; but a nearer source was essential, so a site was selected about eight miles from the property, a well was sunk about 700 ft., and a modern motor-driven pump was installed. A ten-in. pipeline carries about a million gallons of water per day to Ajo; and thus it is that one of the most pleasing sights on reaching the little township is the verdant plaza alongside the railway station, in which trees and well-kept grass lawns serve to relieve the monotony of the surrounding landscape.

Providing Creature Comforts for Residents

The buildings of Ajo have been designed in Mission style and are undeniably attractive and artistic. The railway station adjoins the business section and the houses of staff employees. A large school building stands at the end of an avenue of cactus; and a modern hospital, with beds for thirty-five patients, is perched on a hill near by. Between the town and the mine are the Mexican quarters, of one-, two-, and six-family houses, attractive alike both for their neatness and variety of design.

For the acquisition of creature comforts and necessaries the employees of the company have not been left entirely to the mercy of local tradesmen. A trading concern was formed at an early date by the New Cornelia Copper Co., and capital was advanced with which to build and equip a suitable general store for the benefit of employees. This is under the control of the company; but, by co-operation between the manager of the store and representatives of employees, the results are satisfactory to all concerned. Surplus profits are distributed among those employees who have been with the company for at least four months, the following distributions having been made to date:

1917 (9 months)...............	$12,052.60 to 472 employees
1918	[illegible]
1919	[illegible]
1920	[illegible]
1921	11,8[illegible]

The average refund to those who have made purchases at the store amounts to about 15 per cent.

GEOLOGY OF THE AJO DEPOSIT

The geology of the deposit was described[1] in 1914 by Ira B. Joralemon, then geologist and now assistant general manager on the staff of the Calumet & Arizona Mining Co., the parent enterprise. His conclusions may be taken as authoritative, particularly because no differences of opinion have developed since they were first published. From this account it is learned that the most important feature of the geologic structure is the large laccolith of monzonite-porphyry, which uplifted the older rhyolite beds to form a dome. The crest of the dome was eroded at a comparatively recent time. This porphyry mass is eight or ten miles long by one to four miles wide, with the long axis extending N. 20 deg. W. The northern part of the intrusion forms high and rocky hills north of the Ajo basin. The southern end forms Copper Mountain, in the center of the basin. The copper deposit occurs in this southern part of the monzonite, where the axis of the laccolith is plunging to the southeast beneath the rhyolite.

On top of Copper Mountain the small remnants of rhyolite lie fairly flat; on the west flank of the intrusion the dip of the rhyolite is steeply to the southwest, the beds on the east flank dipping to the southeast at an angle of about 20 deg. The pitch to the south of the domed rhyolite beds is fairly steep; all the contacts are irregular. Copper Mountain and the Ajo basin surrounding it are thus formed by the monzonite and by the contact beds of rhyolite. To the east and to the west of the basin are hills of rhyolite lava, breccia, and tuff, with flat-lying beds of andesite lava and basalt in the distance, usually beyond gravel-filled valleys. South of the basin a large body of the red-brown conglomerate stretches away to the dark andesite and basalt mass of Black Mountain.

There are many inclusions of rhyolite within the monzonite, and dikes or irregular intrusions of monzonite break through the rhyolite, especially east of the Copper Mountain. Diorite or diabase dikes cut both monzonite and rhyolite, but apparently have had no important effect on the structure or the mineralization. Both the monzonite and the rhyolite near it are thoroughly shattered by fractures, which run in all directions. Some of these fractures are accompanied by considerable gouge, and may be faults of importance, but most of them can be traced for only a short distance, and are probably fissures of contraction.

The genesis and the history of the Ajo ore, according to Mr. Joralemon, have been easy to trace. After the monzonite intrusion had uplifted the rhyolite, the slow cooling of the porphyry was accompanied by considerable contraction. This resulted in a thorough jointing and fissuring of the monzonite, especially near the rhyolite contact, and in a less complete fracturing of the rhyolite itself. Near the center of the intrusion some of the fissures continued to a great depth. Probably soon after the solidification of the outer layer of porphyry, hot mineral-bearing solutions rose along these deep fractures; these solutions were charged heavily with iron, sulphur, silica, and, later, copper. The iron and the sulphur were carried through the joints and fissures of the rock far from the source of the mineralization, and caused a general though scanty pyritization of the monzonite mass; this pyritization was heaviest in the eastern part of the intrusion. Later, as the proportion of the silica and copper in the solutions increased, these solutions rose through the larger fractures in the monzonite until they encountered the impervious and less thoroughly fractured beds of overlying rhyolite. These dome-shaped beds acted as a dam, stopping the upward flow of the mineralizing solutions and causing them to spread out through the jointed monzonite on both sides of the large and deep-seated

School at Ajo

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[1] *Trans. A. I. M. E.*, Vol. 49, p. 598.

fractures. Here they remained imprisoned until they gave up their mineral content, depositing veins of quartz, chalcopyrite, and bornite along the fissures and joint-planes, and partly replacing the rock itself with the same minerals. The mineralization was greatest near the large central fractures through which the solutions had risen, and in the more thoroughly jointed portions of the monzonite near rhyolite contacts. In this manner was formed the mushroom-shaped disseminated orebody, grading on the sides and bottom to rock less thoroughly mineralized, or mineralized with iron instead of with copper sulphides.

FRACTURE AND EROSION OF THE DEPOSIT

Some of the larger fractures, usually accompanied by monzonite dikes, extended for a considerable distance up into the rhyolite. Along these fractures, it is maintained, the rich bornite veins in rhyolite were deposited, sometimes extending a long distance from the large disseminated orebody. The porphyry dikes accompanying the veins were more or less mineralized, and small quantities of chalcopyrite, bornite, and pyrite were deposited in the rhyolite walls of the veins. Probably soon after the end of the period of mineralization, before the rhyolite cap of the ore had been eroded, the whole country was covered by a great thickness of andesitic lava and basalt. This covering protected the ore from surficial alteration until the present geologic period. Erosion in early Quaternary times must have been rapid. Deep canyons were cut in the recent lavas; the covering was stripped from the Ajo monzonite, and much of the orebody itself was washed away; the erosion was so rapid that oxidation did not keep pace with it. The copper in the ore that was eroded was left in the rock fragments washed down the hillsides or was carried off by the surficial drainage. The detritus from the eroded part of the orebody filled the canyons and valleys that had been cut in the lava east and south of Ajo. Part of the detritus was cemented into the hard ferruginous conglomerate by surface water that flowed over the pyritic porphyry east of the ore, and had taken into solution some of the iron of the oxidized pyrite. Boulders of oxidized ore remain scattered through the conglomerate and through the valley wash or gravel for several miles from Ajo.

Hospital at Ajo

Mr. Joralemon concludes by stating that, following this period of rapid erosion, stable conditions have lasted to the present time. The water level has remained nearly stationary, at a shallow depth, long enough to allow a thorough oxidation of the rock to this level. Where the mineralization was chiefly with pyrite, much sulphuric acid was formed by the oxidation of the pyrite to limonite. This acid thoroughly softened and kaolinized the feldspars of the monzonite, and helped to take into solution the copper from the traces of chalcopyrite that accompanied the pyrite. The copper was carried down by the descending surface waters, and was redeposited at water level to form the thin layer of chalcocite ore.

In the siliceous chalcopyrite and bornite orebody, it seems that little sulphuric acid was formed during the oxidation; the descending surface water, probably always small in amount in that arid climate, contained an excess of lime and of carbonic acid. The result of this was that, as soon as the copper sulphides were oxidized, the copper was precipitated almost in place, in the form of malachite and other oxide minerals. The iron of the chalcopyrite and bornite remained in place in the form of limonite and hematite. The silicified monzonite was only slightly altered, because of the small quantities of sulphuric acid available, and remained hard and resistant to weathering, forming steep hills. The small amount of sulphuric acid that was formed probably reacted at once with the calcium carbonate in the oxidizing waters, forming calcium sulphate. Thin seams of the resulting gypsum occur here and there in the carbonate ore, and there is much gypsum in the gravel of the valleys. The result of this cycle of changes was a large body of low-grade primary bornite and chalcopyrite ore, oxidized above a rolling nearly horizontal plane at the present water level, to a malachite ore of exactly the same grade as that of the sulphides. The ore was deposited from rising deep-seated solutions.

There is no overburden of lean or barren rock, for the oxidation was accompanied by almost no leaching or transportation of the copper from the primary ore. The ore rises above the surrounding barren ground, and continues without any considerable increase or decrease in copper content from the surface to the body of the orebody.

To be continued

Acetylene as a Precipitant for Cyanide Solutions

Acetylene has recently been investigated as a gold and silver precipitant from cyanide solutions.

The acetylene used in the tests, according to Serial No. 2346, *Reports of Investigations*, Bureau of Mines, was made from a commercial calcium carbide. A number of experiments resulted in more or less complete precipitation of silver, but in none of the experiments was gold precipitated.

As silver acetylide, obtained by precipitating the silver from an ammoniacal solution of silver nitrate by acetylene, is yellowish white, easily soluble in cyanide and highly explosive, and the precipitate obtained from the cyanide solutions was black, not soluble in cyanide and not explosive, it was decided to investigate the nature of the silver precipitate from the cyanide solutions. In preparing a large quantity of the precipitate it was found that after complete precipitation of the silver the solution contained soluble sulphides. This provided a clew, and after appropriate tests the precipitate was proved to be silver sulphide.

Heat Requirements in Chloridizing Volatilization

Fuel Consumption Appears Crucial Point in Commercial Application of Process—Depends Chiefly on Tonnage, Draft, and Radiation

By Rudolf Gahl
Metallurgical Engineer, Denver, Col.

VOLATILIZATION of metals is a subject which has recently received much attention, and an article by Harai R. Layng in the Aug. 27 issue of the *Mining and Scientific Press* proved unusually interesting to me. I have tried to estimate the heat requirements of a volatilization kiln, and I quote the following from my records of a test made in Peru.

A fair volatilization was obtained under the conditions specified below with a small test kiln essentially of the same construction as the one used by the U. S. Bureau of Mines.

Rate of feeding ore per day, dry tons	3.02
Fineness of ore	–14 mesh
Limestone added (—100 mesh), per cent	15
Salt consumption (NaCl, 6 per cent; $CaCl_2$, 1.35 per cent; regeneration, 53.1 per cent), lb. per ton	3.45
Coal used per ton of ore (13,000 B.t.u., pulverized), per cent	14.80
Length of kiln, ft	24
Inside diameter of kiln, in	16
Height of lip at discharge end, in	2
Speed of kiln, r.p.m	3
Inclination of kiln, in. per ft	⅜
Velocity of gases leaving kiln, ft. per sec., reduced to 0 deg. C	2
Temperature of gases leaving kiln, deg. C	340

Most of the salt used was sodium chloride, but a small quantity of calcium chloride was also added, it being assumed that the fume, when melted down with limestone and carbon, regenerates calcium chloride, which would again serve as a volatilization agent.[1] Determinations showed that more than half of the chlorine contained in the volatilization agent is recovered in the fume. This being so, the proportion between calcium and sodium chloride might have been raised. Perhaps there is a slight advantage in using a mixture higher in calcium chloride for the ore in question.

Feeding the salt at the fire end of the kiln seemed preferable to mixing it with the ore. This, I believe, checks the experience of the engineers of the Bureau of Mines, who were feeding the calcium chloride thus when I visited their testing plant.

Finely ground limestone to the amount of 15 per cent of the ore was fed with the ore. The addition of a diluent of some kind seemed to be a necessity in this instance, to raise the sintering temperature.

When conducting some tests on volatilization, with the co-operation of the engineers of the Salt Lake station of the U. S. Bureau of Mines and of the University of Utah, I investigated various addition agents with the view of counteracting the tendency to sinter. Of those easily available, limestone seemed to be the best. I found later that I was not the first to discover this, as the use of limestone for this purpose had been patented in an application antedating my experiments, I believe by G. H. Wigton. Perhaps I should also mention that the Peruvian experiments were made at an altitude of 14,000 ft.

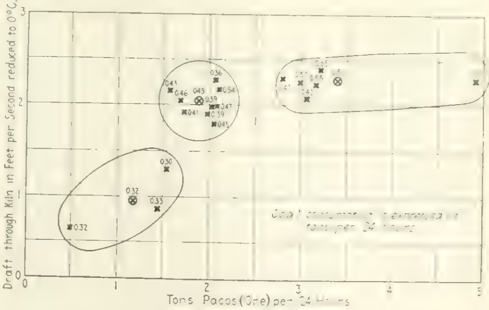
The results emphasized the fact that air is necessary to obtain good volatilization. When the air was reduced to a smaller volume than that mentioned above, the percentage of metal volatilized (silver in this instance) dropped materially. It rose when more air was admitted. The figures as stated seemed to constitute the conditions under which volatilization without excessive coal consumption was best secured.

To obtain as full an insight as possible into coal consumption, which appears the crucial point of the whole process, I have plotted the coal consumed in each test as a function of the tonnage and of the draft. The accompanying cut represents this plot and shows that the coal consumption increases with increasing tonnage and increasing draft. Perhaps the figures are not exact enough to enable one to say with precision how much is due to one factor and how much to the other. However, to shed as much light as possible on the question, an attempt was made to segregate the influence of the different factors mathematically.

Apparently the coal consumption can be represented in first approximation as a linear function of both tonnage and draft and of a constant representing the coal consumed on account of radiation. The coal consumption should therefore be representable by a function of the character:

$$z = a + bx + cy$$

where z signifies the coal consumption, x the tonnage in twenty-four hours, and y the draft in feet per second reduced to 0 deg. C. If three points of the plot are firmly established, the three constants can be calculated from the position of those three points. With the end in view of locating three points as correctly as possible, the plot was divided into three regions as indicated, and each region was averaged. This resulted in the establishment of the three points that are shown in the plot surrounded by circles.



Coal consumed in volatilization tests, function of tonnage and draft

The determination of the three constants a, b and c, according to ordinary algebraical operation, gives the following results:

$$a = 0.1715 \qquad b = 0.0375 \qquad c = 0.0925$$

The equation quoted above therefore becomes:

$$z = 0.1715 + 0.0375\,x + 0.0925\,y$$

From this formula it is possible to calculate the fuel consumption of the experimental furnace for any tonnage and draft, which, of course, has to be done with a certain amount of precaution, as the experimental als from which the formula is derived are not absolutely correct, and as the formula can be expected to agree only with the experimental results within a certain range. Nevertheless, I think it is safe to draw the following conclusions:

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[1] This procedure corresponds to U. S. patent 1,368,885, of Robert H. Bradford.

The coal consumption is caused by three elements, one depending on the tonnage treated, one dependent on the draft, and one independent of both. In other words, if both the tonnage treated and the draft applied were cut down to almost nothing, there would still remain an appreciable coal consumption. This portion of it is apparently due to radiation; it occurs no matter what tonnage of ore is put through the furnace or what draft is used, so long as a certain temperature is maintained.

The amount of radiation indicated by the formula applies, of course, only to the special furnace used in the tests, which had a 4-in. brick lining throughout the whole length and a 2-in. asbestos lining outside for the greater part of the length. It is evident that radiation will be reduced the larger the furnace becomes, because the larger the furnace diameter the smaller the radiating surface in proportion to the cross-section, which is a rough measure of the furnace capacity.

Assuming a furnace so perfect that radiation is almost avoided, the formula derived above would be reduced to:

$$z = 0.0375\,x + 0.0925\,a$$

Then for three tons per twenty-four hours and a gas velocity of 2 ft. per second, reduced to 0 deg. C., the coal consumption would be 0.2975 tons per twenty-four hours, or 9.92 per cent of the tonnage treated.

It may be argued that if this is the coal consumption obtainable with a perfect furnace of those dimensions, it could always be reduced by adding an extra length to it, with the object of utilizing the heat of the gases for preheating the ore. This is undoubtedly true. The same can also be accomplished by providing other means for preheating the ore with the exhaust gases. For instance, the type that is described under the name the Stetefeldt drying furnace in Schnabel's "Handbook of Metallurgy" (Translation by Louis, second edition, p. 815) would seem to be a suitable adjunct to a rotary kiln for this purpose. A similar addition to a volatilization kiln has been suggested by Harai R. Layng (*Eng. and Min. Journ.*, Nov. 12, 1921, p. 769). It would seem to me, however, that although the idea expressed in that article is perfectly sound and in agreement with my own, the form in which it is shown is practicable only in connection with, and perhaps is only meant for, a briquetted feed.

With an entire avoidance of radiation and with perfect utilization of the waste heat of the gases, the coal consumption would be reduced to 3.75 per cent of the feed, assuming the furnace to be fed at the rate of three tons per twenty-four hours, as assumed above.

This, of course, would be an ideal which it might not be possible to approximate under practical conditions; for, if an attempt were made to reduce the coal consumption to such a low point by introducing means for saving the heat contained in the waste gases, it is possible and perhaps probable that the chloride fume would precipitate on the cold ore, which would result in impaired volatilization. It is, therefore, by no means certain that the fuel economy of a volatilization kiln can be carried to the point indicated.

If I understand Mr. Layng's recent article in the *Mining and Scientific Press* correctly, he bases his calculations of the heat requirements of a volatilization kiln on the assumption that 25 per cent excess air is sufficient—which thus broadly stated would seem unsafe to me—and that the gases can be discharged from the kiln at a temperature materially below the condensation point of the fume, so that the latent heat of evaporation of the chlorides can be saved. I am convinced that if condensation of chlorides is permitted in the kiln, the volatilization efficiency will be lowered.

Analogies with other processes hardly prove the point. In the lime-burning operations cited by Mr. Layng, no fume is formed, and, consequently, there is no objection against discharging the gases at a very low temperature. In chloridizing roasting it is a distinct advantage to discharge the gases at a low temperature, as this cuts down volatilization losses; and I wonder if there is not a causal relation between the facts that the Holt-Dern furnace uses a minimum of fuel and (at least according to the claims of its designers) roasts without losses from volatilization.

For these reasons I would not feel convinced by a calculation of such constants as specific heat and latent heat that it is possible to operate a volatilization kiln with good heat economy. I would consider that the Bureau of Mines proceeded correctly in carrying out volatilization in an actual furnace and observing the fuel consumption.

Apparently their experiments, begun I believe by Oliver C. Ralston, have shown that volatilization can be carried out without serious practical difficulty and with a reasonably small percentage of salt. The practical applicability of the process will then largely depend on how far the fuel consumption can be reduced.

In its present form the Bureau of Mines process will hardly compete with other processes except in localities where fuel is unusually cheap. The problem to be investigated next should be to determine to what extent the fuel consumption can be reduced by suitable modifications of the furnace. Possibly Mr. Layng's suggestions to that effect point in the right direction.

Bunker Hill & Sullivan Reports Improved Conditions

The ore blocked out in the Stemwinder, Sullivan, and Bunker Hill mines of the Bunker Hill & Sullivan Mining & Concentrating Co. amounts to 4,227,008 tons. Production during 1921 was high, in consequence of improvement in labor supply; but lowered value of lead resulted in decreased returns. Custom-ore receipts were satisfactory, and are increasing regularly. Operations at the company's smelter and refinery were maintained throughout the year on a satisfactory basis, according to Stanly A. Easton, the general manager.

According to the annual report just issued, the mine at Kellogg produced 426,530 tons of ore, at an average cost of $3.199 per ton, compared with $3.189 in 1920. Exploration work aggregated 3,471 ft., at a cost of $16.81 per foot. The ore was trammed to the mill at a cost of 8.2c. per ton, compared with 9.2c. during 1920. General mill expense was 33c. per ton. The tonnage handled in the plant at Kellogg was 592,346, which included 158,820 tons of Sweeney mill tailing and 11,996 tons of Sierra Nevada ore The concentrate produced amounted to 89,923.20 tons, of the following composition: lead, 41.36 per cent; silver, 13.88 oz. The company shipped 89,746.99 tons of concentrate. Costs and technical data are given in great detail in the highly informative report.

Rotch Hall, containing the Simpkins ore-dressing, assay, and metallurgical laboratories at Harvard University

Mining Instruction at Harvard

Four- and Five-Year Curricula—Close Association of Harvard College and Technical Divisions—Business Administration Subjects and Mining and Metallurgy Brought Together —High Admission Requirements Maintained—Contact With Large University Stimulating

By George J. Young

Western Editor, *Engineering and Mining Journal-Press*

About eleven years ago I visited the mining school at Harvard University, and, in December, 1921, I visited it again. In the decade and more there has been but little change in appearance, in appurtenances, or in other features. Surely, with the many changes taking place in the mining industry during this interval, one would expect to see a commensurate growth in the resources and methods of the school, but such has not apparently been the fact, or at least I was unable to discover it.

Delving into the history of the school, it is of interest to know that undergraduate work in technical subjects was discontinued in 1906, but that it was maintained on a graduate basis until 1914. At that time, aided and abetted by many well-wishers, a flirtation between the Harvard engineering schools and the Massachusetts Institute of Technology resulted in a marriage between the two technical schools. I infer that the marital period was not an altogether happy one. In 1917, the Supreme Judicial Court of Massachusetts decreed that the Harvard McKay fund could not be used in the furtherance of the family life, and a divorce resulted.

The general disturbance of the war period and the shifting of policy from one direction to another, and back again, are without doubt important causes of the present status of the mining school; they furnish an obvious explanation for its failure to maintain a progressive development as noted previously. Before 1914, Harvard undoubtedly had an excellent school, which compared favorably with other mining schools, but at present there is apparent need for an active interest on the part of those in control in modernizing various features of the school.

Harvard established the Harvard Engineering School, of which the mining school is a part, in 1918. This school provided undergraduate and graduate programs. The four-year program leads to a degree of Bachelor of Science, and in the case of mining, an additional year secures the degree of Mining Engineer. Thus it may be inferred that the program on a graduate basis was not a great success. That it was not wholly a failure is shown by the adherence to the idea of a considerable amount of college work in non-technical subjects as a prelude to the technical work. Approximately four-fifths of the four-year engineering program is prescribed and the remainder is available for electives in general subjects to be selected in Harvard College. The student who wishes to spend more time, can give an extra year to general studies before beginning his third year by extending the prescribed studies of the first two years over three years. There is the definite purpose of maintaining close relationship between the student bodies and faculties of the school and college "in order that engineering students may participate fully in the life of the college, and also have the benefit of instruction under teachers whose interests and activities lie outside of technical fields."

Entrance by Examination Required

Several plans, the basic idea of all being the examination method, are available to the student for entrance into the first year of the engineering programs. The new plan requires that the candidate for admission present evidence of an approved school course satisfactorily completed, and that he must take examinations in English, French, or German, or Spanish, or Latin (two-years), or Greek, mathematics, or physics, or chemistry, and a fourth subject, which may be language, history, mathematics, physics, or chemistry. An attempt to get at the real qualifications of the candidate is made. It is of interest to note that neither Greek nor Latin is definitely required for entrance. In substance, entrance is predicated on attainment of a good high-school course.

In addition to the four-year undergraduate courses in mining and metallurgy, two five-year programs are offered, one in mining and business administration, and one in metallurgy and business administration. Business administration is superimposed on the mining course and begins with the principles of accountancy in the third year. In the fourth year factory management and shop accounting, marketing, and industrial finance, and in the fifth year, business policy, labor problems, and business economics, are given.

The same courses are given in the parallel five-year course in metallurgy and business administration. This grafting of managerial, financial, labor, and economic subjects on the technical course is of considerable interest to mining educators. The attempt to graft cultural subjects upon the technical course is relegated to the background and depends upon the student's volition. These two grafts (I am using the term in its horticultural significance), represent two modern trends, both of which have been furthered by engineers. As there has not been sufficient time for either to take properly, the outcome of this experiment is yet to be seen. I feel sure, however, that the business administration must ultimately be given from the viewpoint of the mining industry and by men thoroughly familiar with the conditions surrounding that industry. It must logically be based upon a thorough course of fundamental economics presented from the industrial viewpoint rather than from the academic. Further, the program logically should be considered for the entire time and the subjects of industrial administration and business practice woven into it consistently rather than appearing as a top graft of dubious virility.

Subjects Covered in Mining Curriculum

The four-year mining course cannot be definitely analyzed, as the courses are inadequately described and time quantities are omitted from the catalog. The subjects given are as follows:

Mathematics—Includes trigonometry, analytic geometry, and calculus.
Chemistry—Inorganic chemistry, theoretical and physical chemistry, qualitative, quantitatve, metallurgical chemistry, and assaying.
Physics—One year.
English—One year or elective if anticipated.
Drawing—Mechanical, freehand, descriptive geometry.
Surveying—Topographical and railroad (eight weeks in summer).
Mining camp—Six weeks or equivalent.
Engineering principles—
  Mechanics, including statics, kinematics, kinetics.
  Resistance of materials.
  Hydraulics and laboratory.
Mechanical and electrical—
  Heat engineering, including laboratory.
  Electrical engineering, including laboratory.
Accounting.
Geology and Mineralogy—
  Mineralogy, general geology, economic geology, geological mapping.
Metallurgy—Principles of metallurgy, metallurgy of iron and steel, leaching processes, non-ferrous metals, ore dressing.
Mining—Prospecting and exploring, metal mining, mining equipment, coal mining.
Fifth year work—Mine surveying, mining projects and design, petrography, economics of mining, mine examinations and reports, problems in the treatment of ores or problems in ore deposits.

The undergraduate course has essentially sound preparation in fundamentals, but has no novel trends, nor are such to be noted in the graduate year. Taking the five years as a whole, there are lacking principles of economics, and sociology and psychology in their relation to industry. The groundwork of engineering principles is given, but further development appears to be relegated to the fifth year and appears in the form of a "project" course, in which the student exploits in an engineering way, on paper, either a real or imaginary mining project. This follows a practice not uncommon in mining schools. Here, as well as at other institutions, the attempt is made to co-ordinate ground-work courses and apply them to a definite problem. Where this is done in a perfunctory way, there is much to be desired, but under painstaking supervision a good deal of benefit accrues to the student. It is an open question whether the same end could not be served better by a systematic set of mining-engineering problems which would tie in all of the various ground-work courses in such a way as to call for concrete application of principles and information, given not only in courses but also available in reference books and periodicals.

Mining and Business Administration

The five-year program in mining and business administration appears to be a concession that something further is needed, in addition to the technical and preparatory courses, to fit a graduate for positions requiring managerial capacity. In the limited time at my disposal I was unable to delve into the substance of the business-administration courses tied on to the technical work, but as I remarked in the beginning, they appear more as appendices than an integral part of the course. Even as such, however, they have value, and the experience of Harvard with them will be of interest to both engineers and others interested in mining education.

The courses devoted to mining and base- and precious-metal metallurgy do not appeal for their novelty in presentation or wealth of accessory facilities. Rather do they appear to need considerable reorganization and modernizing. Apparently, the lecture system prevails, and with it go its inseparable limitations. However, a hard-working student can get, by supplementary work of his own, a fair position in these subjects.

Rotch Laboratory, which includes the ore-dressing, assaying, and chemical laboratories, and the mining class-rooms and library, was planned and equipped a number of years ago, and relatively few changes have taken place since. The ore-dressing equipment is the result of an attempt to put a mill into a laboratory, and the arrangement does not appeal to me as being either particularly useful or convenient. A great deal could be done in improving and modernizing both the small and large equipment.

Foxcroft House has been turned over to the department of economic geology and has been improved and made suitable for the purpose. This particular unit is well organized and is in keeping with the mineralogical work. Mineralogy, geology, and economic geology have apparently held to a good pace and compare favorably with equivalent work in other institutions.

Only a few of the other laboratories were visited, and the time available permitted only a superficial view. The electrical and mechanical laboratories are interesting. The metallographical laboratory maintains its high standard.

HARVARD CONSPICUOUS IN ACHIEVEMENT OF ITS GRADUATES

Harvard University has been conspicuous, in common with other great American universities, in the achievement of its graduates. It is interesting to inquire into what ideals have been developed that may contribute their share toward producing men of leadership and power. I discussed this subject with Professor H. T. Hughes, dean of the Harvard Engineering School, and the result is given in the following:

The admission requirements of Harvard are the highest. Students are encouraged to participate in the advantages of Harvard College and the life of the institution as a whole. There is close contact of students and faculty as well as intercontact of faculty members. Some of the faculty members are conspicuous leaders in their subjects. The general policy of the engineering school is away from facts and specialization and toward fundamental scientific training. Teaching a man to think and developing ability to solve new problems are the objectives of the instruction. Student activities are subordinated and kept in proper balance.

The foregoing are excellent ideals and in substance prevail to a greater or less extent in all well-organized universities and technical schools. Harvard and other schools may well inspect their curricula and methods of instruction in the light of modern trends and the complex life about us, and determine to what degree general ideals and modern demands upon graduates are being co-ordinated, and the inherent responsibilities of educators fulfilled.

There are not many students in the mining department at Harvard. As far as my information goes, there has been never more than a relatively small number. Whether there will be larger numbers when the engineering school recovers fully from the separation from the Massachusetts Institute of Technology remains to be seen. With greater numbers there will undoubtedly be a larger development of the essentially technical part of the course. The course as a whole, as it now stands, has a certain value to mining students in that it offers good teachers and excellent fundamental work, as well as contact with a great university, in a considerable proportion of the present curriculum. This equips the graduate to develop his own position and strengthen his technical knowledge during the time in which he is getting a foothold in the industry. The course thus affords important advantages to the individual, and the outcome may be quite as satisfactory as would be the case with a more intensive cultivation of technical knowledge in the university.

Mineral Production of Ecuador

The mining industry of Ecuador is limited to the production of gold, petroleum, and salt. The total value of the mineral production is not known, as no official records have been kept, but the production remains approximately the same each year, according to F. W. Goding, of Guayaquil, writing in *Commerce Reports.*

Gold is produced at one mine—the South American Development Co., at Portovelo, in the southern part of Ecuador, near Zaruma. The control of this industry is based on a contract between the Ecuadorian government and the company in charge. The production in 1921 was 22,224 lb. of metallurgic precipitates, valued at $774,975, and 1,313 troy ounces of mill bullion, worth $4,561. The production is disposed of to the United States, the total output being exported. No stocks are kept on hand. A considerable sum has been expended during the last few years to place this industry in a first-class condition, and new veins have been located which are said to be richer than those previously discovered. These mines are rather difficult to reach, all freight and passengers being carried on the backs of mules over the tops of the mountains.

The salt industry of Ecuador is a government monopoly. The deposits are found in the region of Payana, Punta Arenas, Salinas, Charapoto, Crucita, Latucunga, Guaranda, and the Galapagos islands.

Deposits of guayaquillite are found in the Canton of Daule, near the Daule River, and occur over a considerable tract of land. The substance is utilized in the manufacture of explosives. No developments have ever taken place in this district, but apparently the mineral exists here in commercial quantities. It belongs to the fossil resins and has the aspect of an impure wax. Judging from the manner in which the nodules of guayaquillite present themselves disseminated in the alluvial soil along the Daule River, it is not probable that large deposits exist.

Ray Consolidated Mining and Milling Cost Approximately Equal

The thirteenth annual report of the Ray Consolidated Copper Co. for 1921 covers greatly curtailed operations, for the plant was shut down for the last nine months of the year. A total of 351,823 tons was hoisted through No. 2 shaft, an average of 3,627 tons per day. The ore shipped to the mill at Hayden amounted to 349,496 tons, averaging 1.65 per cent copper, and 2,327 tons, averaging 3.10 per cent copper, was sent direct to the smelter for fluxing purposes. Of the total ore, 8 per cent came from development, 2 per cent from active stoping, and 90 per cent from reserve drawing. The mining cost for the year was $1.31 per ton, exclusive of depreciation. Coarse crushing and loading accounted for 4c. of this.

Following shows five years' milling performance:

Year	Tonnage	Feed, Per Cent Copper	Recovery, Per Cent	Pounds of Copper Recovered Per Ton of Ore
1921	406,172	1.646	77.82	25.62
1920	1,706,928	1.720	81.98	28.20
1919	1,621,600	1.814	79.47	28.83
1918	3,411,000	1.613	74.92	24.17
1917	3,560,900	1.635	74.53	24.37

The recovery of copper in the form of sulphide was 89.42 per cent, whereas only 29.66 per cent of the oxide copper was recovered. The cost of milling, exclusive of depreciation, was $1.22 per ton.

Mining Regulations in Mongolia

THE following provisional regulations governing mining enterprises in Mongolia have been sent us by W. F. Collins, now at Peking, China:

1. All exploitation of mines in Mongolia shall be conducted under the following regulations, which are additional to the existing Regulations for Mining Enterprise and administrative orders relating thereto.

2. Mongols desiring to exploit mines in Mongolia coming under Classification 1 of the Regulations for Mining Enterprise shall submit applications in accordance with the requirements of Article 9 of the said regulations as now existing.

3. With reference to minerals coming under Classification 2 of the Regulations for Mining Enterprise: If the land has not been leased by the Mongol owner thereof, he being holder of the surface rights, the situation will be governed in accordance with the provisions of Article 10 of the Regulations for Mining Enterprise and Articles 13 to 15 of the detailed regulations. However, if he shall have leased the land, these prior rights shall belong to the lessee, who will enjoy the same.

4. When additional land is needed by the holders of the mining rights, for any of the purposes set forth in Article 57 of the Regulations for Mining Enterprise, the Mongol owner thereof may not arbitrarily withhold the same in order to obtain an exorbitant compensation. Moreover, holders of mining right are not allowed to engage in other enterprises within the limits of the said land thus acquired, nor within the area of the original mining concession.

5. In accordance with the provisions of Articles 59 to 64 (inclusive), of the Regulations for Mining Enterprise, the (Mongol) owner or other persons concerned, is entitled to compensation (for land taken) under the provisions of the last article (No. 4), but should the Mongol owner have already leased his property to others, then the lessee is entitled to the said compensation.

6. Holders of mining rights shall not prevent the Mongols from having access to the lands of the mining area not yet in actual use, nor to those for which they have received compensation (as provided for heretofore in Article 4), for the purposes of dwelling, pasturing cattle, cultivating, or engaging in other ways the obtaining of a livelihood.

7. In addition to the mining taxes imposed in accordance with the provisions of Article 79 of the Regulations for Mining Enterprise, supplemental taxes shall be paid to the Mongolian authorities as follows:

(a) For concessions on which the mineral being mined comes under Classification 1 of Article 6 of the Regulations for Mining Enterprise, the annual tax shall be ten cents (yuan) per mow (one-sixth acre).

For alluvial sands containing platinum, gold, tin or iron the annual tax shall be ten cents (yuan) per ten chang (117½ ft.) in length of river bed.

For minerals being mined which come under Classification 2 of Article 6, the annual tax shall be five cents (yuan) per mow.

(b) For mining concessions which have not yet been prospected, the annual tax shall be calculated at the uniform rate of two cents (yuan) per mow.

8. In addition to the taxes imposed upon the basis of mineral output or production, in accordance with the provisions of Article 81 of the Regulations for Mining Enterprise, supplementary taxes shall be paid to the Mongolian authorities as follows:

(a) For minerals which come under Classification 1 of Article 6 of the Regulations for Mining Enterprise, a tax of .005 the market price at the place of production.

(b) For minerals which come under Classification 2 of Article 6 of the Regulations for Mining Enterprise, a tax of .0035 the market price at the place of production.

(c) In the future, should the rate of tax to be paid under the existing Regulations for Mining Enterprise be revised, the supplementary area and production taxes imposed under the provisions of Articles 7 and 8 of these regulations shall be paid at the rate of one-third of those imposed by the amended regulations.

After the mining concessionaire has paid the taxes called for by Article 7 and 8 of these regulations, the Mongolian authorities shall not under any pretext extort or levy further commissions, duties, or taxes of any kind.

9. In view of the fact that the additional area and production taxes, as provided for by Articles 7 and 8 of these regulations, have been imposed, should the concessionaire have any difficulties with either Mongol officials or Mongol people, and the latter take advantage of the situation to stir up trouble and hamper the mining operations, it shall be the duty of the responsible authorities to deal with the matter according to law, and in addition, the Mongol head-men will be severally held responsible and required to guarantee the necessary protection and to take immediate measures to do away with the malpractices.

10. It is not permitted to pledge the land surface of mining concessions as security for loans, nor may the land rights be transferred to others.

11. All cases in connection with the exploitation of mines in Mongolia are to be dealt with by the Board of Agriculture and Commerce as well as by the Mining Supervision Office, according to law. The concessionaire, having received his permit (from the Board of Agriculture and Commerce), and the same having been duly registered, he will then apply to the Bureau of Mongolian and Thibetan Affairs for a mining license in the Mongolian language, and the said bureau will issue the necessary instructions to the Mongolian authorities, in order that no misunderstanding may arise.

12. The concessionaire, at the time of taking out the above-mentioned license, in the Mongolian language, must pay to the Bureau of Mongolian and Thibetan Affairs for the same, a fee of 20 per cent of the amount of the registration fee paid to the Board of Agriculture and Commerce.

13. All mines for which permits have already been granted prior to the official promulgation of these regulations shall be subject to and governed by the old procedure.

14. These regulations will take effect from the date upon which they are duly authorized and officially promulgated.

Marketing of Talc*

The Mineral in Ground Form Is Used in a Number of Important Manufactures—No Generally Accepted Specifications Have Been Established—Trade Customs as to Shipment and Settlement—Market Usually Steady

BY RAYMOND B. LADOO
Mineral Technologist, U. S. Bureau of Mines

TALC[1] is marketed principally in powdered form; it is used in a great variety of industries.[2] The most important uses in approximate order are: in paper, chiefly as a filler; in ready roofing, as a filler and as surfacing material; in paints, as an inert extender; in rubber, as a dusting agent and filler; in textiles, chiefly as a filler; in soap, as a filler; in toilet preparations; in wire-insulating compounds; as a ceramic material; and in dressing leather. Massive talc is sawn into crayons and pencils for metal workers, black-board use, and for tailors (tailor's chalk). When turned or carved into various forms and baked to a hard dense substance it is known as "lava," and is used for gas-burner tips and electrical insulation.

The industries which use talc as a raw material are suggested in the preceding paragraph. Practically all the ground talc sold is ground by the producers of crude talc, and little is sold for later grinding by jobbers.

LARGEST MARKETS IN NORTHEASTERN STATES

The largest markets for talc are the great industrial districts east of the Mississippi and north of Virginia and Kentucky. No system of centralized marketing points or "basing points" exists in the talc industry, and practically all talc is sold f.o.b. cars at mill. For Vermont talc the principal points are Johnson, Waterbury, East Granville, Rochester, and Chester, Vermont; for New York talc the principal points are Gouverneur and Natural Bridge; for California, Los Angeles and Keeler. Some large talc companies are not much interested in job-lot business, but prefer to sell in car lots to jobbers and let them handle the smaller orders. Thus the marketing points for small lots may be New York, Chicago, Philadelphia or other cities where jobbers maintain warehouses.

EXPORTS NEGLIGIBLE

The annual consumption of talc in the United State for the last ten years is shown in the accompanying chart. As exports are negligible, total domestic consumption has been assumed as domestic production plus imports. Seasonal fluctuation in demand seems to be small, though possibly a stronger demand is usually shown in spring and summer, particularly for the grades of talc which enter into building supplies such as paint and ready roofing.

SPECIFICATIONS NOT GENERALLY STANDARDIZED

No generally accepted standard specifications and tests for talc now exist, although some individual consumers have their own standards. Most talc is purchased either on the basis of a comparison with material previously used and found satisfactory, or upon the basis of actual plant tests. In general, chemical analyses are of little value and are not often made, for the value of a talc usually depends upon physical properties such as color, fine grain-size, "slip," and "retention." However, some consumers, for example some manufacturers of paper and of toilet powders, demand a low lime content. To other consumers in the same industries lime does not seem objectionable. A high content of iron oxide is often detrimental, as it usually indicates poor color. In some industries a high silica content is objectionable, for it indicates free silica or grit.

Apparently, specific gravity of the ground talc may be important for some industries—paint, for example. New York fibrous talc may vary from thirty-one up to forty-six pounds per cubic foot.

A high-grade talc, in general, should be of a pure white color, low in lime and iron, free from grit and specks or impurities, and finely ground (200 mesh or finer). A good "slip" (greasy feel) may or may not be desired. This grade of talc is used mainly by the toilet-powder trade.

Industrial talc usually is not as pure white in color, excepting New York fibrous talc and some Canadian talcs, as that used for the other purpose noted. It often contains lime and sometimes free silica; often it is not as finely ground.

VARIOUS TYPES NAMED FOR THE DISTRICT

Talcs from various districts vary greatly in appearance and physical properties and are known to the trade by the name of the district from which they come. The principal types sold in the United States are Vermont talc (foliated, granular, and "grit"[3] talc); New York fibrous talc, also known as asbestine, (from the Gouverneur district, St. Lawrence County); New York granular talc (from the Natural Bridge district); North Carolina pyrophyllite (from Glendon and Hemp, N. C.); North Carolina white talc; California toilet-grade talc; Canadian talc (toilet and industrial grades); and Italian and French talcs (toilet grades).

The fineness of grinding varies widely and depends upon the use for which the talc is intended and upon the consumer's ideas of his needs. In general, industrial grades of talc are standardized according to the proportion through a 200-mesh sieve, various specifications requiring from 95 to 99.8 per cent through the screen. Roofing-grade talc, if used as a dusting agent, may have a maximum grain size varying from 100 to 140 mesh or even finer. For prepared roofing granules various grades, such as through 20 mesh on 40 mesh, through 40 on 60, through 40 on 100, through 30 on 80, and so on, are made.

Talc pencils and steel workers' crayons are sawn from massive talc. The 5-in. length has been the stand-

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[1] With talc is also included pyrophyllite, which closely resembles talc in nearly all its properties and is mined, ground, and sold as talc.

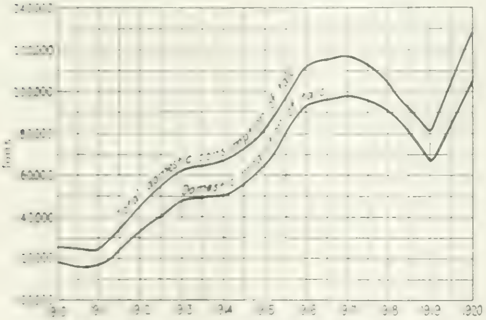
[2] An extensive list of uses is given by Ladoo, R. B., "The Uses of Talc and Soapstone," *Chemical & Metallurgical Engineering*, Aug. 11, 1920, pp. 235-236.

[3] "Grit" talc is a local name for an intermixture of talc and dolomite.

and, but lengths of 3½ and 4 in. have been made, and the 3½-in. length has become standard, due to its greater sturdiness. Some of the most common sizes made are, in inches, [illegible]. These are packed in wooden boxes containing one-half to one gross each. Fairly hard, tough crayons are preferred, as they are stronger and do not wear readily.

MATERIAL SHOULD BE KEPT DRY

As the costs of fine grinding by dry methods increase greatly for damp materials, an effort is made to keep the talc as dry as possible. Thus the moisture in the finished product is usually low. The price of the finished talc is influenced little if at all by small variations in quality. If the talc is satisfactory it is accepted at the contract price; if it is unsatisfactory it is rejected and will not be taken at any price. Large consumers of talc usually buy on a yearly contract basis, and all shipments are in carload lots. Small purchases from jobbers may be in any quantity, from a few pounds up to a minimum carload, but usually are in multiples of 50-, 100-, or 200-lb. bags.



Curves showing production and consumption of talc in the United States

As noted, talc is either accepted by consumers as satisfactory or entirely rejected. Therefore no system of premiums or penalties prevails. There is no standard system of sampling talc by consumers; in fact, some consumers rarely test their talc, except in purchasing from a new source, unless something goes wrong in their plant which might be attributable to the talc. In any circumstances samples are usually taken at random.

SUNDRY SPECIFIC TESTS MAY BE MADE

There are no fixed standards of grade, quality, or type of talc and no uniform, standard methods of testing used either by producers or consumers. The only tests approaching a standard are screen tests, but no standard screen scale has been adopted and some screen tests are made dry and others are made wet. Thus even guaranteed screen tests have little meaning.

Grit is determined qualitatively by "gritting" between the teeth, by drawing a spatula over a small quantity of talc on a piece of crisp paper, by rubbing between the thumb or finger nails, or by noting the residue after elutriating with water. *Shape and nature of grains* is determined microscopically. *Suspension* tests are sometimes made by shaking up a definite quantity of talc in a definite quantity of water (or oil) and noting the time of settling, or the amount of settling in a given time. *Retention* tests for the paper industry must be made by actually making samples of paper with definite quantities of talc. It should be noted that suspension and other tests used by paper-mill chemists to determine the value of clay as a paper filler are wholly inadequate and misleading when applied to talc. Talcs which show poor suspension often have an unusually high retention value. *Color* tests are made by comparison with an acceptable "standard," either in a dry condition on the hand or on white or blue paper, or, wetted with oil or turpentine, on paper or glass. Other tests may be used by individual companies to suit their own needs.

Few tolerances in weighing or analyses are recognized in the trade, except that the weights of bag and sack containers are usually included in net weights. Some consumers have their own tolerances for screen analyses, but these are variable.

TRANSPORTATION, STORAGE, AND SHIPMENT

Talc is packed in 50-lb. paper, 100-lb. cloth (often double thickness) and 100- and 200-lb. burlap bags. The 50-lb. paper sacks and 200-lb. burlap bags are probably the most common containers. For the paper trade, paper sacks are often preferred, so that the whole package, without emptying, may be thrown into the pulp beater. Some of the lower grades of talc, roofing grade for example, are also sometimes shipped in bulk in tight box cars.

Storage at the grinding mill is usually in bags stacked high in dry storage sheds, though a few producers store in bulk and bag only on order just before shipment. This reduces the loss by breakage of paper sacks and decreases handling charges. The principal objection to bulk storage is that some talcs have a tendency to pack in bins, and removal may be difficult.

Shipment is made in tight box cars, which are thoroughly swept or even washed, and are often lined with building paper to prevent contamination. Cargo is packed and braced, and doors are boarded so that serious movement in transit is impossible. The minimum carload varies from 36,000 lb. to 60,000 lb., depending upon railroad and length of haul; maximum carload is the carrying capacity of the car, often thirty tons. It is not customary to insure talc shipments.

SETTLEMENT BASED ON BAG COUNT AND RAILROAD WEIGHT

The value of a talc shipment is based upon a fixed price per net ton. Weights apparently are settled on the basis of bag count checked by railroad weights. In some instances prices include bags; in others an extra charge is made at the rate of $1 per ton for paper sacks or $3 per ton for returnable burlap bags. Terms of settlement vary from net cash, thirty to sixty days, to 1 to 2 per cent discount for payment in ten to thirty days.

To market successfully, a producer should be thoroughly familiar with the varied needs of his different types of customers. He should be sufficiently acquainted with the methods of manufacture used by his customers, so that he may recommend the most suitable grade of talc and demonstrate its value. This is important, for there are so many varieties, types, and degrees of fineness of talc that one grade may be wholly unsuited for a given purpose, though another may give excellent results.

There are no important trade groups which control marketing conditions and prices. The bulk of the production is sold by producer direct to consumer in carload lots. The broker or jobber usually sells in small lots. However, the middleman, even in such small sales, has an important influence on the talc industry, an influence not often recognized. Possible customers for talc in new lines of industry often buy small trial lots of talc from jobbers who usually have no technical knowledge or interest in the product. If the single sample tried is not suitable, talc in general may be condemned and a wall of prejudice built up which is difficult to break down. This has retarded the development of new uses in several instances.

RANGE OF PRICES IS WIDE

The price of talc varies greatly, depending upon its quality, degree of fineness, and intended use. As this is written (March, 1922,) the following ranges of price prevail per short ton, f.o.b. cars grinding mill:

Vermont, 20-50 mesh (roofing grade), bulk (bags extra)	$7.50-$8.00
Vermont, 150-200 mesh, bulk (bags extra)	8.00-16.00
New York, fibrous talc, 150-300 mesh in bags	11.75-18.00
New York, granular talc, 150-200 mesh, in bags	12.00-13.00
California, toilet powder grade, in bags	16.00-20.00
Talc crayons, produced mainly at Chatsworth, Ga. Glendon and Hemp, N. C., Waterbury, Vt., per gross	1.00- 2.00

The only conditions which influence price are those of grade and degree of fineness, except for competitive conditions with other talc producers and with producers of competitive materials. Thus, as a paper filler, talc must compete both on a quality and on a price basis not only with other talcs but also with English China clay and with white filler clays from the South. In fact, the chief competitor of Vermont talc is not New York talc but clay, particularly English clay.

The marketing unit for ground talc is the short ton, and for talc crayons, the gross. The average weight of the most common size of talc crayons, that is ½ x $\frac{3}{16}$ x 5 in., is about 7½ lb. per gross. Fluctuations in prices are small and changes are slow, perhaps due to the sale of large quantities on a yearly contract basis.

As noted before, prices of talc of a definite grade from a definite mine do not change with small changes in quality. Prices of 150- to 200-mesh talc of industrial grade at present range from $9 to $18 per ton. Toilet-grade talc from California sells in Eastern markets at $35 to $40 per ton in competition with imported high-grade French talc at $40 to $45 per ton f.o.b. New York City, and with Italian talc at $44 to $55. These prices represent the range due to differences in quality for ground talc of approximately the same fineness. Prices bear no close relation to quantities sold nor to the time of year, except, of course, that less-than-carload lots bring a higher price, and some price concessions may be made to large consumers.

The following prices, from the U. S. Geological Survey, represent the average selling price of all grades of ground talc per short ton for the years 1913 to 1920.

Year	1913	1914	1915	1916	1917	1918	1919	1920
Price ..	$8.42	$8.54	$8.37	$8.57	$9.11	$10.55	$10.55	$12.00

The prices for the various grades for many years have borne about the same relation to one another as that indicated previously.

IMPORTS ARE AN IMPORTANT FACTOR

Imports of talc in the past have had little effect on domestic prices or production. In recent years, however, since toilet-grade talc has been developed in California, imports of high-grade Italian and French talc have offered serious competition to the domestic product. Talc mining in California is expensive, and freight rates to the principal markets in the East are so high that successful competition, without an adequate protective tariff, with the low priced but high-grade European talcs, is difficult.

Talc from the Madoc, Ontario, district, in Canada, is of from medium to high grade, and sells for a price intermediate between that of domestic industrial grade and that of imported toilet grade. This talc competes in part for the toilet trade, and in part for the higher-class industrial trade. Competition from this source has been felt, so far, by but few domestic companies; but with a low tariff and increased Canadian production the competition in some lines may be important. The record imports of all talc (in 1920) amounted to about 10 per cent of domestic consumption by tonnage and about 19 per cent by value.

The competition afforded by imported English China clay, especially in the paper trade, is severe and helps to keep down the price of paper-grade talc to a point where there is little profit for some producers.

DOMESTIC AND FOREIGN TALCS COMPARED

As previously noted, imported talcs differ considerably from most domestic talcs in type and quality, and are largely non-competing except for the toilet-powder grades. The toilet-powder trade has a strong prejudice in favor of European talcs, particularly Italian, which is noted for its absolutely white color, good "slip," fine grain size, and freedom from grit and other impurities. The best grades of California talc seem to equal the Italian talcs in every way. Some consumers recognize this equality, though others insist that there are no domestic talcs equal to the Italian. As the value of the talc itself is such a small part of the sale price of a package of talcum powder, manufacturers of toilet goods can afford to purchase Italian talc, even if its superiority over the best California talc is not established.

"Nickel Cans" Instead of "Tin Cans"?

Experiments with a view to making nickel-coated steel sheets as a substitute for tin plate have been in progress for about twelve months in England, according to *The Ironmonger*. It is stated that among those interested in the process is Henry Mond. Despite the optimistic reports which have appeared in the daily press, the experiment so far does not seem to have been commercially successful, although some samples have been produced. The aim of the process is to produce a steel sheet coated with nickel, just as sheets coated with tin are now manufactured. Practical tin-plate makers are skeptical as to the possibilities of obtaining a sufficiently ductile product, and this want of ductility appears to be one of the principal difficulties to be overcome.

Some years ago one of the important Welsh steel and tin-plate concerns laid down a plant for the production of aluminum-coated steel sheets, which, it was suggested, would supplant tin plate in the manufacture of food containers and domestic ware. The product, however, did not prove popular, and although efforts were made to interest the biscuit manufacturers and other large users of the material, the process was not a commercial success, and in the end the plant was scrapped. Any substitute for tin plate will have to overcome a considerable amount of prejudice, because, despite its limitations, tin plate is regarded by food packers and others as the most satisfactory material obtainable for their purpose.

USEFUL OPERATING IDEAS

Hanging Scaffold for Taking Down Loose Back in High Ground

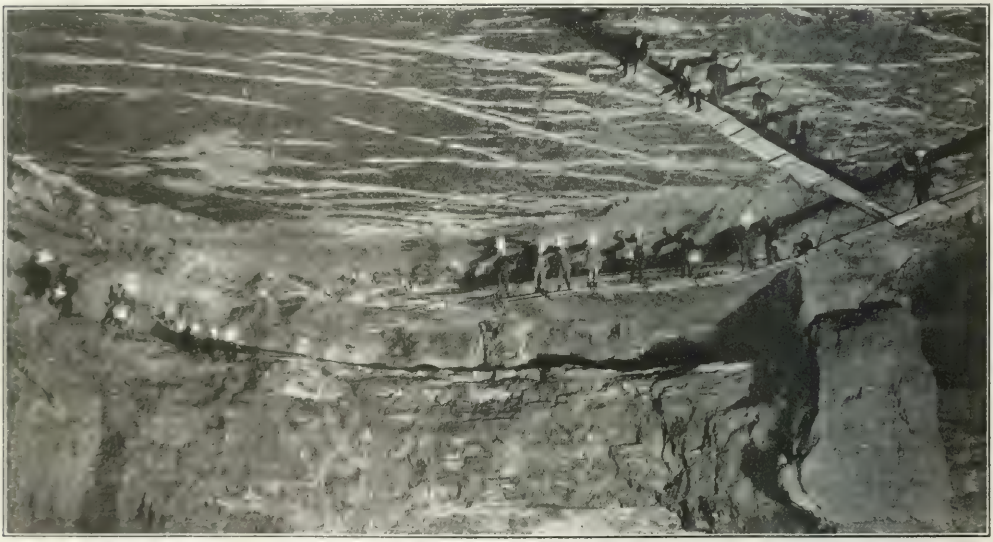
Ingenious Method Employed to Reach Otherwise Inaccessible Points in Lofty Untimbered Stopes

By Irwin H. Cornell

AT THE Bonne Terre division of the St. Joseph Lead Co. properties open stopes of great height are not uncommon. There are a number of these stopes ranging from 50 ft. to 160 ft. high, so the ordinary practice of the district of building towers to the back to take down any loose rock is not practicable. E. W. Campbell, mine captain, has devised an ingenious method of hanging scaffold to the back by means of hooks and eye-bolts which is simple in construction and unusually flexible in its application.

The accompanying picture shows the upper part of a stope 157 ft. high in which the back became loose. It was necessary not only to take down the loose rock but to provide a permanent means of testing this ground for protection of the mechanical-shovel crew working on the ground immediately under this area. A 3-ft. roadway around the breast of this stope, 7 ft. from the back, did not furnish means of reaching the loose ground in the center which had to be taken down.

With the machine set up on this roadway, two 3-ft. holes were drilled at an angle of approximately 45 deg. with the horizontal plane of the back in the portion shown in the side and end views of the accompanying sketch. Into these holes, eye-bolts (E) with wedges (F) were driven until secure. From these eye-bolts, side rods (B) were hung, which, when hanging vertically, were within easy reach of the miner standing on the roadway. After cross rods (C) connecting the side rods were placed, oak boards (A) were fastened to the cross rods by means of U-bolts (D) and the entire section was pushed forward until side rods were in the position shown in the side view of the sketch. The oak boards were then pinned securely to the roadway and the first section was completed. The next set of eye-bolt holes was drilled from the end of the completed section and the second section extended in the same way.

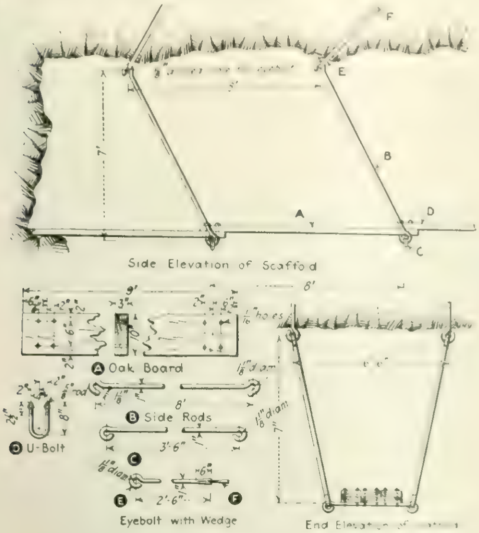


Upper portion of stope 157 ft. high in mine of St. Joseph Lead Co., Bonne Terre, Mo., showing scaffold in use.

The scaffold proved to be steady enough to permit setting up a column at the end of each section, and in this way flat holes were drilled to take down the loose ground ahead. By changing the position of the eye-bolt holes and the holes in the boards, fourteen sections of the scaffold were extended in an arc of a circle to permit trimming the brow tied between pillars. By additional tie rods, the scaffold was braced to prevent swinging sideways, and seven sections were extended at right angles to the others as shown.

Three men, accustomed to this work, can easily put up three or four sections in one eight-hour shift, and the same crew can take down from six to eight sections with no loss of material except the eye-bolts fastened in the back.

Details and dimensions of the scaffold described are given in the following drawing.



Details of hanging scaffold

A Handy Gear Reduction

By Charles Labbe

When a slow revolving motion is needed, it is at times difficult to find anything suitable. A handy gear reduction can be made out of a tool grinder. A pulley disk of any size can be clamped in place of the emery wheel, and another disk, a pulley, or agitator arms can be attached to the shaft in place of the crank. By using different sizes of pulleys or disks made of wood or metal, nearly any speed ratio can be obtained. The gear reduction is usually 30 to 1.

Wanted—Useful Operating Ideas

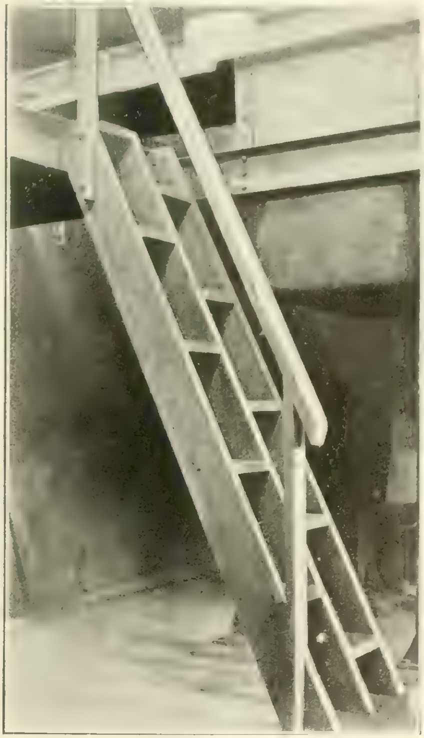
WHAT ingenious devices or methods are you using in your plant? Something out of the ordinary is to be seen in many mines and mills. Standard practice does not always give the solution to difficulties that arise in operation. Then again, necessity may be the mother of invention. Often these products of ingenuity are little known outside a limited area. These pages are intended to serve as an exchange of such ideas. Articles and sketches describing them will be welcomed.

—Editor.

Making a Steep Flight of Steps Safe

By Henry M. Payne

A unique method of making a steep flight of steps safe and easy to ascend or descend when both hands are occupied is shown in the accompanying photograph. The steps in each set have a 9-in. tread and 18-in. risers, so that, as staggered, the effect is that of a 9-in. tread and 9-in. risers, or the equivalent of 45 deg. The construction is so simple and the results are so practical that it seems strange that the idea has not been worked out before (or has it?). The photograph was taken at the smelter of the Bunker Hill & Sullivan Mining & Concentrating Co., at Kellogg, Idaho, in the Coeur d'Alene district.



Steep flight of steps of novel construction

Filing Tracings

By Roy H. Poston

New tracings filed in flat drawers and cabinets usually curl up, especially if the drawing is on the smooth side, which is usually rolled on the inside of the roll by the manufacturer. To obviate this, each new tracing should be filed on the bottom of the pile. It should project sufficiently toward the front of the drawer and beyond the drawings above to permit the file number written on its margin to be seen. If kept in this manner, tracings and drawings will be found readily when they are wanted.

THE PETROLEUM INDUSTRY

Favorable Structures in Iniskin Bay Area of Alaska*

The Iniskin Bay oil field, which is on the small peninsula between Iniskin and Chinitna bays, on the west side of Cook Inlet, in Alaska, has been known as a possible source of petroleum ever since petroleum seeps were discovered there by the Russians in 1853. From 1902 to 1906 Oil Bay, which is on the south side of the peninsula, and Dry Bay, which is about five miles northeast of Oil Bay, were scenes of active drilling, but the work done did not show conclusively the value of the field. No drilling was done after 1906, although much of the ground abandoned then has been restaked since the oil-land leasing law was passed, in 1920. In 1921, detailed topographic and geologic surveys of the district were made by F. H. Moffit, of the U. S. Geological Survey.

The peninsula has a total area of about 150 square miles, but at least twenty square miles of it is occupied by igneous rocks, which cannot possibly contain petroleum, so that the surveys made in 1921 were confined to the area occupied by sedimentary rocks. Practically all the peninsula except its extreme west side is occupied by sedimentary beds of Middle and Upper Jurassic age. The lowest formation (Middle Jurassic) is the Tuxedni sandstone, which has a thickness of possibly 8,000 ft. This formation may be divided into a lower part, whose beds are prevailingly sandstone and sandy shale, but include also minor amounts of conglomerate, arkose, and a little limestone; and an upper part, whose beds are chiefly sandy shale, but include thin beds of sandstone and a few thin beds of conglomerate.

The Tuxedni sandstone occupies the central and western parts of the peninsula and is separated from the volcanic rocks of the mainland by a great fault which runs parallel to the axis of Cook Inlet. The Tuxedni sandstone is overlain by the Chinitna shale (Upper Jurassic). It is a fairly homogeneous formation, about 2,300 ft. thick, consisting of gray and black shale, containing throughout many beds of concretions and, in its upper 500 ft., many sandy, calcareous beds that become yellow on weathering. Above this shale comes the Naknek formation, beneath which locally there is a massive coarse conglomerate called the Chisik conglomerate, which consists chiefly of igneous boulders and cobbles and which reaches a thickness of 290 ft. on the shore of Iniskin Bay.

The Naknek formation is at least 4,500 ft. thick. Its lowest beds throughout most of the area are fine conglomerate and arkosic sandstone (probably equivalent in time to the Chisik conglomerate), which are overlain by sandy shales and thin beds of sandstone. This lower part of the Naknek formation is about 1,500 ft. thick, and is overlain in turn by massive white or light-colored beds of sandstone, which form conspicuous cliffs along the crest of the mountains near the coast of Cook Inlet and have protected the underlying softer shale and sandstone from erosion.

The sedimentary beds are folded in such a way as to form a broad major anticline that extends north-northeast through the valleys of Bowser and Fitz creeks from Oil Bay to Chinitna Bay. All the sedimentary beds east and south of the anticline as far as the shore of Cook Inlet dip toward the curving coast line. West of the anticline is a syncline, which is followed farther west, in the valley of Portage Creek, by a closely compressed anticline. Part of this anticline, however, is cut off by the great fault. Because of this fault and of the closeness of folding and the generally disturbed condition of the beds, the westernmost anticline offers little encouragement to prospectors for oil.

All the known oil seeps of the Iniskin Bay field are in beds of the Tuxedni sandstone, although the gas spring at Dry Bay is in a higher formation. The principal oil seeps are either near the head of Oil Bay or on Iniskin Bay, and possibly owe their presence here to the faulting and jointing that have affected the Tuxedni sandstone in this vicinity. The main anticline of the valleys of Bowser Creek and Fitz Creek flattens out near Oil Bay and pitches beneath the Chinitna shale between Iniskin and Oil bays. An east-west fault cuts out the upper part of the Tuxedni sandstone in this locality and brings the lower part into contact with the Chinitna shale. The oil from the seeps at Oil Bay and the drill holes therefore appears to come from a horizon not higher than the middle beds of the Tuxedni sandstone, but there is no evidence to determine where it originates.

The oil from the seeps is dark green when it first comes up, but turns dark brown on exposure to the air. It has a paraffin base, and would be a refining oil. Four wells were drilled at Oil Bay between 1902 and 1906, two of which yielded oil and gas in amounts that are now difficult to determine. The first and deepest well is said to have been sunk to a depth of more than 1,000 ft., and was abandoned because of salt water. The third well was sunk to 900 ft. Both wells are reported to have obtained oil from beds about 700 ft. below the surface. The wells are near the axis of the anticline that extends through Bowser and Fitz Creek valleys, but are in an area where the fold is much flattened and is beginning to lose its identity as an anticline. The wells are in the disturbed area near the intersection of the east-west fault with the jointing and fault planes parallel to the shores of Oil Bay, which, as already pointed out, have possibly given rise to the oil seeps near by. Two wells were started near Dry Bay at about the same time as the wells at Oil Bay, but both were abandoned because of loss of tools or accident to the machinery. Although oil lands have again been staked in the Oil Bay district, no work has been done there recently, and, so far as is known, no drilling is being considered in the near future.

Further prospecting in the Iniskin Bay oil field might well be extended so as to test the main axial anticline of the peninsula, instead of being restricted to the vicinity of the known oil seeps. It should be kept in mind, however, that the valley of Bowser Creek, and the corresponding valley north of it, may be eroded below the horizon at which the oil occurs, and that in consequence the boundary between the Tuxedni sandstone and the Chinitna shale may prove to be a more favorable location for drilling. The area of anticlinal structure between the right arm of Iniskin Bay and Chinitna Bay is less promising for oil, as the gathering ground is smaller, and the beds have been shattered and otherwise greatly disturbed by faulting.

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*Abstracted from Report U. S. Geological Survey.

In summarizing, it may be said that the Iniskin Bay region includes a number of long, narrow anticlines, which are joined on the seaward side by a great monocline. This monocline should have afforded a considerable underground drainage area for oil, and may contain valuable pools.

Oil in Peru and the New Petroleum Law

Special Correspondence

In no Peruvian product, except silver and copper, is the ascending scale of products, for the capital invested, more marked than in that of petroleum. Peru's oil fields, it is claimed, hold promise of a great national revenue. In 1903 her total oil yield was 11,639 tons; 235,133 tons was produced in 1919; and in 1921 these figures were more than doubled, with 500,000 tons. The export duties on oil and oil byproducts in 1919 brought a large revenue to the state, the basis of duty being approximately $4 a barrel.

Peruvian oil was well known under the ancient Inca regime and was used for painting pottery and other industrial purposes. The Spaniards also used it for caulking. In more modern days the geologist revealed to the world the great deposits of the Montana, of the long 1,500-mile stretch of coast from Port Tumbes to Ilo, of the hills at 8,000 to 15,000 ft. above sea level, and of Abancay and Ayacucha. In the center of Peru oil was found in the Nazca region, and also in the provinces of Yauli, Jauji and Huancavelica, although there its extent and value need a more precise investigation. In southern Peru at Canas, Lampa, Azangaro, and especially at Huancane, near the shores of the mountain lake, Titicaca, commercially satisfactory oil has been found.

Following the geologist, in 1867, came the earliest modern exploiters of Peruvian oil, the Americans. Later still, in 1888, came the London Pacific Petroleum Co., which completed its No. 8 well in 1899, and whose eventual output rose from 40,000 tons in 1904 to 350,000 tons in 1920. The year 1914 recorded the coming into the field of the International Petroleum, Ltd., controlled by the Imperial Oil, Ltd., itself mainly owned by the Standard Oil Co. of New Jersey. Another great company is the Lobitos Oilfields, Ltd., whose production is taken, under contract, by the International Petroleum, Ltd. These various companies have drilled 1,406 wells, of which 849 are at present producing.

The new petroleum law is framed on the same lines as the Mining Code. The duties imposed are not to be altered for twenty years and the act is designed to develop greatly the Peruvian oil industry. By its terms all laws and regulations in conflict are repealed, although existing concessions may be made to conform to it if desired. Under it all petroleum and hydrocarbons are national property. The superficial extension of the concessions granted under this law will be divided into areas of 40,000 sq.m., called claims. No exploration block granted shall exceed 15,000 claims on the coast, 20,000 on the Sierra, and 30,000 in the Montana. The term of an exploration concession may be four years, with power to extend for another two years. An annual exploration tax shall be paid on each claim of one sol on the coast, 40 centavos in the Sierra, and 20 in the Montana, payable semi annually.

Exploitation privileges shall be granted for an indefinite period. Two classes of contributions are required from the concessionnaire of an exploitation zone, one on the area of the concession and the other on the production of the well or wells. The contribution on the former is approximately $5 annually per claim, payable semiannually in advance; on the latter according to a prescribed scale, which gives 50 centavos on a production of ten or more tons per claim. In concessions in the Sierra or Montana, the scale is reduced 50 per cent.

No foreign government, nor any company in which a foreign government is interested, may secure petroleum concessions in Peru. All companies shall be constituted in conformity with the Commercial Code, and be considered as national companies with domicile in the republic.

Government in April Nets $1,000.000 From Oil Leases

Royalties accruing to the United States Government in the month of April from the production of oil and gas on leased public lands in the states of Wyoming and California amounted to $1,009,007.86, according to reports submitted by the Bureau of Mines to the General Land Office. Of this amount, $784,600 is credited to Wyoming and $224,400 to California. The total net royalties accruing to the Federal Government to April 30, as the result of oil and gas production on public lands under the terms of the general leasing act, approved Feb. 25, 1920, amount to $4,650,286.81. A total of 7,328 permits for prospecting for petroleum and natural gas on public lands had been issued up to the end of April.

Under the terms of the general leasing law, the technical supervision of oil and gas producing operations on leased public lands is intrusted to the Bureau of Mines. Offices for the conduct of this supervisory work are at Denver, Col.; Casper and Salt Creek, Wyo.; Bakersfield, Cal.; Winnett, Mont.; and Shreveport, La., general headquarters being in Denver.

Prospecting for Oil in Australia

Special Correspondence

The finding of pieces of pitch in the Kimberley field, North West Australia, has resulted in the formation of a number of companies for oil exploration, and already a number of geologists and prospectors has been dispatched to the field. Three members of state geological departments have been granted leave of absence to report for various leaseholders, namely T. Blatchford, of West Australia; L. J. Jones, of New South Wales, and D. J. Mahony, of Victoria. Huge areas are already held by some of the prospecting companies, and as the country is only sparsely settled and without means of transport, many delays and difficulties will be experienced before definite results can be expected.

New Books

Science for the General Reader

A committee of the Washington Academy of Sciences recently published a list of one hundred popular books in sciences. The selection is a tentative one, and criticism is invited. The first test for the kind of a book that is considered desirable for the list is: Would the average reader who uses a public library, after beginning to read the book in question, read it through to the end and come back to the librarian for another on the same subject? The list follows, some of the titles being somewhat abridged, and the names of publishers and other details being omitted: "The Origins of Invention," Mason; "Woman's Share in Primitive Culture," Mason; "Men of the Old Stone Age," Osborn; "The Study of Men," Haddon; "Savage Childhood," Kidd; "The Hopi Indians," Hough; "Newer Knowledge of Nutrition," McCollum; "Food Products," Sherman; "Origin of Species," Darwin; "Inbreeding and Outbreeding," East; "Heredity and Eugenics," Castle et al.; "Theory of Evolution," Morgan; "Heredity and Environment," Conklin; "Hereditary Genius," Galton; "Applied Eugenics," Popenoe; "Wonder of Life," Thomson; "Problems of Evolution, Headley; "Hybridization," Lotsy; "Life and Her Children," Buckley; "Winners in Life's Race," Buckley; "Living Plant," Ganong; "Experiments with Plants," Osterhout; "Physiology of Plants," Sorauer; "Flowers, Fruits, and Leaves," Lubbock; "Geography of Plants," Hardy; "Insectivorous Plants," Darwin; "Sand Dunes and Salt Marshes," Townsend; "American Animals," Stone; "African Game Trails," Roosevelt; "Jungle Peace," Beebe; "Camps of an Ornithologist," Chapman; "Wild Birds," Herrick; "Insect World," Fabre: "Wasps," Peckham; "Life of the Bee," Maeterlinck; "Vegetable Mould," Darwin; "Gleanings from Nature," Blatchley; "Upland and Meadow," Abbott; "Seashore Life," Mayer; "Animals of the Past," Lucas; "Extinct Monsters," Hutchinson; "Geology," Dwerryhouse; "The Story of the Earth," Seely; "The Changeful Earth," Cole; "Evolution of the Earth," Lull; "Time and Tide," Ball; "Political and Commercial Geology," Spurr; "Geographic Influences in History," Brigham; "Work of Rains and Rivers," Bonney; "Waves of the Sea," Cornish; "Volcanoes," Bonney; "Volcanoes of North America," Russell; "About the Weather," Harrington; "Climate and Weather," Dickson; "Weather Science," Lempfert; "Climate," Ward; "Realm of the Air," Talman; "The Ocean," Murray; "Rocks and Their Origins," Cole; "Rocks and Minerals," Bennett; "Guide to Minerals," Gratacap; "The Sun," Abbot; "Story of the Heavens," Ball; "Astronomy," Dyson; "Stellar Evolution," Hale; "Splendors of the Sky," Lewis; "Beginner's Star Book," McKready; "Voyage Through Space," Turner; "Lectures in Astronomy," Stahl; "Creative Chemistry," Slosson; "Everyman's Chemistry," Hendrick; "Chemistry of Commerce," Duncan; "Modern Chemistry," Martin; "Matter and Energy," Soddy; "Fragments of Science," Tyndall; "Relativity," Einstein; "Physical Science," Whetham; "Constitution of Matter," Ames; "Waves and Ripples," Fleming; "Spinning Tops," Perry; "Musical Sounds," Miller; "World of Sound," Bragg; "Light Waves," Michelson; "Colour Measurement," Abney; "Soap Bubbles," Boys; "Radium," Soddy; "Number Concept," Conant; "Mathematics," Whitehead; "Philosophy of Mathematics," Shaw; "Study of Mathematics," De Morgan; "History of Science," Libby; "History of Science," Sedgwick; "Warfare of Science and Theology," White; "Number Stories," Smith; "Astronomy," Berry; "Chemistry," Thorpe; "Founders of Geology," Geikie; "History of American Geology," Merrill; and "Biology and Its Makers," Locy. We are ashamed to say that we have read so few of these books that we shall not attempt to criticize or suggest substitutions. Copies of the reprinted bulletin containing comments on each book may be obtained from Robert B. Sosman, editor of the *Journal of the Washington Academy of Sciences*, Washington, D. C.

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The Sordid Side of a Mining Camp

Sketches of Butte. By George Mesley Davis. The Cornhill Company, Boston. 1921. $1.75.

This is an odd little book; likewise it is interesting. At least half of the incidents related lack even the most remote connection with Butte. The author apparently has them in his system and uses the book as a vehicle for getting them into print. He is by no means a scholarly writer but he has some entertaining ideas on the philosophy of life, and his style is agreeable enough. He fancies his own "poetry," but is considerate in inflicting only small doses.

In his effort to be impressive he overdoes things. For instance, he talks of "a city of upward of 100,000," a figure at least twice as large as the most ardent booster ever claimed as the population of Butte; because there are a few houses that are not exactly like all the rest, he dilates on the wonderful variety of architecture; Columbia Gardens, a commonplace combination of pleasure resort and park, is called "a wonderland of nature," and elicits further praise that makes Butte's best friend blush.

The general impression that the book would leave on the mind of the casual reader is certainly unjust to Butte. The "tenderloin" district, the dope colony, the saloons and gambling houses, fashionable courtezans, corrupt copper barons, heinous blackmailers, hired character assassins, even war profiteers and slackers, are described vividly, and scored roundly. Granting that there are facts to support everything he says—and Butte's admirers will not deny that there are quite a number of blotted pages in her history and a goodly collection of skeletons in the closet—the author is certainly unfair to the "largest mining camp in the world." There is evil everywhere, but there is also honesty and decency everywhere, and Butte is not now, nor has it ever been, an exception. The author of "Sketches of Butte" tells one side only. The book should not be taken too seriously, but, as we have said, it makes interesting reading. A. B. P.

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Laboratory Principles

A Textbook of Fire Assaying. By Edward E. Bugbee. Second edition. John Wiley & Sons, Inc., New York. $3.

The author has revised and enlarged his earlier excellent treatise, with consequent improvement. The layout is the same as in the former work, but much useful material has been added, including hitherto unpublished results of research as well as data from other sources. Effort is made to ground the student thoroughly in the principles that underlie the various operations in the laboratory rather than to provide him with a set of recipes which he may be tempted to follow blindly. One must not understand from this that a burdensome amount of theory is given without any practical instruction. On the contrary, the book is intended to guide and instruct the student in his laboratory work, and to this end gives an adequate course of experiments and exercises, with copious explanatory notes. It is in the addition of new research and other data that the expansion of the former edition has chiefly taken place, and the result is that the assayer of experience will find some chapters of considerable interest. A. H. H.

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Practical Science for Miners

Mining Physics and Chemistry. By J. W. Whitaker. Longmans, Green & Co., New York. $3.

This is an elementary treatise on physics and chemistry by an English author, intended to serve as a groundwork for further studies in the technology of coal mining. Attention is given to the subjects of air composition and analysis, mine gases, mine waters and explosives, the book concluding with a chapter on coal, gas works and coke ovens. It is written lucidly, and offers much practical information within small space.

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The Determination of Sulfur in Iron and Steel. By H. B. Pulsifer. The Chemical Publishing Co., Easton, Pa. $2.50.

This book gives a critical description of the methods in use, together with a large number of detailed analyses. Most of its 160 pages, however, are devoted to a chronological résumé and bibliography of all the published literature on the subject, including that from French and German sources. The book has every appearance of being well done.

SOCIETIES, ADDRESSES, AND REPORTS

Smithsonian Reviews Field Work During 1921

Smithsonian field parties visited during 1921 the Canadian Rockies, Alaska, the Philippines, China and Japan, the West Indies, and Chile, besides many localities in the United States. The preliminary results of this field work are described and fully illustrated in a pamphlet entitled "Explorations and Field Work of the Smithsonian Institution in 1921," which has just been issued. Through its field work, the institution not only carries out one of its main objects, the "increase of knowledge," but also adds much valuable and interesting material to the exhibition and study collections of the National Museum at Washington, D. C.

In the Canadian Rocky Mountains, Secretary Charles D. Walcott continued his geological studies which have been carried on in this region for many years. The particular objects of this season's work were to secure data on the pre-Devonian strata of the Sawback Range in Ranger Brook Canyon, and a reconnaissance of the pre-Devonian formations to the Northwest as far as the headwaters of the North Fork of the Saskatchewan River, Alberta. Although the unusually cold and stormy season interfered greatly with this work, many formations were examined and a large number of fossils were brought back to Washington for study.

Dr. R. S. Bassler, curator of paleontology in the National Museum, spent part of the field season in collecting geological material and in mapping and studying the economic resources of Franklin quadrangle, in Williamson County, Tenn., in co-operation with the Geological Survey of Tennessee. This section is of special interest on account of phosphate and oil shale possibilities.

J. W. Gidley, assistant curator of vertebrate paleontology in the museum, conducted successful field explorations in Arizona.

Astrophysical field work is carried on by the Smithsonian on Mount Harqua Hala, Arizona, and on Mount Montesuma, Chile, these two regions being among the most cloudless in the world. At these two stations are made observations of the sun on every suitable day throughout the year, under the direction of Dr. C. G. Abbott, assistant secretary of the Smithsonian Institution. From the Chilean station daily telegrams are forwarded to Buenos Aires, Argentina, giving the observed value of the solar constant of radiation for the day.

Expeditions covering biology, archeology, and ethnology were also made.

American Iron & Steel Institute Meeting

The twenty-first general meeting of the American Iron & Steel Institute was held at the Hotel Commodore, New York, on May 26. Preceding the opening address by Judge E. H. Gary, the following papers were presented:

"The Development of the Iron and Steel Industry of Australia," by David Baker, general manager of the Broken Hill Proprietary Co., New Castle, N. S. W., Australia; "The Relation of the Doctor to the Steel Plant," by Loyal A. Shoudy, chief surgeon of the Bethlehem Steel Corporation; "Industrial Housing," by C. L. Woodbridge, general superintendent of the Carnegie Land Co., Pittsburgh; "The General Effect of Electrification of Steel Mills Upon Their Operation," by Wilfred Sykes, assistant to operating vice-president of the Steel & Tube Co. of America, Chicago; "The Importance of the Iron Ores of the Adirondack Region," by Frank L. Nason, geologist, New Haven, Conn.; "Methods of Using Fuel in Open-Hearth Furnaces," by Herbert F. Miller, Jr. assistant superintendent of the Lackawanna Steel Co., Buffalo, and "Gas and Air Valves for Open-Hearth Furnaces," by W. C. Bulmer, superintendent of the open-hearth department, Ohio works of the Carnegie Steel Co., Youngstown, Ohio.

In his paper, "The Importance of the Iron Ores of the Adirondack Region," Mr. Nason pointed out that the total iron-ore bearing area of that region is approximately 10,000 square miles. Three operating companies, Witherbee, Sherman & Co., the Port Henry Iron Ore Co., and Chateaugay Ore & Iron Co. are equipped to produce 1,500,000 tons of concentrates annually. At least 750,000 tons of this output will average from 61 to 65 per cent iron, with phosphorus at 0.01 to 0.004 per cent. The crude ore in sight is estimated at 186,000,000 tons, and the prospective tonnage of the region is stated to be 1,736,000,000.

Need for the Gold Standard

An interesting pronouncement of views as to the status of the gold standard was made by D. R. Crissinger, Comptroller of the Currency, when he addressed the Pennsylvania Bankers' Association at Pittsburgh on May 26. Comptroller Crissinger declares that at no time has the gold standard been so necessary as at present. In the course of his speech he said in part:

"We must recognize that political rehabilitation and economic reconstruction are so intimately related that they cannot possibly be separated the one from the other. In both, our country is under necessity to serve civilization.

"Almost the last among great financial communities to commit ourselves definitely to the gold standard, we find ourselves now summoned to determine, for all the world, whether that standard shall be maintained or whether we shall abandon it and allow the economic craft to struggle without chart or rudder.

"During the years of the heated controversy over the gold standard we were constantly being assured that our country was the victim of the gold standard because we were a debtor nation, and others controlled the world's gold. We were told that the tendency was for gold constantly to increase in value, compelling the debtor always to pay in a dearer money than that in which he had borrowed.

"It was not always easy to answer, for effective answer required the consideration of economic fundamentals concerning production, exchange, and consumption. But in 1896, after a campaign of education in these fundamentals, the verdict was in favor of maintaining a gold standard. I am sure that if today the verdict had to be sought again on those issues, the gold standard would win again by a far greater majority.

"In the quarter century since 1896, we have seen that this standard does not mean the economic enslavement of a debtor country; rather, it means the assurance of equal opportunity to develop resources, and the chance to transform the debtor community into a creditor state. In 1896 we were the greatest borrowing community in the world; in 1922 we find ourselves the greatest lending community, the mainstay and reliance of business, of bankers, of nations, of civilization itself, in the effort to weather the greatest storm that ever burst over mankind.

"If the gold standard meant so much of opportunity to us as the great debtor state, how much more must its maintenance mean to us, now that we have become the great creditor nation? Every argument that could be made in 1896, with however much plausibility, against maintaining the gold standard, now applies with a thousandfold more force in favor of rigidly adhering to it.

"We know how absolutely necessary is a uniform monetary standard throughout the world. We know that without it our problems of exchange and of international commerce cannot be solved. We realize that the debts which are owing to us, the balances which must be paid to us or by us, must somehow be adjusted to a single, common, universal standard; and that, as these obligations have all been thus far related to or measured by gold, we cannot safely depart now from that standard.

"The security of the gold standard depends on the maintenance of a free gold market, on the comparatively unrestricted flow of gold. If the movements of commodities shall too long positions in a particular direction, they must inevitably create a vacuum which can only be filled by a movement in the opposite direction.

"In the last eight years, the value of commodities has been [illegible] forced out [illegible], and the movement of gold has been toward us. The result is that one side of the world tends to gather to itself more than it needs of the gold, while the other side, burdened with debts, finds its store of gold continually reduced, and its powers to maintain a gold standard correspondingly weakened. The gold standard cannot be maintained by piling up all the gold in one place.

"It has been proposed that a conference of the various national financial establishments be held, to devise measures to restore and maintain the gold standard. In every such discussion it must be kept in mind that the permanency of the gold standard depends fundamentally upon some adjustment or settlement, not cancellation, of all international debts, in terms of gold, so that they can be paid by the contracting parties without sorely impoverishing the people through unbearable burdens of taxes. It is well to remember that the economic possibilities of reconstruction must be measured in units of human energy, and an overload, or a lack of such units, means default and disaster. In every such effort our country must obviously take a part, for we are not only the leading creditor nation but we have become custodian of the greater share of the world's gold."

MEN YOU SHOULD KNOW ABOUT

W. H. Emmons is making a survey of the Ducktown mining district.

Kirby Thomas was in Washington last week conferring with Federal officials.

J. F. Wolff, of Duluth, was recently on the Gogebic Range doing some geological work.

G. T. Jackson, of the Shasta Zinc & Copper Co., recently made a visit to San Francisco.

J. K. Turner, mining engineer, of Goldfield, has gone to New York for an indefinite stay.

W. H. Blackburn, general manager of the Tonopah Mining Co., has gone to Salt Lake City on business.

L. D. Gordon, president and general manager of the Round Mountain Mining Co., has gone to San Francisco.

C. H. Monroe, **O. B. Perry**, and **J. F. Newsom** are in the Federated Malay States with headquarters at Ipoh.

Dr. A. S. Eakle, professor of mineralogy at the University of California, is visiting mining districts in Nevada.

P. S. Smith is en route to Alaska to make geologic investigations in the region tributary to the Alaska Railroad.

O. B. Hart, superintendent of construction for the Yukon Gold Co., will leave June 3 for the Federated Malay States.

J. B. Mertie, Jr., is en route to Alaska to investigate the gold deposits of the Fairbanks and Rampart districts.

Charles Butters has returned to Oakland, Cal., after a three months' trip in Honduras, Nicaragua, and Salvador.

Dr. C. K. Leith, with a party of students from the University of Wisconsin, is spending a few days on the Gogebic Range.

Raymond Guyer has returned to his home in Spokane after a short trip of inspection to the Cori Gold Mines' holdings in Mexico.

L. A. Dodd, who has been gold commissioner at Barkerville, B. C., for some years, has been transferred to Nanaimo, B. C.

Edward Sampson is to continue work in the Pend d'Oreille district of Idaho in co-operation with the state Bureau of Mines and Geology.

J. S. Lutes, general manager of mines for the Tod-Stambaugh Co., is now in Cleveland to confer with the officials of his company.

R. E. Cranston has gone to New Zealand to inspect the dredge of the Rimu Gold Dredging Co., operating near the town of Hokitika.

G. S. Blaylock, for many years general manager of the Consolidated Mining & Smelting Co., has been elected a director of that company.

J. W. Sherwin, general manager of the West End Consolidated Mining Co. and allied companies, is in Tonopah from Oakland and Las Vegas.

Paul J. Kruesi, a manufacturer of Chattanooga, Tenn., will act as assistant Secretary of Commerce during the absence of **C. H. Huston** in Alaska.

B. H. Stoddard is to do field work in New York, Massachusetts and New Hampshire for the mineral resources division of the U. S. Geological Survey.

R. A. Angst and **E. W. Hopkins** have been in Cleveland attending the meetings of the subsidiary mining companies of Oglebay, Norton & Co.

Waldemar Lindgren has been engaged by the U. S. Geological Survey to make a special report on the geology and ore deposits of the Bradshaw Mountain.

Felix A. Vogel, mine manager for Ladenberg, Thalmann & Co., spent a week on the Gogebic Range, Michigan, accompanied by **Andrew Formis**, superintendent of the Bates mine, at Iron River.

G. R. Mansfield, of the U. S. Geological Survey, is visiting the potash fields of Texas and the borate fields of California. On his return, about the end of June, he will visit some of the eastern phosphate fields.

E. H. Finch, formerly on the Land Classification Board, U. S. Geological Survey, has gone to Central America for several months, for the purpose of making geologic examinations of prospective mineral lands.

M. W. Hayward, chief engineer of the Cia. Minera de Peñoles, has finished his inspection trip and has returned to Monterey to confer with **Heath Steele**. They probably will visit the camp together early next fall.

George E. Deatherage, recently in charge of furnace plant construction for the Indian Iron & Steel Co., of Asansol, India, spoke before the Engineers Club of Northern Minnesota on May 27 at Chisholm, Minn. His subject was "India Industrially."

Glenn L. Allen, specialist in ore concentration, has completed a month's work at the mill of the Minas Pedrazzini Gold and Silver Mining Co., Arizpe, Sonora, Mexico. After June 1 his address will be in care of La Fe Mining Co., Guadalupe, Zacatecas, Mexico.

W. J. Olcott, president of the Oliver Iron Mining Co., also **S. B. Sheldon**, vice-president and general manager of the Minnesota Steel Co., are in New York attending the meeting of the presidents of the subsidiary companies of the U. S. Steel Corporation.

Prof. A. P. Coleman, who, after being thirty years on the staff of the University of Toronto, is resigning his position as head of the Department of Geology and Dean of the Faculty of Arts, was given a complimentary dinner by his colleagues and friends on May 22.

Mining and metallurgical engineers visiting New York City last week included: **Norman Carmichael**, of Clifton, Ariz.; **R. J. Grant**, of Denver, Col.; **David White**, of Washington, D. C.; **John G. Kirchen**, of Tonopah, Nev.; **E. H. Suender**, of Frackville, Pa., and **Thor Warner**, of San Antonio, Tex.

OBITUARY

Frank P. Mills, for several years in charge of the Cleveland-Cliffs Iron Co. interests at Ishpeming, Mich., died at Berkeley, Cal., on May 18. Under his direction the Lake mine, at Ishpeming, was developed.

A. J. Schumacher, of Weiser, Idaho, died suddenly on May 9. Mr. Schumacher was graduated from the Colorado School of Mines, was a member of the A.I.M.E., and for many years superintendent of the Parrot Smelter, at Butte, Mont. Leaving Butte, he bought and operated for some years the Baker City Iron Works, but sold out to develop mining properties in Idaho.

John M. Longyear, mining engineer and capitalist, died at his home, Brookline, Mass., on May 28. Mr. Longyear was born in Lansing, Mich., in 1850. He lived for a number of years at Marquette, Mich., and held extensive lumber and mining interests in that region. He was a member of the corporation of Massachusetts Institute of Technology, and for twenty-five years was a member of the board of control of the Michigan College of Mines.

THE MINING NEWS

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Leading Events

REDUCTION of freight rates horizontally, effective July 1, was suddenly announced by the Interstate Commerce Commission on May 24.

Increasing activity among copper producers marks the beginning of June. Moctezuma, North Butte, and Davis Daly have resumed operations, United Verde has started its smelter and the Copper Queen output is to be increased.

Details of the bill of complaint in the suit of Wolf's Mineral Process Corporation against Minerals Separation are given in this issue.

Minnesota's tonnage tax law has been held constitutional.

Decision in the Naica Mining Co.'s case has been reversed by the Mexican Supreme Court.

Formation of an export silver association has been suggested to control the silver market for American producers after Pittman Act purchases are completed.

I. C. C. Orders Horizontal Cut in Freight Rates

Reduction Averages 10 Per Cent, Though Higher on Some Commodities—Effective July 1

A general horizontal reduction of 10 per cent in freight rates below the rates which became effective on Aug. 26, 1920, was ordered by the Interstate Commerce Commission in a decision handed down on May 24. The new rates are to become applicable on July 1. Carriers were requested to notify the commission by May 31 whether the decision was acceptable.

This action of the commission in reducing rates marks the end of the exhaustive investigation begun last fall into the rate situation. It is said that in practically all instances where readjustments and reductions have been made by the commission or voluntarily by the railroads since Aug. 26, 1920, the 10 per cent reduction just granted will replace the earlier readjustments.

Moctezuma Copper to Start Mill

The Moctezuma Copper Co., at Nacozari, Sonora, will start the first unit of its 3,000-ton mill on June 1. Production was suspended April 15, 1921. Since then the concentrator has been remodeled and considerable development work done. It is expected that the unit will produce about 1,000,000 lb. of copper in June.

Hayden Smelter Resumes

At the Hayden smelter of the American Smelting & Refining Co., a reverberatory has been started on Ray Consolidated's copper concentrates. The copper department at the company's El Paso smelter has also resumed work with one furnace.

United Verde Begins Smelting

The United Verde Copper Co., of Jerome, Ariz., has started a reverberatory and will put a blast furnace also into operation soon.

North Butte Ordered To Resume

Announcement was made the last week in May that the North Butte Mining Co., Butte, Mont., would resume operations June 1 after a shutdown since April, 1921. During the shut-down about 100 men have been employed on development and repairs. Anaconda's Washoe smelter will handle North Butte's ore.

Davis Daly's Colorado Mine Again Operating

The Colorado mine of the Davis-Daly Copper Mining Co. resumed work on June 1 with about 300 men. This mine continued operating after other mines in the Butte district shutdown in April, 1921, finally suspending because of difficulty over its smelting contract with the East Butte company. A new contract has apparently been arranged. The company's Hibernia mine has continued in operation, producing silver ore.

International Nickel Reopens Port Colborne Refinery

The refinery of the International Nickel Co., at Port Colborne, Ont., has been reopened, after an extensive shutdown. There are sufficient supplies of matte on hand to keep the refinery in operation for a considerable time, and no attempt will be made to start the smelter at present. It is understood, however, that one or more furnaces will be placed in operation some time during the fall.

Sulman & Picard Broke Contract, Alleged in Wolf's Suit

Used Information Obtained in Making Tests as His Agents to Secure Basic Flotation Patent

In the action brought by Wolf's Mineral Process Corporation against Minerals Separation North American Corporation, the bill of complaint charges infringement of the plaintiffs' patent No. 787,814, of April 18, 1905, and that the licenses granted by Minerals Separation have infringed this patent.

This patent has never been used by the Wolf company, it is stated, nor has its use been permitted, though the company says it has been willing to grant licenses on the payment of a reasonable royalty.

On or about Feb. 5, 1903, according to the bill, Jacob D. Wolf contracted with Sulman and Picard, of London, to test certain processes invented by him for concentrating ores and separating minerals from their ores, and also to construct exact formulas for the most economical and efficient working of the processes on a commercial scale; also to improve the results of the processes and determine the best methods of using them; and to turn over to Wolf the results of their acts. For this Sulman and Picard were to receive a salary of 100 guineas per month.

Sulman and Picard, the bill states, agreed to observe the obligation of secrecy as to investigations and experiments to be made and agreed to make detailed reports and explanations to Wolf of the work done upon the processes, and of all discoveries, inventions, designs, and improvements made or worked out from time to time, or in course of investigation, by them or by their assistants. All such discoveries and improvements were to belong to Wolf absolutely. Sulman and Picard were to render any assistance in their power to enable Wolf to obtain successfully such discoveries and improvements. Wolf's right to acquire any patent under the agreement was to include and extend to all improvements and [illegible] extensions.

The agreement further provided that its obligations should be binding upon the executor, administrator, and assigns of each party and that Wolf should be at liberty to assign validly and effectually to any third party the benefit of the obligations of the contract. On April 8, [illegible], it is stated, Wolf assigned to Wolf's Mineral Process Corporation all his rights under the contract.

Wolf performed his part of the contract, the bill of complaint states. Sulman and Picard performed it in part by making tests and experiments based upon the disclosure which Wolf had made to them of his processes and by making certain representations and assisting Wolf in preparing and prosecuting his application for a patent.

Sulman and Picard, it is alleged, broke the contract by concealing from Wolf certain of the results derived from their experiments and by disclosing the processes and results of the experiments made under the contract to other persons. It is alleged that they caused or permitted Sulman, Picard and (John) Ballot to apply for and obtain U. S. patent 835,120, dated Nov. 6, 1906, for certain new and useful improvements in ore concentration, which improvements were the result of Wolf's invention and were developed by Sulman and Picard under Wolf's direction and as his agents.

Sulman and Picard, it is further alleged, caused and permitted this patent and others, United States and foreign, to be taken out in the name of other persons than Wolf, and refused and neglected to assign them to Wolf, although such assignment was duly demanded.

The patentees, it is further alleged, then wrongfully assigned or attempted to assign patent 835,120 and other patents of which Wolf was the equitable owner to Minerals Separation, Ltd., which was organized at the instance of Sulman and Picard. They were then assigned by Minerals Separation, Ltd., to Minerals Separation American Syndicate, Ltd., which in turn assigned them to the defendant Minerals Separation North American Corporation. The defendant, the bill states, is the assignee of the obligations of Sulman and Picard under their contract with Wolf.

Discovery of the amount of royalties and profits made by the defendant under patent 835,120 is asked.

The plaintiff further requests (1) a writ of subpœna requiring the defendant to appear; (2) an injunction against the infringement of the plaintiff's patent 787,814; (3) an injunction asking the assignment of patent 835,120 and all other patents including any invention or discovery or improvement made by Sulman and Picard or associates in the course of their experiments for Wolf under contract; (4) an accounting of profits; and (5) that plaintiff recover the profits.

The Wolf's Mineral Process Corporation and Wolf, it is alleged, were unable to ascertain the fact that the defendant was infringing. They state that they have been prevented from previously bringing action by the acts of the defendant and by the financial inability of Wolf.

Naica Mining Co. Decision Reversed

The Supreme Court of Mexico has rendered a unanimous verdict in the appeal of certain shareholders of the former Naica Mining Co., against a previous decision disbanding the company. Eight months ago the Supreme Court handed down its decision adverse to the Naica company, in favor of the Stopelli heirs, who had alleged irregularities in the company organization and asked for a return of the property and an accounting.

The Naica is one of the richest silver-lead producers in the republic. The company was organized with only eighty shares, which have reached at times a market value of $25,000 per share. The case has been extremely sensational and led to a number of the American stockholders appealing to the American State Department. Serious charges were also made against three of the Supreme Court judges, including the president, and a special grand jury of the Mexican congress has been instituted to investigate.

A portion of the mine, not affected by the decision, is still operating.

Mexican Government Objects to Durango Mine Tax

There has been a sharp interchange of notes between the Secretary of the Treasury, in Mexico City, and the Governor of the State of Durango, caused by the recent imposition of a special state mining tax of "2 per cent per hundred." The federal government says that the intention of the tax is vague and subject to various interpretations, in the first place, and illegal in the second, the central government reserving itself the right to tax mines, oil, coal or other minerals which primarily belong to the nation at large.

Nichols Copper Co.'s Plant Damaged by Fire

The plant of the Nichols Copper Co. at Laurel Hill, New York City, was damaged to some extent by fire on May 27. The anode plant was destroyed, this being the principal loss. At the office of the company it was stated that newspaper reports of the accident were greatly exaggerated, and that there would be no serious interference with the company's copper production as a result of the incident. The fire had its origin in a spill at one of the furnaces.

Minnesota Tonnage Tax Valid, Judge Johnson Holds

Rules It Is Constitutional—Companies to Appeal

In a decision handed down by Judge Tillman D. Johnson, of Salt Lake City, in U. S. District Court at St. Paul, Minn., on May 24, the constitutionality of the Minnesota occupational, or so-called tonnage, tax was upheld. This is a blow to the iron-ore producers of the northern part of the state, who sought to obtain a permanent injunction restraining the state from collection of the tax. More than thirty mining companies, including the Oliver Iron Mining Co., subsidiary of the U. S. Steel Corporation; the Republic Iron & Steel Co.; the Cleveland-Cliffs Iron Co.; the Interstate Mining Co.; and the Bennett Mining Co., were involved in the litigation.

Attorneys for the mining companies state that they will appeal the case to the U. S. Circuit Court of Appeals. Pending this appeal a temporary injunction against collection of the tax, granted by Judge Booth, of St. Paul, will remain in force.

Increasing Copper Queen Output

The output of the Copper Queen smelter, at Douglas, Ariz., is to be increased from 6,250,000 lb. of copper per month to about 7,500,000, according to a recent announcement by D. D. Irwin, superintendent of the Copper Queen branch of the Phelps Dodge Corporation.

Keating Wins from Inland Steel

An award of $44,618 has been made to the Thomas Keating Co. by the jury in the case of Thomas Keating Co. vs. Inland Steel Co. This award was based on the estimate made by the plaintiff's engineer of the extra cost of reopening the mine concerned under the conditions existing.

Appeal will be taken to the higher court by the Inland Steel Co.

Thomas Keating was the original fee owner on a forty-acre tract of mining land on the Cuyuna Range near Crosby, Minn., which he leased to George H. Crosby and which was subleased to the Inland Steel Co., and later developed as the Thompson mine, opened in 1912. The operators abandoned the lease in 1919 as an unprofitable operation. Keating is now suing the operating company for upward of $300,000 damages which he is alleged to have suffered through use of improper mining methods, through the intermixing of merchantable iron ore with sand on a waste dump, through the filling of the open pit with overburden removed in subsequent stripping operations, and through the leaving of the underground workings in an unsatisfactory condition.

The decision establishes a precedent which is expected materially to affect the future relations of fee owner and mine operator in the district.

News from Washington

By PAUL WOOTON
Special Correspondent

Cyanide Restored to Free List

Senate Makes Better Progress With Metal Schedule—Rates on Zinc Oxide, Graphite, Fluorspar and Other Products Adopted—Duty Asked on Petroleum

FOR the first time since the tariff bill has been under discussion, the Senate overrode the Finance Committee when it voted, 46 to 14, to restore cyanide to the free list. Chairman McCumber, of the Finance Committee, actively assisted by Senator Frelinghuysen, of New Jersey, made a hard fight to hold in the bill 10 per cent ad valorem duty on "potassium cyanide, sodium cyanide, all cyanide salts and cyanide mixtures, combinations and compounds containing cyanide."

The amendment transferring cyanide from the dutiable schedule to the free list was introduced by Senator Oddie, of Nevada, who contended that the gold mining industry is entitled to free cyanide. Senator Frelinghuysen, in opposing the amendment, established, beyond fear of contravention, the fact that the officers and employees of the Roessler Hasslacher Chemical Co. were entirely loyal throughout the war. Senator Sterling, of South Dakota, did not question the loyalty of the company during the war, but stated that, in addition to its being the only producer of cyanide in the United States, it has intimate connection with the interests which control cyanide production in Germany and in England. Senator Pittman declared that, regardless of opinions, one way or another, about the Roessler Hasslacher company, certain facts are uncontroverted. These he stated to be as follows:

That the control of the stock now is in the hands of the Alien Property Custodian; that the company was organized by two men sent to the United States by the German syndicate; that the company has had no competition in the manufacture of cyanide since its establishment in 1885; that the concern always has been and now is the exclusive manufacturer of cyanide in this country; that it is the sole distributor of imported cyanide; that it "manufactures at this end of the line when it pays to manufacture here and sells here the German stuff when it pays better to sell the German stuff."

Rapid progress was made by the Senate in passing on the items in the metal schedule of the bill. In one day the Senate adopted the committee-rates in the first five paragraphs of the metal schedule, in contrast to previous procedure, which usually disposed of only one item a day in the tariff bill.

On motion of Senator Smoot the proposal to place manganese ore on the free list was deferred for action later.

Following extended debate in which the rates were attacked by Senator Jones, of New Mexico, the Senate adopted the provisions of the bill with respect to zinc-oxide. The rates adopted are 1¾c. per lb. on zinc oxide and leaded zinc ores containing not more than 25 per cent of lead; ground or mixed with oil 2¼c. per lb.; lithopone 1¾c. a lb.

Senator Johnson, of California, introduced an amendment making the duty on unwrought and unmanufactured diatomaceous earth at $1.50 a ton and on wrought or manufactured diatomaceous earth at $3.25 a ton.

Senator Harreld, of Oklahoma, introduced an amendment imposing a duty of 35c. a barrel on crude petroleum and 25c. a barrel on fuel oil.

The duty of 2c. a pound on antimony as regulus or metal was adopted, notwithstanding opposition by Senator Jones, of New Mexico.

The Senate also adopted the duties recommended by the committee on lime, limestone, plaster rock or gypsum, pumice stone, and bauxite.

Senator Jones, of New Mexico, sought to reduce the duty on fuller's earth from $3.25 to $1.50 a ton, but the Senate adopted the higher rate.

After extensive debate the Senate adopted the graphite rates as recommended by the Finance Committee, as follows: Amorphous graphite, 10 per cent ad valorem; crystalline, 20 per cent, and flake 2c. a pound.

Senator Jones opposed increasing the duty on fluorspar from $1.50 to $5.60 a ton but the increase was adopted by the Senate, Senator McCumber explaining that it was desirable to protect this mining product, although mining interests had asked for from 50 to 60 per cent higher duties.

Amendments to the bill introduced by Senator Poindexter, of Washington, propose to change the duties crude magnesite from $\frac{5}{16}$c. per lb. to ½c. per lb., and on dead-burned and grain magnesite from [illegible]c. a lb. to ¾c. a lb.

On motion of Senator Smoot, the Senate reduced the duty on strontium from 50 to 25 per cent ad valorem, on the ground that the product is virtually controlled in this country by one concern.

The Senate also adopted the duty of $1.50 on glass sand, after defining that product as sand containing 99 per cent or more of silica.

The mica duties were adopted, following opposition of Senator Walsh, of Montana, who objected to the higher duties on manufactured mica.

The talc duty was also adopted, following opposition expressed by Senator Myers, of Montana, whose amendments to reduce the duties were rejected.

The duty of 25c. a pound on quicksilver was adopted by a vote of 30 to 25. Senators Johnson and Shortridge, of California, urged a 35c. duty, but their attempt to reject the committee rate was defeated.

Coates & Tweed Get Award Under Amended War Minerals Act

Subject to the approval of the Secretary of the Interior, the War Minerals Relief Commissioner has made the following recommendations: Coates & Tweed, Duluth, Minn., $59,323.20; Gordon & Emery, Yreka, Cal., $548.81; Robert Brown, Elko, Nev., disallowed, non-commercial; C. E. Groce, Blythe, Cal., disallowed, stimulation not established; F. M. Knight, Prairie City, Ore., disallowed, not within the act; Eleanore Manganese Co., Butler, Tenn., $1,243.35; H. B. Greever, Bluefields, W. Va., $5,626.67; Audley H. Stone, Bluefields, W. Va., $8,568.97; Edmond Putnam, Johnson City, Tenn., $899.18; Holter & Faucher, Grants Pass, Ore., former award ample; Gose Mines, Burk's Garden, Va., former award ample; Herbert W. Smith, Washington, D. C., $4,158.94; John Madrid, Angels Camp, Cal., insufficient evidence; W. S. Crammer, Fresno, Cal., not commercial; Louis L. Cleaner, Prairie City, not within the act; Carolina Chrome Co., Waynesville, N. C., previous award ample; W. H. Shewan, Fanning, Nev., prior award ample; Herman Neipp, Blythe, Cal., not commercial.

In the case of Coates & Tweed, losses aggregating $81,631 were claimed. The entire amount was disallowed by the original War Minerals Relief Commission, but under the amended act, the company was able to establish stimulation and an award, as set forth above, has been recommended.

Mine Law Hearing Again June 8

Further hearings on the revision of the mining laws proposed in the Arentz bill will be given by the House Committee on Mines and Mining on June 8, when H. V. Winchell, a member of the engineering committee which drafted the measure, and possibly H. G. Moulton, of New York, and Representatives Raker, of California; French, of Idaho; and McArthur, of Oregon, will be heard.

Interior Department Economizes

Secretary Fall has reported to the President that through various economies the Department of the Interior has saved $936,416 this year as compared with expenditures last year. In the Bureau of Mines, he says, there has been a saving of $52,995.

Export Silver Association Suggested

Would Protect Market for American Producers After Pittman Act Purchases Have Been Completed, It Is Said

Formation of an export silver association along the lines of the Copper Export Association has been proposed by the American Gold and Silver Institute as a means of protecting the future market for American silver when the purchases authorized by the Pittman Act have been completed. Discussing the proposition, H. N. Lawrie, the managing director of the Institute, among other things, says: "An effort should be made to develop an export association similar to that organized for the purpose of marketing the copper production of the nation to better advantage. Many silver producers are forced to market their product immediately in order to develop income wherewith to meet operating costs. A silver export association properly organized to extend credit to the producer would make possible a more orderly marketing of the silver production of the country. This, of course, is not a factor at the present time, for the reason that the international price is below the Pittman price.

"The London control of the price of silver has been sustained largely because of the speculative demand for the metal for delivery in the Orient. This is a factor which must not be overlooked in anticipating the success or failure of an export association here. There must be a liquidating market, and unless the speculator will come to the rescue of the market, as he has in supporting the London market, there will be difficulty in operating such an association. A strong association, capable of purchasing the entire world's production of silver, would be in a unique position to force the speculator to come to it for accommodation. The United States and Mexico produce 70 per cent of the world's silver. This country should assume a stronger position in determining the market. It also might develop to be of great assistance to such an export organization if the co-operation of the Standard Oil Co. and other American companies, who transact large volumes of business in the Orient, were to co-ordinate closely their bullion operations with those of the silver association."

Bill To Validate Placer Patent Introduced

To meet the recent decision of the U. S. Supreme Court which invalidated placer mining patents in the Red River region of Oklahoma and Texas, Representative Oldfield, of Arkansas, has introduced by request a bill authorizing the Interior Department to issue placer-mining patents to cover claims heretofore made in good faith. The bill points out that the Melish Consolidated Placer Oil Mining Association made placer-mining entries in good faith prior to Oct. 1, 1919, on land belonging to the United States in the south half of Red River, Oklahoma, and brought in discovery wells demonstrating the presence of oil. It recites that the Supreme Court has held that the land was "not technically subject to the mining laws of the United States."

Helium Embargo Proposed

Legislation proposing an embargo on helium exports, which is soon to be considered by a committee of the House of Representatives, differs from embargoes on commercial articles, it is pointed out, in that helium is primarily a weapon of warfare. Moreover, it is a weapon on which the United States has a monopoly. It seems to be the consensus of opinion among Army and Navy officials concerned with helium that it would be entirely foolish to allow the exportation of this gas to a possible enemy.

The helium bill, it is further pointed out, does not put the Government into business. There are numerous precedents in which the Government develops fundamental facts and brings a process to the point where it can be developed commercially. In the case of helium, the cost of experimental work and the uncertainty as to its outcome, would have precluded for an indefinite period any exploitation of the helium resource by private capital.

News by Mining Districts

London Letter

Katanga's Position—Fanti Consolidated's Contract Canceled—Electrolytic Zinc Co. Busy.

By W. A. Doman

London, May 19—Although the Union Minière du Haut-Katanga has never under-rated the magnitude of its mineral concession, it is questionable whether the management has hitherto quite appreciated the fact that to develop the copper deposits successfully, the capital expenditure must be upon an ever-increasing scale—at least there seems no likelihood of its ceasing for some time. As one of the directors pointed out at the recent meeting of shareholders, the board simply cannot stop; development must go on. The possibilities are so great that to call a halt now would be to endanger the future.

The company has raised on share issues 40,000,000 fr.; on debentures, 60,000,000 fr.; secured creditors amount to 5,000,000 fr., and unsecured creditors [illegible] 70,323,000 fr. and bills payable figure in the balance sheet as on Dec. 31, 1920 (the latest issued) at 1,[illegible] fr.

By an agreement with the Special Katanga Committee, the mineral concessions have been prolonged to March, 1990. To carry out the program for the treatment of the low-grade ores, it is estimated that a further 300,000,000 fr. will be required. As the Tanganyika Concessions' fortunes are bound up with those of the Union Minière, the former had the right to take up 43,248 capital shares at 400 fr. each, and to receive 20,000 dividend shares free in new capital to be issued by the Union Minière. As the Union Minière was unable to pay a dividend, having to provide about 10,000,000 fr. for depreciation, Tanganyika shareholders also get no return upon their investments. That their time will come, however, seems certain, but the production scheme must be made secure first. The Union Minière now produces about 100 tons of copper a day—something of an achievement in Central Africa. The intention is, of course, to proceed by stages to 100,000 tons per annum. The Union Minière has continued operations while most other large producers of copper had to shut down. In 1914 the output was 10,722 tons; last year it had reached 30,470 tons. The electro-leaching test plant has proved satisfactory, and shows that the leaching process is the most suitable method for treating the low-grade ores of Katanga. Copper ore reserves on Jan. 1 last were estimated to be 49,006,000 tons of ore, carrying 2,830,000 tons of copper.

At the annual meeting of shareholders of Fanti Consolidated (Gold Coast Colony, West Africa) in May, 1921, it was stated that a contract had been entered into for the sale of 500,000 tons of manganese ore, deliverable at the rate of 100,000 tons per annum, with a guaranteed minimum profit of 7s. 6d. per ton. At the meeting of shareholders on May 16, Edmund Davis, the chairmman, said the contract was canceled because difficulties had arisen over its interpretation, and, in particular, those relating to items chargeable to working costs previous to arriving at the guaranteed profit. The matter is quite clear, of course, but the question has been asked why the basis was not worked out and agreed upon before the contract was made.

The Electrolytic Zinc Co. of Australasia is now getting to work. The full plant of 30,000 hp., with an output capacity of 45,000 tons of zinc per annum, is expected to be running in July. The company has spent in six years approximately £3,000,000, and the government of Tasmania over £1,000,000, in experimental, development and construction work. The company purchased 750,000 tons of zinc concentrates from the British government, and there is over 100,000 tons of high-grade ore in reserve in the company's own local properties, and approximately 12,000,000 tons of reserves at the

Broken Hill mines. The British government has agreed to purchase 45,000 tons of spelter per annum for a period of years, and, in addition, the company expects to produce over 125,000 tons of sulphuric acid and 15,000 tons of leaded zinc oxide.

Development in the Geduld Proprietary Mines was of such a satisfactory nature last year, about 863,000 tons, which raised the value of the whole 3,545,000 tons of reserves by 0.1 dwt., and the width by 1 in. to 8.1 dwt., over a stoping width of 62 in., that the directors have decided to increase the milling capacity. The nominal capacity of the present reduction plant is 40,000 tons monthly; and it is to be raised to 65,000 tons. This is a step in the right direction, for the property is a large one, and the management has hitherto proceeded very cautiously in the matter of expansion. Their object has evidently been to prove the property first.

CANADA

British Columbia

Shutdown of Dolly Varden Railroad Hinders Work in Alice Arm District

Alice Arm—Mining men and prospectors of the Alice Arm district are in difficulties because of lack of transportation up the Kitsault valley. The Dolly Varden R. R. has been closed down, and the company does not appear to be prepared to maintain a service this season. The provincial government has been asked, it is understood, to take such steps as are necessary to provide the operators of this section with the means of transporting supplies and ore from mines and prospects to tidewater. There is no present indication of how the problem is to be solved.

Kaslo—Preliminary operations incidental to resumption at the Cork-Province mine, on the South Fork of Kaslo Creek, are well under way.

Sandon—The flotation plant of the Silversmith mill has been in operation since May 9, and is reported to be working satisfactorily, with an indicated output of 400 tons of zinc-silver concentrates per month. The output will run 50 per cent zinc, with 35 oz. silver per ton. The concentrates will be stored pending arrangements for shipping to Trail. The other section of the mill is now producing 500 tons of silver-lead concentrate per month. The silver-lead output is netting the company about $90 per ton, and net shipments to date this year approximate $200,000. It is said that dividend payments will start in July, and be maintained regularly on a monthly or quarterly basis.

Trail—Ore received at the Consolidated smelter May 8 to 14 inclusive totaled 7,701 tons, of which 7,107 tons came from the company's mines. The other shippers were: Utica, Adamant, 27; Florence, Princess Creek, B. C., 72; Mountain Chief, West Robson, B. C., 100; Quilp, Republic, Wash., 115; Standard, Silverton, B. C., 193; and Silversmith, Sandon, B. C., 87.

Ontario

Coniagas Option on Newray Ratified—High Heads Continue at Dome

Cobalt—The Coniagas' option on the control of the Newray mine, in Porcupine, at a price of 35c. a share, has been ratified, and diamond drilling will be started at once. The company has to spend $4,000 a month during the life of the option.

Two more veins, carrying some silver, have been cut in the shaft of the Victory mine at a depth of 430 ft.

The 1921 report of the Mining Corporation shows a severe decline in both production and profits, as compared with the previous year. Total revenue was $578,913 from 1,226,717 oz. of silver, and gross profits were $23,420, compared with $651,461 in 1920. After deducting $63,367 for income taxes, there was written off $232,939 loss on Canadian Industrial Minerals Ltd., which was formed to supply war minerals, and $231,023 loss on optioned properties, giving a net loss of $522,434. The company's exploration department covered North and South America, Europe, and Asia, but the best results have been obtained in northern Ontario. The Buffalo purchase turned out to be important, and the Frontier, in South Lorraine, is developing well. The average grade of ore for the year was 20 oz. and cost per oz was 84.64c. Quick assets are given as $1,191,440.

During the week ended May 19 there was no shipment of ore from Cobalt.

Porcupine—The Holtyrex, which adjoins the McIntyre, has let a contract for 3,000 ft. of diamond drilling. The company has been successful in marketing its stock, and has a considerable amount of cash on hand.

The Clifton-Porcupine has been successful in marketing 170,000 shares and work on the property has been resumed. It is said that a small mill will be built.

A report from the Davidson is to the effect that diamond drilling at a depth of 1,200 ft. cut 25 ft. of ore averaging $7.12. It is understood that the London flotation has not been successful and that about 80 per cent of the stock has been turned back to the underwriters.

High heads are continuing at the Dome, and it is understood that the company is considering the repayment of $2 a share on capital account.

A company has been formed to take over the McLeod property at Night Hawk Lake. Developments at the Peninsular have been satisfactory.

Quebec

The asbestos industry of Quebec province has been seriously affected by the falling off in the demand for asbestos in 1921, in consequence of which the output is being greatly curtailed. Practically all the properties in East Broughton and Robertson are closed down, and in the Thetford and Black Lake districts production is on a greatly restricted scale.

MEXICO

Explosives Importing Bill Awaits Signing—Prospecting for Diamonds—Inquiries for Machinery Increase

Mexico City—A decree of vital interest to the mining interests in Mexico authorizing the free and unrestricted importation of explosives is awaiting the President's signature. For several years, owing to revolutionary activities, the importation of explosives has been in the hands of the War Department, and an almost intolerable amount of red tape and frequently "grease" was required to keep the mining camps supplied. Often plants have been obliged to close for weeks at a time because of their inability to get the necessary explosives. Under the proposed ruling, responsible companies will be permitted to import without any restrictions or delays, the government requiring them to make a statement from time to time of quantities received and how and when used.

After a lapse of several years the American press is carrying stories once more of the discovery of diamonds in the State of Guerrero. These reports are based on the alleged discovery of diamonds in that section, just a hundred years ago, by the revolutionary general, Vicente Guerrero. The location is usually given as in the vicinity of Tetela del Oro, in the Sierra Madre range of mountains, southern Mexico.

The republication of these diamond stories has actually started some prospectors on the trail again. Within the past few weeks two small parties have outfitted from this city, and one from the Port of Acapulco. Guerrero is a highly mineralized state, and if the diamond seekers fail in the main purpose, they may find something else to their taste and profit.

Dealers in and agents for mining machinery report a strong increase in the number of inquiries and requests for estimates on mining machinery.

Apparently, most of the inquirers are accumulating figures for their budgets, having in view an early resumption of work or the opening up of new properties. The trend of the inquiries show that the latest ore treatment processes are being considered, and that plans are being made in many instances to treat large quantities of low-grade ores.

Durango

Promontorio Ore Not Amenable to Flotation—Cerro de Mercado Survey Finished

By Alberto Terrones Benitez

Guanacevi—The Cia. Minera de Sultana y Anexas has decided to start work at its properties at San Pedro adjoining the Soto mines. Ignacio Bolivar will be in charge.

Hilario Losoya is negotiating for the installation of an hydro-electric plant near Carrizo, for which a survey has been made.

[illegible] [illegible], manager of the [illegible] Esmeralda, at Guanacevi, is planning to install a gas plant at the San Rafael mines.

Santiago Papasquiaro—The S[illegible] [illegible] & Milling Co. has finished the [illegible] of a fifty-ton mill at S[illegible] near the Tepehuanes railroad terminus. The mill is now treating ores from the [illegible] N[illegible] and Napo[illegible] mines of the company. The concentration ratio is 20 to 1. It is using a Ruth flotation machine, and by the use of sodium sulphide the operators expect to increase the extraction to 87 or 90 per cent. Ore and concentrates are being shipped to the Asarco smelter. At present there is a shortage of labor.

Flotation experiments at the Pro[illegible] mill proved that the ores were not suitable for that process. This is probably due to the fact that the operating company is now treating oxidized ores from the dumps and the upper levels. Operations are still going on. Max Damm is personally in charge.

Durango—Geologists of the Geological Institute of Mexico City have finished their survey of the Cerro de Mercado and of the surrounding country. This is the first important geological survey ever undertaken in Durango, and it is planned to continue the work all over the state. Two geologists and a petrographer will be sent to Guanacevi next October.

According to official reports, an announcement has been made by the federal government to the effect that free importation of explosives and machinery used in mining will soon be decreed.

CALIFORNIA

Original Sixteen-to-One Makes Strike —Estabrook Dredge May Not Resume

[illegible] Special Correspondent

San Francisco—Recently the Original Sixteen-to-One mine, in the Alleghany district, Sierra county, made a rich gold strike, and $250,000 was taken out in drifting 50 ft. through the the oreshoot. No stoping was done, and only the ore in the development work was removed.

The Strode gold mine, near Carrville, Trinity County, has been sold to the Strode Mines Co., an Arizona corporation.

The dredge operated by the Pacific Gold Dredging Co., near Trinity Center has been shut down. It appears likely that the Estabrook dredge which was to have been started up will not resume.

At French Gulch, Shasta County, leasers have started milling at the Brunswick mine. Both the Washing- and the Shasta Hills mines are active.

At Graniteville, Sierra County, a quartz vein of promise has been opened at the Eureka mine. The Plumbago mine, near Downieville, Sierra County, will be reopened. Hugh McCormick is superintendent. Pay gravel has been struck in the Gold Lead placer at North Bloomfield, Nevada County.

NEVADA

Simon Roasting Plant Completed—United Comstock's Crew Two-Thirds Normal

From our Special Correspondent.

Virginia City—No further information has been given out regarding future plans by the Middle Comstock Mines Syndicate, which holds an option on the Middle Comstock group. It is understood that the Paramount Comstock Mines Co., vendors of the property, with permission of the option holders are running a crosscut from the north drift in Savage ground.

Labor conditions underground in the Gold Hill property of the United Comstock Mines Co. are gradually adjusting themselves. The men are returning to work, and the underground crew numbers about 200 men, which is approximately two-thirds of normal.

Mina—The roasting plant at Goldfield is completed, and the Simon Silver-Lead Mines Co. is now shipping its zinc concentrates there for preliminary treatment before shipping to the zinc-oxide plant at Harbor City, Cal. About 1,500 tons of concentrate has accumulated at the mine, content being approximately 44 per cent zinc, 5 per cent lead and 4 oz. silver per ton. The lead concentrate is being shipped to Utah smelters, as usual. Daily tonnage treated is 200, with a production of approximately twenty tons each of lead and zinc concentrates.

The West End Consolidated Mining Co., which holds an option on the Mabel mine, is preparing to sink the shaft to the 300 level. Development work to the west continues to disclose ore, but development to the east toward the old Garfield mine has been disappointing, and work has been stopped in that direction.

Tonopah—Operations in this district are normal, and production is as usual, as indicated by recent bullion shipments. For the first fifteen days of May, shipments were: Tonopah Belmont, $116,000; West End, $86,000; Tonopah Extension, $63,000; and Tonopah Mining, $52,000.

Divide—A body of sulphide ore has been discovered on the 500 level of the Tonopah Divide mine about 600 ft. southeast of the shaft. A winze is being sunk and is down 20 ft. in ore of good grade. The ore carries higher proportionate values in gold than is usual throughout the Divide mine. Net receipts from 1,564 tons of ore shipped during April were $43,872, an average of $28.05 per ton.

Pioche—Shipments for the week ended May 25 are showing a greater variety of producing mines, and in the next ninety days the total should be doubled. Production was: Bristol Silver, 240 tons; Black Metals, 100; Consolidated Nevada Utah, 140; Prince Consolidated, 50; Hamburg, at Highland, 45; total, 575 tons.

The Tempa Mining & Milling Co. expect to start construction of a seventy-five ton mill soon at Fay, twenty-five miles from Pioche.

WASHINGTON

Rich Silver Shipment Made from Old Dominion

Colville—Two carloads of rich silver ore are being sacked for shipment at the Old Dominion mine, near Colville. The management has announced that the shipment will assay 1,100 oz. of silver per ton, and the gross value of two cars is estimated at $80,000.

The Old Dominion is a well-known producer of early days, and is credited with a production of $600,000. It has been practically dormant for twenty years until reopened about a year ago by W. H. Linney. The ore occurs as irregular replacements in limestone and the body which is yielding the high-grade was found about six months ago at a depth of 700 ft. The new development work is being financed by local capital.

Northport — The Washington Black Rock Mining Co. has shipped four cars of high-grade zinc ore recently. These shipments are going principally to Trail smelter. This ore is coming from shaft sinking operations. A new level will soon be opened for stoping.

A discovery of a large body of high-grade gold ore is reported at the Mountain View mine, near Myers Falls, Stevens County. It is understood that the mineralized area was narrowly missed by former operators. The oxidized surface ores carry sufficient values to permit shipment in crude form, and three shifts are now employed getting out the ore.

The Republic mine, a gold producer of the Republic camp, Ferry County, has resumed shipments of crude ore to the Trail smelter.

Chewelah—A car of high-grade crude ore shipped recently by the United Silver-Copper mine netted the company $3,016. Values ran $61.82 silver and $19.90 copper per ton.

OREGON

Bay Horse Mine Continues Crude-Ore Shipments

Huntington—Shipments of crude ore from the Bay Horse mine are being made at the rate of two cars per week, and it is anticipated that three cars per week will be the regular output soon. The ore is going to the Bunker Hill smelter at Bradley, Idaho.

IDAHO

Callahan Zinc's Subsidiary Has High-Grade Ore

Wallace—The ore recently cut by the Galena Mining Co. in the No. 6 tunnel lead at a point 25 ft. above the shaft collar assays 18 per cent lead and 13 oz. silver across the full 4-ft. face of the drift. This ore has now been proved from the 400 level, thus giving a back of 425 ft. It is being drifted on to the east. The point cut is 550 ft. below the crest of the hill. The Galena Mining Co. is a consolidation of the Chicago-Boston and the Killbuck properties. Control is owned by the Callahan Zinc-Lead Co.

ARIZONA

McCracken Silver-Lead Property Sold to Satisfy Judgment

Kingman—The property of the McCracken Silver-Lead Co. has been sold to satisfy a judgment of $13,000. The mine lies in the McCracken Mountains of Mohave County, Ariz. Execution to satisfy a judgment of $21,000 has been issued against the property of the Globe and Lost Gulch Silver-Copper Mines Co. in Gila County, Ariz.

COLORADO

Pactolus Company Building Dredge on South Boulder Creek

Rollinsville—After a year or more of exploration with the churn drill and by test pits, the Pactolus Gold Dredging Co. is installing a dredge on South Boulder Creek, near Rollinsville, in Gilpin County. The company is composed of California interests, and the management is under A. A. Clark, formerly with the Yuba Manufacturing Co., of San Francisco.

The company estimates that its holdings on Boulder Creek comprise 6,000,000 cu.yd. of workable gravel. The hull of the dredge has been completed, and equipment is being installed. Gravel will be lifted to the dredge by a steam shovel mounted on a Holt tractor. The capacity of the dredge is 2,000 cu.yd. in twenty-four hours. Electric power will be used.

A second dredge is being installed on the Gamble Gulch placer, about two miles distant, which will be operated by an allied organization under the name of the Oro Dredge Co. It is estimated that the dredge will handle about 1,200 cu.yd. daily and that the holdings comprise 2,500,000 cu.yd. of workable ground. The depth to bed-rock on both the Pactolus and the Gamble Gulch placers is from 10 to 25 ft.

Montrose—The Western Colorado Power Co., serving the mining camps and towns of the San Juan district, announces that it will expend $130,000 this summer in extending its transmission line from the Camp Bird mine, in Ouray County, to Montrose, in Montrose County, where the line will connect the hydro-electric plant with the steam-generating plant at this place. Increased demand for power at the mines, smelter, and various towns has necessitated the movement to obtain auxiliary generating facilities.

MONTANA

Walkerville—Shipments of ore from the Goldsmith mine of the Crystal Copper Co., whose property is situated north of Walkerville, have been showing increased values in gold and silver from the 600 level. It is planned to sink to the 1,000 level. Three cars assayed respectively as follows: 43.2 oz. of silver and $7.20 in gold; 57.2 oz. of silver and $9.60 gold; and 45.7 oz. of silver and $5.60 in gold, the value of the three cars totaling slightly more than $7,000.

UTAH

Park City Mining & Smelting Corporation Files Articles

Park City—Shipments for the week ended May 19 were 2,411 tons. Shippers were: Silver King Coalition, 766 tons; Ontario, 708; Park Utah, 503; Judge, Daly, and Daly West, 434.

The new milling plant of the Silver King Coalition is treating about 250 tons of ore daily, and producing seventy to seventy-five tons of concentrates.

Production by the Park-Utah, Park City's new producer in the eastern and hitherto undeveloped section of the camp, for the week ended May 19 (503 tons) was twice as much as that for the week preceding.

Articles of incorporation for the Park City Mining & Smelting Co., a Colorado corporation, have been filed with county and state authorities. The company has a capitalization of 1,500,000 shares of non-assessable stock of a value of $7,500,000. All the property and assets of the Daly West Mining Co. are stated to have been conveyed to the new corporation, and it is expected to take in the Judge Mining & Smelting Co., whose stockholders have responded favorably to the plan of a merger, on a basis of 1⅞ shares of stock in the new company for one share of Judge stock. Directors of the new company are: Otto Luedeking, Cincinnati, Ohio; Adolph G. E. Hanke, New York; Harry M. Stonemetz, Boston; Oscar N. Friendly, Park City; G. W. Lambourne and Edward Rosenbaum, of Salt Lake City. Officers are: G. W. Lambourne, president; M. C. Fox, treasurer; O. N. Friendly, manager; D. C. Murphy, secretary and assistant treasurer, and W. A. Dunn, assistant secretary. The new merger offers the advantages that its financial rating will be larger than that of the combined ratings of the companies going to form it (owing to the fact that operations can be coordinated and carried on on a more extensive scale); that, owing to the coalition of interests, some of the tax burdens will be eliminated; and that the properties will be placed on a more uniform earning basis.

MICHIGAN

The Copper Country

New Baltic Shaft in Well Mineralized Ground—Mayflower Cuts Lode 1,450 Level

By M. W. Youngs

Houghton—Quincy is producing approximately 1,500,000 lb. of refined copper per month. This includes mass copper, which constitutes almost one-fourth of the output. Quincy has long been noted for the quantity of its mass. The company is making a good record in its No. 1 stamp mill in recovering copper from the tailings. It has reduced losses to about 4½ lb. per ton of rock stamped. Quincy's yield from vein rock is about 17 lb. per ton, mass copper bringing this up to 22.12 lb. in 1921.

The south drift at the 1,100 level of Arcadian Consolidated's New Baltic shaft continues in highly mineralized ground. The miners are in over 50 ft. in this rich zone, and there is no change in the character of the rock. The vein is 10 to 12 ft. wide and is heavily shot with copper, the showing being considered the equal of any ever uncovered in an amygdaloid lode in the Lake district. To the north of the shaft, at the same level, the vein also is well charged with copper.

Mayflower-Old Colony has met what is thought to be the Mayflower lode in the west crosscut at the 1,450 level. It carries some copper, and opening work here will continue in an effort to establish the strike. If the boundaries of the fault can be thus determined by this means, further development of the property will be attended with less uncertainty.

Seneca is making good headway in repairing No. 2 shaft, Gratiot, the shaft having been stripped to the thirteenth or bottom level, ready for the laying of a concrete skipway. With the completion of this work, sinking will be resumed. The old hoist will be used temporarily, but the new power and hoisting plant will be ready, it is expected, to go into operation by midsummer.

Ahmeek continues to take mass copper from the fissure vein in No. 2 shaft, the best showing in this vein being in the ninteenth level drift, west, where a fourteen-ton mass recently was cut from the main deposit. Ahmeek mass, it is estimated, adds fully 20 per cent to the production of the mine.

There is no change in Calumet & Hecla's operatione. Repairs to the Red Jacket shaft probably will take the greater part of the summer, and in the meantime No. 5 shaft will handle the tonnage ordinarily hoisted through the Red Jacket. Eventually, when the haulageway at the eighty-first level is completed, this will be the only hoisting shaft, and changes are being made with that end in view.

Gogebic Range

Freight Reduction Less Than Expected—Ottawa to Resume Mining

Ironwood—Pickands, Mather & Co. has started shipping a moderate amount of ore from the Plymouth pit at Wakefield.

Probably with the announcement of freight reductions effective July 1, the mining companies will make plans to begin heavy shipping on that date. The reduction in rates on ore is not as much as the mines had expected. Ore rates were formerly set to include the cost of switching and of spotting cars for steam shovels. When the Government took over the railroads it raised the rates in the same proportion as on other freight and in addition charged high rates for switching and spotting. On many roads in the mining country the ore traffic was made to "carry" all other traffic. It is this situation from which the mining com-

[illegible] have sought relief. Some of the larger [illegible] operators own their own railroads and are not much interested in increases, so that the fight for lower rates has been left to the smaller companies.

The mills are working at [illegible] [illegible], and regular mining will be resumed as soon as possible. During the depression nothing but development work was done.

Marquette Range

Isabella Mine to Put On Full Crew—Valuation of Marquette County Mines Less

By William H. Newett

Palmer—The Steel & Tube Co. of America has issued orders to put on a full crew at the Isabella mine. Development work and a little mining were being done. A diamond drill has been placed at work on surface. The Richmond pit of the Richmond Iron Co. has started work and is shipping. This property is worked only during the period of navigation.

Negaunee—The Cleveland-Cliffs Iron Co. is again mining ore at the South Jackson pit. Few shipments are being made from any of the mines in the district, and most of the stockpiles are large.

Ishpeming—The State Tax Commission has placed a valuation of $35,000,000 on the iron ore mines of Marquette County for this year. This is a reduction of $300,000 from last year's figures.

Menominee Range

Bengal Mine to Resume Work—Two New Furnaces This Year

Iron River—Orders have been given by Pickands, Mather & Co. to resume operations at the Bengal mine, idle for two years. About 200 men will be employed. Ore hoisted will be shipped direct to the docks. The tax commission has granted a reduction in valuation of 10 per cent to idle mines and 5 per cent to active in the Iron River field.

Quinnesec—A considerable tonnage of low-grade iron ore has been developed by diamond drilling on the McKenna lands, and this will be mined and melted in the new blast furnace to be erected here. Another blast furnace is to be built at Iron Mountain to take ore from the West Chapin mines. It is expected that both will be built this year.

MINNESOTA

Mesabi Range

Oliver Company Starts Mining at Hull-Rust Pit

Hibbing—Ore operations at the Hull-Rust open pit, operated by the Oliver Iron Mining Co., have begun on a small scale.

The Rogers Brown Iron Mining Co. has resumed sinking on one shift.

Ely—The Zenith mine, operated by the Zenith Iron Mining Co., has begun shipping. The total hoist is being shipped daily.

JOPLIN-MIAMI DISTRICT

Hearing on Indian Lands Held at Miami

By P. R. Coldren

Joplin—A special hearing was begun at Miami, Okla., on May 26, before the special commission sent by the Indian Department to determine the value of Indian zinc and lead lands in Ottawa County, Okla.

It is expected that this hearing will be the final one before a report is made by the commission. It is being conducted at the Hotel Miami, and the important feature of the first day of the hearing was the announcement by W. W. Hastings and Horace B. Durant, attorneys for the Indians, that they considered 15 per cent a fair royalty for the lands.

This is at least 5 per cent higher than the ore producers feel the royalty ought to be, and some believe it should be no higher than 7½ per cent. They point out, too, that a higher royalty than 10 per cent will probably work to keep down operation of many mines and thus deprive the Indian land owners of money that they ordinarily would get.

The hearing is being held before J. E. Dawson, special supervisor from the U. S. Bureau of Mines, and O. K. Chandler, Quapaw Indian agent at Miami.

It is understood the investigation that has been conducted by the special commission is practically completed.

Zinc-ore producers are complaining of a shortage of shovelers in the district, a condition brought about largely by the fact that many of the men who who ordinarily work at shoveling have gone with their families to the strawberry fields in and near Joplin.

NEW YORK

Northern Ore Co. to Increase Output 50 Per Cent

Edwards.—The Northern Ore Co. is operating at maximum capacity and is planning to increase its production 50 per cent as fast as machinery and men can be secured. Effective May 1 the wage scale was advanced approximately 15 per cent. The company is employing practically all applicants. It has purchased electric haulage equipment and will electrify the underground haulage system. New equipment is to be installed in the mill to increase capacity. W. R. Wade is manager.

GEORGIA

Development of Bauxite Lands Proposed

F. C. Dunn, of 12 Bridge St., Hackensack, N. J., has taken an option on about 2,000 acres of clay land in Georgia, including deposits of bauxite, fuller's earth, and kaolin. The bauxite deposit is said to cover an area of about 500 acres and to represent a large tonnage. It is reported that a company will be organized to take over this land and install sufficient machinery to mine the bauxite. A three-and-a-half-mile railway spur will be needed.

ALABAMA

Furnace Activity Increasing—Interest Aroused in Raw Material Sources of State

By George Huntington Clark

Birmingham—The steady increase in iron making in Alabama shows no sign as yet of having reached a stopping point. To its two furnaces already active, one at Sheffield and the other at North Birmingham, the Sloss-Sheffield Steel & Iron Co. has added another at North Birmingham. Also it is announced that one City furnace and the Philadelphia furnace of the company will be making iron the first week in June, this bringing production to normal.

After two years of idleness, the Woodstock Operating Corporation, of Alabama, which controls the La Follette blast furnace situated at La Follette, Tenn., and the Woodstock blast furnace properties at Anniston, Ala., is preparing to resume operations at La Follette. The coal mines at La Follette are already in active operation. The Talladega furnace of the Bird Coal & Iron Co., which was rebuilt, will be started again, as soon as possible, together with the company's own coal mines and coke plant, red and brown ore mines, and limestone quarries.

Owing to the success of new methods for extracting aluminum from substances hitherto considered as not of commercial value, much interest has been aroused in this class of raw materials which are known to exist in substantial amounts in Alabama near available power sources.

To assist development of raw materials, the Alabama Geological Survey has established a substation as Birmingham. Here will be assembled exhibits of every class of raw material found in the state, together with all information obtainable.

ILLINOIS

Hillside Fluorspar Mines Completes New Plant

Rosiclaire.—The Hillside Fluorspar Mines has completed its new plant. Its new mine is now opened by a shaft and on three levels, the lowest being at 350 ft. The mine and mill are equipped electrically throughout. Concrete storage bins are used and are drained and covered to insure dry spar, which is loaded directly into Illinois Central cars at Roseview by belt conveyors. The mine on the original Rosiclaire vein is producing gravel and lump fluorspar.

VIRGINIA

Lyndhurst.—The Mount Tory Furnace tract consisting of more than 8,000 acres, including the Mount Tory iron and manganese mines, has been purchased by the Mount Tory Products Co. The company plans to erect a blast furnace and add mining equipment. Bonds will be issued to finance the improvements.

THE MARKET REPORT

Daily Prices of Metals

May	Copper, N. Y., net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
25	13.625	30.25	31.125	5.50@5.625	5.425	5.20
26	13.625	30.25	31.125	5.50@5.625	5.45@5.50	5.225@5.25
27	13.625	30.25	31.25	5.50@5.65	5.45@5.50	5.25
29	13.625	30.50	31.50	5.50@5.75	5.50	5.25
30	......	.....	......	.	......	....
31	13.625	30.75	31.75	5.65@5.75	5.50	5.25@5.30

*These prices correspond to the following quotations for copper delivered: 13.875c. for the week.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

May	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
25	62⅜	62¾	68½	151	152½	24⅞	23⅜	27⅝	27½
26	62⅜	62¾	68½	150⅜	151¾	25	23⅜	27⅞	27¾
27	...	...	...	....	....	...	...	...	...
29	62⅜	62¾	68½	151	152¼	25	23½	28⅛	27⅞
30	62⅝	63	68½	152¼	153½	25⅛	23⅝	28⅛	27⅞
31	62¾	63⅛	68½	152⅜	153¼	25¼	23¾	28⅛	27⅞

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

May	Sterling Exchange "Checks"	Silver			May	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
25	444½	99⅝	72¼	36⅝	29	444½	99⅝	71⅞	36⅜
26	444½	99⅝	72¼	36⅝	30	....	...	...	36½
27	444⅝	99⅝	71½	36¼	31	444⅝	99⅝	72¼	36½

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, May 31, 1922

The metal markets have been quiet, owing to the Memorial Day holiday yesterday, especially as it was at the end of the month. Prices have in general held their own or advanced moderately. The coal strike still appears far from settlement, but no fuel scarcity is yet apparent at most plants.

The average prices for May published in another column reflect the improvement in metal prices which has taken place in the last two or three months. The figure for copper is one-half cent above the March and April average. Copper has shown a decidedly advancing tendency since the first of April. The lead average of 5.4c. compares with 4.7c. in March and 5.1c. in April. The advance in zinc has been regular and long continued, the upward movement dating from February. In that month the average was 4.5c., increasing by 0.2c. each following month. Zinc is still below the price of lead, however, an unusual condition for normal times. Tin has not fluctuated widely, but has been successively stronger the last two months. The advance in silver began on the first of March, the average for that month being 64.4c., and for April, 66.6c. Quicksilver and antimony also are advancing. Platinum has held exceptionally steady for four months.

Average Metal Prices for May

Copper

New York Electrolytic	13.111
London Standard	61.092
London Electrolytic	66.554
Lead:	
New York	5.420
St. Louis	5.281
London	24.462
Silver:	
New York, foreign	71.154
New York, domestic	99.625
London	36.023
Sterling Exchange	444.106
Zinc:	
St. Louis	5.110
London	27.304
Tin:	
99 per cent	30.149
Straits	30.971
London	150.163
Antimony	5.467
Quicksilver	54 885
Platinum	85.529

Copper

Sales have not been of large volume, and the advance in price has not been continued. On Thursday and Friday, some effort was made to obtain 14c. delivered, but this price was, in general, realized only on carload lots, or where delivery charges were higher than normal. Practically all producers were quoting and selling at 13.875c. delivered, though it was possible to shade this price by 5 or 10 points on Monday and today in transactions where consumers' plants are so situated that freight rates are not more than 10c. or 15c. per hundred pounds. Copper for spot and June delivery was in only slight demand, most of the business being for July and August, with an occasional order for September. Near-by deliveries are bringing the same prices as are asked for later deliveries, though only one or two producers have any metal available for prompt shipment.

European prices ranged from 13¾ to 14⅛c. c.i.f. on business of approximately normal volume.

Lead

The official contract price of the American Smelting & Refining Co. was advanced from 5.50 to 5.65c. per lb., New York, on Monday, May 29.

Though somewhat affected by the higher prices and the holiday, lead sales have continued in large volume, with some good-sized orders in the market. The demand has been good recently for corroding grades, which are commanding 10 points' premium. After Thursday, there was practically no lead available for less than 5⅝c. in the open market in New York, and prompt supplies even at this price were decidedly [illegible] many producers having sold out for May and the greater part of June. Today the usual price is 5.75c., with occasional quotations of prompt lead at 5.80c. The St. Louis market has advanced to a less degree, 5.50c. being generally realized on Monday and today. In that district there is now a pronounced effort to avoid a runaway market, and a lot of lead will probably be sold before the price goes much higher. An unhealthy reaction is feared by some producers, though fundamental conditions continue excellent, and the lead is not unexpected. The present firm market throughout the world is, of course, due to curtailed production in Spain and Australia, but production in those countries will doubtless gradually increase when conditions become more normal.

Zinc

The market has not been an active one, but prices show a slight advance. All weakly held lots have disappeared from the market, and stocks are now so low that producers are not anxious to sell beyond current production. Were the coal strike settled, the demand for zinc would be likely to improve rapidly, with a sharp advance in prices. As it is, there seems no reason why the gradual advance of the last three months should not be continued. High-grade has advanced to 6½c., with freight allowed, after continuing at 6c. for many weeks. Premiums for forward deliveries vary from 2½ to 5 points for each month beyond June. New York prices are 35 points above the St. Louis quotations.

Tin

Spot supplies of both 99 and Straits tin are rather scarce, but inquiry is not insistent. Prices continue substantially unchanged, nor is any disturbing factor now apparent. Tin for forward delivery has been available during the last three or four days at from ¼ to ½c. discount from the prices asked for spot.

Arrivals of tin, in long tons: May 23d, Straits, 75; 24th, Straits, 75; 25th, China, 15; 26th, Straits, 5; Liverpool, 50; 29th, London, 25; Batavia, 200.

Gold

Gold in London: May 25th, 93s. 5d.; 26th, 93s. 5d.; 29th, 93s. 3d.; 30th, 92s. 9d.; 31st, 92s. 9d.

Foreign Exchange

Foreign exchanges were featureless for the week. Today, francs were 9.125c.; lire, 5.235c.; marks, 0.3675c.; and Canadian dollars, 99.03c.

Silver

The weakness which developed last week continued until the 27th. On that date prices steadied and have advanced slightly since. The market closes quiet, but appears firm in tone, with a moderate inquiry from China.

Mexican **Dollars**—May 25th, 55¼; 26th, 55¼; 27th, 54⅝; 29th, 55; 31st, [illegible]

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17.25@18.25c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 5.40@5.50c. W.C.C., 6@6½c. Cookson's "C" grade, spot, 8.75c. Chinese needle antimony, lump, nominal, 3.5@4c. per lb. Standard powdered needle antimony (200 mesh) nominal at 5¼c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 6.75@7c.

Bismuth—$2@$2.10 per lb.

Cadmium—$1.15@$1.20 per lb.

Cobalt — Metal, $3@$3.25 per lb., black oxide, $2 per lb. in bbls.

Iridium—Nominal, $150@$170 per oz.

Magnesium—Ingots, 99 per cent, $1.10 per lb.

[1]**Molybdenum Metal**—In rod or wire form, 99.9 per cent pure, $32@$40 per lb., according to gage.

Monel Metal—Shot, 32c.; blocks, 32c. per lb., f.o.b. Bayonne, N. J.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Outside market quiet at 29@32c. per lb.

Osmium—$70 per troy oz. Nominal, $70, Los Angeles, Cal.

Palladium—$55 per oz.

Platinum—$85@$87.50 per oz.

Quicksilver—$55 per 75-lb. flask. San Francisco wires $54.70. Firm.

[1]**Rhodium**—$100@$115 per troy oz.

[1]**Selenium** — Black powdered, amorphous, 99.5 per cent pure, $2@$2.25 per lb.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $18@$20 per lb.

[1]**Tungsten Metal**—Wire, $35@$60 per kilogram, according to purity and gage.

Metallic Ores

Chrome Ore—Basis 48 per cent Cr_2O_3, 40@45c. per unit, c.i.f. North Atlantic ports. Limited demand for 40@44 per cent Cr_2O_3 at $20 per net ton, f.o.b. Oregon main-line points.

Iron Ore—Lake Superior ores, per ton, Lower Lake ports: Old Range bessemer, 55 per cent iron, $6.45; Mesabi bessemer, 55 per cent iron, $6.20; Old Range non-bessemer, 51½ per cent iron, $5.70; Mesabi non-bessemer, 51½ per cent iron, $5.55.

Magnetite Ore — F.o.b. Port Henry N. Y.: Old bed 21 furnace, $4.85; old bed concentrates, 63 per cent, $5.75; Harmony, cobbed, 63 per cent, $5.75; new bed low phosphorus, 65 per cent, $8.50.

Manganese Ore—26@27c. per unit, seaport; chemical ore, $45@$60 per gross ton, lump. Nominal.

Molybdenum Ore—50c. per lb. of MoS_2, for 85 per cent MoS_2 concentrates. Demand is good.

Tantalum Ore—Guaranteed minimum 60 per cent tantalic acid, 50c. per lb. in ton lots. Hand-sorted ore, 70 per cent combined columbite-tantalite, active at 40c. per lb., South Dakota.

[1]**Titanium Ores**—Ilmenite 52 per cent TiO_2, 1¾@2c. per lb. for ore. Rutile, 95 per cent TiO_2, 12c. per lb. for ore, with concessions on large lots or contracts.

Tungsten Ore — Chinese ore, $3.50@$3.75 per unit of WO_3. Colorado producers remain closed down on account of lack of profitable market.

Uranium Ore (Carnotite) — Ore containing 1½ per cent U_3O_8 and 5 per cent V_2O_5 sells for $1.50 per lb. of U_3O_8 and 75c. per lb. of V_2O_5; ore containing 2 per cent U_3O_8 and 5 per cent V_2O_5 sells for $2.25 and 75c. per lb., respectively. Market reported dead in Colorado.

Vanadium Ore—$1 per lb. of V_2O_5 (guaranteed minimum of 18 per cent V_2O_5), New York. Nominal.

Zircon — Zirconium silicate, f.o.b. Pablo, Fla., 4½@13c. per lb.

Zinc and Lead Ore Markets

Joplin, Mo., May 27—Zinc blende, per ton, high, $32.30; basis 60 per cent zinc, premium, $31.50; Prime Western, $29@$32.50; fines and slimes $28@$27; average settling price, all grades of blende, $29.69. Calamine, basis 40 per cent zinc, $15.

Lead, high, $73.40; basis 80 per cent lead, $70; average settling price, all lead ores, $71.11 per ton.

Shipments for the week: Blende, 11,570; calamine, 32; lead, 1,888 tons. Value, all ores the week, $448,270.

Shipments for five months: Blende, 176,503; calamine, 458; lead, 39,195 tons. Value, all ores five months, $7,418,140.

In the purchase on $32.50 basis the blende was high in iron, and the higher basis was offered rather than reduce the system of penalizing for iron content.

Lead continues in strong demand, though two concerns have dropped from the market. The remaining three in the market keep competition keen enough on the ruling basis price.

Platteville, Wis., May 27—Blende, basis 60 per cent zinc, $31 per ton. Lead ore, basis 80 per cent lead, $73.50 per ton. Shipments for the week: Blende, 407 tons; lead ore, 70 tons. Shipments for the year: Blende 6,407 tons; lead ore, 937 tons. Shipped during the week to separating plants, 663 tons blende.

Non-Metallic Minerals

Asbestos—No. 1 crude, $900@$1,200 per ton, f.o.b. Quebec mines; No. 2, $450@$600; long spinning fibre, $350@$500; spinning fibre, $250@$350; shingle stock, $90@$125; paper stock, $35@$55; cement stock, $22@$28; short fibre, $15. Market is decidedly improved on all short fibres. Movement of crudes and spinning fibres is slow.

Barytes—Crude, $9 per ton, f.o.b. mines. Ground white, $23, f.o.b. mills. Off-color grades, $16@$21, f.o.b. Southern mills. Foreign barytes, c.i.f. New York, $7.80@$8.25 per ton crude.

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[1] Furnished by Foote Mineral Co., Philadelphia, Pa.

Market improving for chemical, rubber, and paint uses.

Bauxite — American, crushed and dried, \$6@\$9 per gross ton; pulverized and dried, \$12@\$14 per gross ton; calcined, \$22@\$25 per gross ton, all f.o.b. shipping points. Foreign bauxite offered at \$5@\$8 per metric ton, c.i.f. Atlantic ports, depending upon grade.

Borax—Granulated, crystals or powdered, in bags, carloads, 5¼c. per lb.; in bbls., 5½c. Boric acid, 11c. Dull.

Chalk—English, extra light, 5c. Domestic light, 4¼@4½c.; heavy, 3½@3¾c. per lb., all f.o.b. New York.

China Clay (Kaolin)—Crude, \$6@\$8; washed, \$8@\$9; powdered, \$12@\$20; bags extra, per net ton, f.o.b. mines, Georgia; powdered clay, \$13@\$20, f.o.b. Virginia points. Imported lump, \$14@\$20, f.o.b. American ports; powdered, \$35@\$45, f.o.b., New York.

Emery—Turkish emery, 6c. per lb. American, 4c. Inferior grades, 3½c., f.o.b. from New England points. Market good and improving.

Feldspar—No. 1 pottery grade, crude, unground, \$6.40 per ton, f.o.b. mines; demand good. No. 1 Canadian, \$22 per short ton, Ohio mills; demand poor. In North Carolina, No. 1, 140 mesh, bulk, \$17.50 per ton, f.o.b. factory; No. 2, 90 to 100 mesh, \$9.50. Market fair.

Fluorspar — Lump, guaranteed 85 per cent calcium fluoride and not over 6 per cent silica, \$20 per ton; gravel, \$17.50. Acid, lump, \$40@\$50. No. 1 ground, \$50@\$55, f.o.b. Illinois and Kentucky mines. Lump, \$12.50@\$13.50; ground, 95@96 per cent, \$25@\$26, f.o.b. New Mexico. Fairly active.

Fuller's Earth—16 to 30 mesh, \$19 per ton; 30 to 60 mesh, \$17.50; 60 to 100 mesh, \$14; 100 mesh and finer, \$14; f.o.b. Florida mines. Exceptionally little demand in East, but some Texas mills running full capacity.

Graphite—Ceylon lump, first quality, 6@7c.; chip, 4½@5½c.; dust, 3¼@4c. per lb.; No. 1 flake, 7@8c.; amorphous crude, domestic, \$15@\$25 per ton (f.o.b. cars); foreign, \$55@\$65 per ton, depending upon quality. Unless otherwise noted, all f.o.b. New York. Practically no market at any price except for best grades.

Gypsum — Crushed rock, \$3@\$4.50 per ton, depending upon shipping point. Ground, \$4, f.o.b. shipping point.

Kaolin—See China Clay.

Limestone—Crushed, New York State shipping points, ½ in. and larger, \$1.10@\$1.25 per net ton. Agricultural limestone, \$2.50@\$3 net ton, f.o.b. eastern shipping points.

Magnesite—Crude, \$8@\$12 per ton. High-grade caustic calcined, lump form, \$30@\$45 per ton. Plastic calcined, \$45@\$50 in bbls., carload lots, f.o.b. California points. Atlantic seaboard, \$60.

Dead-Burned — \$33 per net ton, Chewelah, Wash.; \$58@\$64, Chester, Pa. Austrian grade, \$28 per ton, f.o.b. Baltimore. (Magnesite brick — See Refractories.)

Mica — India block mica, slightly stained, per lb.; No. 6, 35c.; No. 5, \$1.25; No. 4, \$2.25; No. 3, \$2.90; No. 2, \$4; No. 1, \$5.20. Clear block: No. 6, 50c.; No. 5, \$1.75; No. 4, \$3; No. 3, \$4.75; No. 2, \$6; No. 1, \$7.50; A1, \$9; ground, wallpaper grade, \$90@\$200 per ton (depending upon quantity); ground roofing mica, \$25@\$70, all f.o.b. New York. Water-ground mica, 100 and 160 mesh, 6½c. per lb., f.o.b. Virginia points.

[1]**Monazite**—Minimum 6 per cent ThO_2, 8@10c. per lb.

Phosphate Rock—Per long ton, Florida ports, pebble grade: 77 per cent tricalcium phosphate, \$8.50 (\$9.50 for hard rock); 75 per cent, \$7; 75@74 per cent, \$6.50; 70 per cent, \$4.75; 68@66 per cent, \$4.40.

Pumice Stone—Imported, lump, 3@40c. per lb.; domestic lump, 5c.; ground, 5@6c., all f.o.b. New York.

Pyrites—Spanish fines, per unit, 12c., c.i.f. Atlantic seaports; furnace size, 13c.; Spanish lump, 13@14c.; domestic fines, f.o.b. mines, Georgia, 11@12c.

Silica—Glass sand, \$0.75@\$1.75 per ton; sand-blast material, \$2@\$4, f.o.b. Indiana and Illinois points.

Sulphur—\$16@\$18 per ton for domestic, f.o.b. Texas and Louisiana mines; \$18@\$20 for export, f.a.s. New York.

Talc—Through 200 mesh, \$18 per ton, f.o.b. California mills; \$13.50, New York mills. Through No. 25 Swiss silk, \$25, California. Tendency is for a finer grind, some paint makers desiring 300 mesh.

Mineral Products

Arsenic Oxide—7c. per lb.

Copper Sulphate—Nominally 6c. per lb. Extremely scarce.

Potassium Sulphate — Powder, domestic, \$1 per unit, basis 90 per cent, f.o.b. New York.

Sodium Nitrate—\$2.70@\$2.80 per 100 lb. ex-vessel Atlantic ports.

Sodium Sulphate—\$20@\$25 per ton, New York.

Ferro-Alloys

Ferrocerium—Per lb., \$12@\$15.

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 11c. per lb. of chromium contained; 4 to 6 per cent carbon, 12c., f.o.b. works.

Ferromanganese—Domestic, 78 to 82 per cent, \$67@\$69, f.o.b. furnace; English, \$67.50; German, \$66, both c.i.f. Atlantic seaports. Spiegeleisen, 19 to 21 per cent, scarce at \$36 per gross ton, f.o.b. furnace; 16 to 19 per cent, \$35.

Ferromolybdenum—\$2@\$2.50 per lb. of contained molybdenum for 50 to 55 per cent grades.

Ferrosilicon—For 10 to 15 per cent, per gross ton, f.o.b. works, \$38@\$40; 50 per cent, \$56@\$58; 75 per cent, \$115@\$120.

Ferrotitanium—For 15 to 18 per cent material, \$200@\$225 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten — Domestic, 70 to 80 per cent W, 45@50c. per lb. of contained W, f.o.b. works.

Ferro-uranium—35 to 50 per cent U, \$6 per lb. of U contained, f.o.b. works.

Ferrovanadium—\$3.75@\$4 per lb. of V contained. Market active.

Metal Products

Copper Sheets — New York base, 20.25c. per lb.; wire, 15.25c.

Lead Sheets—Full lead sheets, 8.75c., cut lead sheets, 9c. in quantity, mill lots.

Nickel Silver—26.75c. per lb. for 18 per cent nickel Grade "A" sheets.

Yellow Metal — Dimension sheets, 17.50c.; rods, 14.50c.

Zinc Sheets—\$7.50 per 100 lb. less 8 per cent on carload lots, f.o.b. works.

Refractories

Bauxite Brick—56 per cent alumina, \$130 per 1,000; 76 per cent, Suprafrax, \$200 per 1,000; f.o.b. works, St. Louis and Pittsburgh.

Chrome Brick—\$40@\$42 per net ton.

Chrome Cement—\$23 per net ton, Baltimore.

Firebrick—First quality, 9-in. shapes, \$28@\$35 per 1,000, Pennsylvania, Ohio and Kentucky.

Magnesite Brick—9-in., straights, \$53 per net ton, f.o.b. works.

Magnesite Cement—\$33 per net ton, Baltimore.

Silica Brick—9-in., per 1,000, \$30@\$35 in carload lots, f.o.b. shipping points.

Zirkite—Powdered, \$50@\$60 per ton; brick, \$100 per ton.

The Iron Trade

Pittsburgh, May 29, 1922

The steel market has grown even quieter in the last week. The price situation shows the market to be in strong position. Bars, shapes and plates are at 1.60c. as minimum, and some sales run up to 1.80c., representing a delivery premium of \$4 a ton. Sheets are firm at the 3.15c. basis, with some selling into third quarter at this figure, and some independent mills quoting advanced prices. At this writing the American Sheet & Tin Plate Co. has not opened order books for third quarter. It is established that tin plate will not be advanced from \$4.75.

Steel ingot production is at a rate of about 38,000,000 tons a year. The Carnegie Steel Co. is operating thirty-five blast furnaces, against thirty-four on April 1.

Pig Iron—A few small sales of bessemer have established a price of \$25, Valley, against the former nominal quotation of \$26. Basic remains quotable at \$25 and foundry at \$24, Valley.

Connellsville Coke — Buying for a furnace at Monessen about to resume has helped to advance the market to \$7 on furnace coke, and foundry coke, with light demand, is up to \$7 in sympathy. Connellsville coal is easier, at \$3@\$3.25 for steam grade.

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[1] Foote Mineral Co., Philadelphia, Pa.

COMPANY REPORTS

Chino Copper Co.

The statement of operations of the Chino Copper Co. for the year ended Dec. 31, 1921, is as follows:

[illegible]		
[illegible]	$1,190,203	
[illegible] @ $20.00	4,288	
		$1,194,492
[illegible]		
[illegible]	$385,686	
[illegible]	54,694	
[illegible]	497,096	
[illegible]	409,105	
[illegible]	30,545	
		1,377,128
[illegible]		$182,635
[illegible]		54,871
		$127,764
[illegible]		
[illegible]		
[illegible]	474,304	
[illegible]	610,348	
[illegible]	101,787	
		1,186,440
[illegible]		$1,314,204

CURRENT ASSETS

	Dec. 31, 1921	Dec. 31, 1920
[illegible]	$1,365,482	$4,727,844
[illegible]	10,768	23,255
[illegible]		88,458
[illegible]	70,791	70,791
[illegible]	181,652	180,100
[illegible]	1,416,342	1,744,854
[illegible]	699,603	385,785
[illegible]	354,555	148,614
[illegible]	$4,099,196	$7,369,705

CURRENT LIABILITIES

[illegible]	$39,304	$232,529
[illegible]	1,547,387	1,565,773
[illegible]	28,937	315,928
[illegible]	750,000	1,750,064
[illegible]	$2,365,628	$3,864,296
Surplus quick assets	1,733,568	3,505,409

SURPLUS FROM OPERATIONS

Balance, Dec. 31, 1920	$13,889,908
[illegible] deduction for depletion	1,314,204
Balance, Dec. 31, 1921	$12,575,703

Because of industrial conditions, the mine at Santa Rita, N. M., was closed down on April 8, and the mill at Hurley on April 12. Operating at 30 per cent of capacity, the net cost was 14.5c per lb. of copper, excluding Federal and excess-profits taxes and depreciation, but including income from precious metals and miscellaneous sources. A total of 361,660 tons was treated, averaging 1.70 per cent copper. Reserves are 105,385,000 tons, of an average grade of 1.58 per cent copper.

North Star Mines Co.

A report of operations of the North Star Mines Co. for 1921 states that during the year the gross production of the mine was $922,769.58. The expenses for current operation amounted to $632,077.59 and for development to $109,148.57, or a total outlay for operation and development of $741,226.16, leaving an operating profit of $181,543.42. At the Champion mines, the sum of $14,109.55 was received as net proceeds of the sale of old materials salvaged, of which $5,000 was credited to improvement account and $9,109.55 to operating account.

The final cleaning up of the Champion mine resulted in a production of $704.25, while sundry expenses amounted to $6,625.17, so that there was a net credit to Champion operating account of $3,188.63. The total production of the company's mines was therefore $923,473.83, with total operating and development expenses of $738,741.78, leaving an operating profit of $184,732.05. Interest and dividends on invested funds amounted to $42,366.64, increasing the total net earnings of the year, before deduction of allowance for depletion and depreciation, to $227,098.69, or, including profit of $2,250 realized from sale of investments, $229,348.69.

The amount allowed for depletion and depreciation at the North Star mine, on the same basis as in previous years, was $175,340.19. At the Champion, the value of the mine having already been written down to the nominal sum of $1,000, no further allowance was made for depletion. The remaining book value of the improvements, after credit of $5,000 received for old materials salvaged, as above stated, and after deducting $9,474.35 as the depreciation allowance for 1921, calculated at the rate established several years ago, was $33,204.15. As operations at the Champion mine have now been finally abandoned, the improvements have no value beyond such small amount as may still be obtained from the sale of materials remaining on hand, and consequently a further allowance of $20,000 was made to represent the loss on the improvements, reducing their book value as at the end of 1921 to $13,204.14. The aggregate amount allowed for depletion and depreciation in 1921 was therefore $204,814.54, reducing the net surplus on the year's operations to $24,534.15. This sum was applied in reduction of the deficiency in surplus account, which at the beginning of the year amounted to $373,166.74, leaving a deficit at the end of 1921 of $348,632.59, as shown in the accompanying balance sheet. One dividend of 2 per cent, amounting to $50,000, was declared as a distribution of capital assets and paid in March.

Deficit Dec. 31, 1920, was $373,166.74. Production for 1921 was $923,473.83, to which interests and dividends was added, giving a total of $968,090.47. Operating and development expenses were $738,741.78; depletion amounted to $152,000, and depreciation was $52,814.54; a total of $943,556.32. Profit was $24,534.15 and the deficit balance on Dec. 31, 1921, $348,632.59.

Tharsis Sulphur & Copper Co., Ltd.

The operations of the Tharsis Sulphur & Copper Co. at its works in Spain were suspended during the greater part of 1921, owing to the small demand for pyrites. Operations at the metal works in England were suspended by the coal miners' strike, and are only gradually being resumed as demand arises for purple iron ore, their chief product.

The profit-and-loss account on Dec. 31, 1921, was as follows:

DEBIT

Income and corporation profits taxes, directors' and auditors' fees		£58,815
Charges account, including management, salaries, law and laboratory expenses		32,848
Amount written off property in Spain		4,587
Net profit for 1921	£45,945	
Net profit for 1920	27,156	
Balance		73,101
		£169,350

CREDIT

Balance carried forward	£158,406	
Less dividend, May 10, 1921	131,250	
		27,156
Interest account		12,668
Profit for 1921		129,526
		£169,350

There are 625,000 shares of £2 each, fully paid. Property and assets total £2,052,560.

METAL STATISTICS

Monthly Average Prices of Metals

Silver

	New York 1921	New York 1922	London 1921	London 1922	Sterling Exchange 1921	Sterling Exchange 1922
January	65 950	65 450	39 985	35 [illegible]	372 650	421 750
February	59 233	65 290	34 745	33 891	385 932	435 511
March	56 023	64 440	32 479	33 269	389 806	436 912
April	59 337	66 575	34 250	34 080	391 784	440 715
May	59 810	71.154	34 165	36 023	396 580	444 106
June	58 510	......	34 971		377 236	
July	60 260	......	37 481		362 565	
August	61 597	......	38 096		364 505	
September	66 160	......	40 082		371 725	
October	70 970	......	41 442		386 315	
November	68 234	......	38 750		396 315	
December	65 760	..	35 645		414 880	
Year	62 654		36 841		384 191	

New York quotations cents per ounce troy, 999 fine. London, pence per ounce, sterling silver, 925 fine.

Copper

	New York Electrolytic 1921	New York Electrolytic 1922	London Standard 1921	London Standard 1922	London Electrolytic 1921	London Electrolytic 1922
January	12 597	13 465	70.964	65 226	79 119	72.321
February	12 556	12 864	70 925	60 250	75 925	66 125
March	11 976	12 567	67.565	59 245	71 190	65.739
April	12 438	12.573	69 381	58.799	71 786	64 028
May	12 742	13.111	73 196	61.092	74 298	66 554
June	12 697	......	71 852	.	75 682	....
July	12 170	......	71 155	..	75 286	...
August	11 634	..	68 614	..	72.705	
September	11 948		67 977	..	72 295	
October	12 673	...	67 327	...	73 476	
November	13 035	..	66 614	...	74 386	.
December	13 555	.	66 706	..	74.525	
Year	12 502	......	69.356	......	74.223	

New York quotations, cents per lb. London, pounds sterling per long ton

Lead

	New York 1921	New York 1922	St. Louis 1921	St. Louis 1922	London 1921	London 1922
January	4 821	4 700	4.747	4.388	23.387	23.667
February	4 373	4 700	4 228	4 396	20.650	20.681
March	4 084	4 720	4 000	4 421	18 911	21.266
April	4 356	5.115	4.272	4 946	20.589	22.993
May	4 952	5.420	4 784	5 281	23 399	24 462
June	4 485	......	4.293	.	22.563	.....
July	4 410	......	4.260		23.399	.....
August	4 382	......	4 217		23.489	.....
September	4 600	......	4.392	..	23.148	.....
October	4 690	..	4 439	.	23.679	...
November	4 683	....	4 356	.	24.483	.....
December	4 700		4.369		25.322	
Year	4.545	..	4.363	......	22.752	.

New York and St. Louis quotations, cents per lb. London, pounds sterling per long ton.

Tin

	New York 99% 1921	New York 99% 1922	New York Straits 1921	New York Straits 1922	London 1921	London 1922
January	31 470	31 480	36 000	32 100	190 464	163.065
February	28 534	29 835	32 142	30 767	166.250	149.850
March	27.296	28 426	28 806	29 171	156.024	143.152
April	28 990	29 810	30.404	30.605	163.905	149.840
May	31 431	30.149	32 500	30 971	177 411	150 163
June	28.514	......	29.423	..	167.506	.....
July	26 755	......	27 655	...	164.530	.....
August	25.662	......	26.301	.	155.318	....
September	26.280	......	26 680	.	156.750	....
October	27 278	......	27.655	..	156 380	.
November	28.592	......	28 935	.	158.898	
December	32 106		32 486		169.738	.
Year	28 576		29 916		165 265	

New York quotations, cents per lb. London, pounds sterling per long ton.

Zinc

	St. Louis 1921	St. Louis 1922	London 1921	London 1922
January	5.413	4.691	25.262	26.321
February	4 928	4 485	24 850	24 215
March	4 737	4 658	25 077	25.467
April	4 747	4 906	25 530	26.576
May	4.848	5.110	26.923	27.304
June	4 421	.....	26 750	......
July	4 239	....	26 262	......
August	4 186	...	25 068	......
September	4 235	..	25 256	......
October	4 605	...	26.315	......
November	4 667	...	25.949	......
December	4.835	...	26.900	......
Year	4 655	..	25.845	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Antimony, Quicksilver and Platinum

	Antimony (a) New York 1921	Antimony (a) New York 1922	Quicksilver (b) New York 1921	Quicksilver (b) New York 1922	Platinum (c) New York 1921	Platinum (c) New York 1922
January	5 258	4 463	48 440	49 960	[illegible]	97.260
February	5 250	4 416	49 545	48 295	70.227	89 545
March	5.282	4 31[illegible]	46 796	50 204	72.463	87 500
April	5 137	4 980	45 423	52 280	73 404	87 [illegible]
May	5 250	5 467	47 000	54 885	73 740	85.529
June	5.087	......	45 846		74 942	
July	4 7[illegible]		44 950		70 440	
August	4.597	......	45.028		73.222	.
September	4.564		42.660		75 960	
October	5 085		39.840		81.800	..
November	4 734		39 804		82 609	....
December	4 500		49 212		78 192	.
Year	4 957		45 462		75 033	

(a) Antimony quotations in cents per lb. for ordinary brands. (b) Quicksilver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer 1921	Bessemer 1922	Basic 1921	Basic 1922	No. 2 Foundry 1921	No. 2 Foundry 1922
January	33.96	21 55	31.96	20 15	33.88	21.34
February	28.96	21 46	26 96	19 71	30.25	20.88
March	28.16	21 35	26 46	19 96	27 85	21 83
April	26 96	22 50	24 46	21 26	26 77	22 70
May	26 21		23.84		25 76	
June	24.96		22 66	..	24 [illegible]	
July	22.84		20.76		22 36	
August	21.96		20.29		21 53	
September	21.96		21 21		22 82	
October	21.96		20 96	.	22 96	
November	21.96		20.96	.	22 74	
December	21.96		20 65		21 96	
Year	25.15	.	23.43	......	5 26	..

In dollars per long ton.

Monthly Crude Copper Production

	1922 January	1922 February	1922 March	1922 April
Alaska shipments	6 909 383	4,193,357	4,899 827	5 892 923
Anaconda	(a)	9,503,000	13,100,000	14,508 955
Arizona Copper	(a)	(a)	(a)	(c)
Calumet & Arizona	(a)	2,462,000	3,167,070	3,756,000
Calumet & Hecla	(a)	(a)	(a)	(c)
Other Lake Superior	6,000,000	6,000,000	6,000,000	(c)
Chino	(a)	(a)	(a)	(c)
Con. Ariz. Smelting	(a)	(a)	(a)	(c)
East Butte	(b) 750,000	(a)	(a)	(c)
Inspiration	(a)	2,485,000	4,965,000	(c)
Magma	(a)	(a)	(a)	(a)
Miami	5,348,000	4,918,000	5,242,000	(c)
Nevada Cons	(a)	(a)	(a)	(c)
New Cornelia	1,602,909	1,459,063	1,606,977	1,496,242
Old Dominion	(a)	(a)	(a)	1,164,000
Phelps Dodge	(a)	4,091,000	5,540,000	5,881,000
Ray	(a)	(a)	(a)	(c)
Shattuck Arizona	(a)	(a)	(a)	(a)
United Verde	(a)	(a)	(a)	(a)
United Verde Extension	(a)	646,110	2,014,886	3,517,902
Utah Copper	(a)	(a)	(a)	(c)
Others, estimated	11,400,000	10,200,000	9,170,000	.
Total United States	32,010,292	45,957,530	55,705,760	.
Imports: Ore and concentrates, matte	7,136,976	5,081.497	3,974,424	10,816,696
Imports of black and blister, unrefined	5,178,068	18.081.802	17.205.149	19,015,875
Imports of refined and old	565,439	5,024,806	17.943.178	9,766.230
Grand total	44,890,775	74,145,635	94,828,511	...
Backus & Johnston	1,118,000	990,000	910,000	888,000
Boleo	1,102,080	954,765	1,117,384	838,000
Cananea	(a)	(a)	(a)	(a)
Cerro de Pasco	4,726,000	4,868,000	4,702,000	4,830,000
Chile	4,000,000	4,000,000	4,000,000	(c)
Cons M & S. of Canada	97,985	26,000	124 000	464,000
Falcon Mines	582,000	566,800	550,682	596.570
Furukawa	2,357,258	2,702,636	3,211,868	..
Granby Cons	1,974,162	955,038	1,922,462	(c)
Hampden Cloncurry	(a)	(a)	(a)	..
Katanga	6,772,600	5,785,920	6,740,000	7,285,000
Mount Morgan	(a)	(a)	(a)	(a)
Mount Lyell	1,152,000	1,152,000	.	..
Phelps Dodge Mexican	(a)	318,000	397,000	379,000
Sumitomo	1,439,488	3,089 353	1,806,888	....
Wallaroo & Moonta	122,575	828,821	489,599	(a)

(a) No copper produced during this month. (b) Estimated. (c) Not available.

Comparative Annual Copper Production

	1919	1920	1921	1922
January	135,733,511	121,903,744	90,596,597	32.010 292
February	111,649,512	117.540.000	86,682,941	45,957,530
March	102,040.460	120,309,316	91 046,345	55,705,760
April	98,808,998	116,078,871	46,946,523	...
May	92,652,975	114,964,207	25,310,511	......
June	95,856,570	116,107,856	24,623,693	....
July	100,369,247	109,729,610	22,033,739	....
August	107,994,040	112,460,254	23,248,398	....
September	108.703,075	104,919,562	23,855,316	....
October	115,143,143	105,231,571	23,231,572	......
November	117,289,735	106,700,178	28,341,442	....
December	102,997,633	95,709,009	29,629,137	....

MINING STOCKS

Week Ended May 27, 1922

Stock	Exch.	High	Low	Last	Last Div.	
COPPER						
[illegible]	Boston	64½	64	64	Sept. '20, Q	$0.50
[illegible]	N. Y. Curb	5½	4½	5¼		
[illegible]	Boston	28	28	28	Mar. '19	1.00
[illegible]	New York	56	54½	55¼	Nov. '20, Q	1.00
[illegible]	Boston	4½	3½	4½	....	
[illegible]	Boston	10	9½	10	Oct. '18, Q	0.50
[illegible]	N. Y. Curb	*23	*20	*22	....	
[illegible]	Boston	15½	15	15½	Sept. '19, Q	0.25
[illegible]	Boston	62½	61	62	Mar. '22, Q	0.50
[illegible]	Boston	298	285	290	June '20, Q	5.00
[illegible]	N. Y. Curb	*47	*43	*43		
[illegible]	Boston	11½	11	11½	Dec. '18, SA	1.00
[illegible]	New York	41½	39½	40¼	Mar. '21, Q	0.50
[illegible]	New York	22½	22¼	22		
[illegible]	New York	31½	30½	31¼	Sept. '20, Q	0.37½
[illegible]	Salt Lake	*29½	*27½	*29½		
[illegible]	N. Y. Curb	*5	*3	*4	Dec. '18, Q	0.05
[illegible]	N. Y. Curb	1¾	1½	1¾		
[illegible]	Boston	45	43½	44½	Mar. '22, Q	1.00
[illegible]	Boston Curb	1¼	1	1¼		
[illegible]	Boston	9	8½	9	Mar. '20, Q	0.25
[illegible]	Boston	12	11½	12	Dec. '19, A	0.50
[illegible]	Boston Curb	*85	*75	*85	Feb. '19, SA	0.15
[illegible]	Boston	2½	2½	2½		
[illegible]	Boston Curb	1½	1½	1½		
[illegible]	New York	35	32½	34½	May '19, Q	1.25
[illegible]	New York	33½	33	33	Nov. '20, Q	0.50
[illegible]	Boston	3½	3½	3½		
[illegible]	N. Y. Curb	3½	3½	3½	Jan. '21, Q	0.05
[illegible]	New York	43	42	4[illegible]	[illegible] '20, Q	1.00
[illegible]	Boston Curb	8½	8	8½	Sept. '20, K	0.25
[illegible]	Boston	25	25	25	Sept. '19, SA	0.50
[illegible]	New York	38½	37½	38½	Dec. '20, Q	0.50
[illegible]	Boston	2½	2½	3½		
[illegible]	Boston	4½	4	4½		
[illegible]	Boston	1½	1½	1½		
[illegible]	N. Y. Curb	32	31½	31½	Jan. '19, Q	0.50
[illegible]	Boston Curb	*14	[illegible]	*10		
[illegible]	Boston	2½	2	2		
[illegible]	Boston	2½	2½	2½	Nov. '17, Q	1.00
[illegible]	New York	30½	29½	30½	May '22, Q	0.50
[illegible]	Boston	3	2½	3		
[illegible]	Boston	65	61	65	Feb. '22, Q	1.00
[illegible]	N. Y. Curb	1½	1½	1½		
[illegible]	New York	18½	18¼	18½	Sept. '20, Q	0.25
[illegible]	Boston	19¼	19	19½	May '22, K	0.25
[illegible]	Boston	14½	13	12¾	Oct. '18, Q	0.25
[illegible]	Boston					
[illegible]	N. Y. Curb	*10	[illegible]	*10		
[illegible]	Boston	26	25	25	Dec. '18, Q	1.00
[illegible]	Boston	37	36	36	June '20, Q	0.50
[illegible]	Open Mar.	†180	†170		Apr. '22, Q	1.00
[illegible]	Boston	47½	45	47	Mar. '20, Q	1.00
[illegible]	New York	18½	17½	18	Dec. '20, Q	0.25
[illegible]	N. Y. Curb	2½	1½	2		
[illegible]	Boston	47	46	46	Apr. '22, K	2.00
[illegible]	Boston	14½	14¼	14½		
[illegible]	Boston	1½	1	1	Nov. '17, Q	0.25
[illegible]	New York	11½	10	11	Jan. '20, Q	0.25
[illegible]	Boston	1½	1½	1½		
[illegible]	Boston	1½	1¼	1½		
[illegible]	New York	12½	12	12½	May '18, I	1.00
[illegible]	Boston	*62	*60	*60	May '13	0.10
[illegible]	Boston Curb	31	29	29¾	May '22, Q	0.25
[illegible]	Boston	3	2	3	Sept. '18,	0.25
[illegible]	New York	69	66½	69	Mar. '22, Q	0.50
[illegible] Metal & T.	Boston	1½	1¼	1½	Dec. '17,	0.30
[illegible]	Boston	2¾	2	2¾		
[illegible]	Boston	1¾	1½	1¾		
[illegible]	Boston	15	14½	14¾		
NICKEL-COPPER						
[illegible]	New York	18½	17¾	18	Mar. '19,	0.50
[illegible] pfd.	New York	80	80	80	Mar. '22, Q	1.50
LEAD						
[illegible]	New York	96½	93½	96½	Mar. '22, Q	1.50
[illegible] pfd.	New York	111	109	109	Mar. '22, Q	1.75
St. Joseph Lead	New York	15¾	15½	15½	May '22, Q	0.25
QUICKSILVER						
New Idria	Boston	1½	1¼	1¾	....	....
ZINC						
Am. Z. L. & S.	New York	20½	19	19¾	May '20,	1.00
Am. Z. L. & S. pfd.	New York	48	47	47	Nov. '20, Q	1.50
[illegible] & Z.	New York	7¾	7	7¾	June '18,	0.50
[illegible]	New York	33¼	31¾	32	Sept. '20,	1.25
[illegible] Zn.-Ld.	New York	11½	9½	11½	June '20, Q	0.50
[illegible] Zn.	N. Y. Curb	146	144	144	May '22, Q	2.00
[illegible]	Los Angeles			*51	Sept. '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce; Colorado Springs, The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.	
GOLD						
Alaska Gold	New York	¾	½	⅝	....	....
Alaska Juneau	New York	1⅞	1½	1½	....	.
Carson Hill	New York	†14	†12	14½		
Cresson Consol. G.	N. Y. Curb	2¼	2½	2½	Apr. '22, Q, X	$0.10
Dome Extension	Toronto			1		
Dome Mines	New York	29⅜	27⅝	29⅜	Apr. '22, Q	1.00
Florence Goldfield	N. Y. Curb	*22	*20	*20		
Golden Cycle	Colo. Springs	*80	*76½	*78	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*8	*8	*8	Dec. '19,	0.05
Hollinger Consol.	Toronto	9.65	9.55	9.65	May '22,	0.05
Homestake Mining	New York	71	70	70	May '22, M	0.25
Kirkland Lake	Toronto	*44¼	*35	*35	.	. .
Lake Shore	Toronto	2.34	2.22	2.25	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	18.00	17.50	17.80	May '22, K	0.05
Porcupine Crown	Toronto	*29	*25	*26½	July '17,	0.03
Porcupine V. N. T.	Toronto	*32	*23¼	*27	....	
Portland	Colo. Springs	*30	*28	*28	Oct. '20, Q	0.01
Schumacher	Toronto	*64	*56	*63	....	.
Silver Pick	N. Y. Curb	*16	*9	*9	....	. .
Teck Hughes	Toronto	*48½	*40	*48	....	. .
Tom Reed	Los Angeles	*71	*70	*71	Dec. '19,	0.02
United Eastern	N. Y. Curb	1 13/16	1⅝	1⅝	Apr. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*9	*8	*8	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*8	*8	*8	....	..
Wright-Hargreaves	Toronto	3.00	2.70	2.75	Apr. '22,	0.02½
Yukon Gold	N. Y. Curb	1	*91	1	June '18,	0.02½
SILVER						
Batopilas Mining	New York	1½	1⅛	1⅜	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*33	*27½	*29	May '20, K	0.03
Comagas	Toronto	1.25	1.20	1.20	May '21, Q	0.12½
Crown Reserve	Toronto	*19	*17	*19	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3¾	3½	3½	Apr. '22, Q	0.12½
La Rose	Toronto	*36	*32	*36	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	*29½	*28	*28	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.05	95	1.05	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅜	6¼	6¼	Apr. '22, Q, X	0.30
Ontario Silver	New York	8¼	8	8	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb		.	*12	Jan. '12,	0.10
Temiskaming	Toronto	*35	*30	*35	Jan. '20, K	0.04
Trethewey	Toronto	*4½	*3½	*4¼	Jan. '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*23	*19	*20	....	.
Cash Boy	N. Y. Curb	*5	*5	*5	....	..
Dolores Esperanza	N. Y. Curb	2½	2⅜	2½	...	.
El Salvador	N. Y. Curb	*6	*5	*5	.	
Jim Butler	N. Y. Curb	*7	*7	*7	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	*6	*5	*6	June '16,	0.05
MacNamara M. & M.	N. Y. Curb	*9	*7	*7	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1¾	1 9/16	1 11/16	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*77	*75	*77		
Tonopah Extension	N. Y. Curb	1¾	1⅝	1 11/16	Apr. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1⅞	1 13/16	1⅞	Apr. '22, SA, X	0.07½
West End Consol.	N. Y. Curb	1⅛	1	1⅛	Dec. '19, SA	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*10	*6	*10	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*95	*94	*94	Dec. '20,	0.15
Chief Consol.	Boston Curb	5⅛	4¾	4¾	May '22, Q	0.05
Consol. M. & S.	Montreal	23½	22	23½	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†3.00	†1.20	.	July '20, Q	0.10
Daly-West	Boston	†2½	†2	2	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†3	†2½	2½	Apr. '21, K	0.05
Electric Point	Spokane	*8½	*6	*8¼	May '20, SA	0.03
Federal M. & S.	New York	16	14½	14½	Jan. '09,	1.50
Federal M. & S. pfd.	New York	52¼	50⅛	50⅛	Mar. '22, Q	1.00
Florence Silver	Spokane	*23	*21½	*23	Apr. '19,	0.01½
Grand Central	Salt Lake	*61	*60	*61	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	6½	6¼	6½	Mar. '22, Q	0.15
Iron Blossom Con.	N. Y. Curb	*22	*22	*22	Apr. '22, Q	0.02½
Judge M. & S.	Salt Lake	†2.50	†2.20	2.60	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*31	*20	*29	June '21, I	0.02
Prince Consol.	Salt Lake	*7½	*5¼	*6	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*6½	*5	*6½	Feb. '19,	0.01
Rex Consol.	N. Y. Curb	*12	*10	*11		
South Hecla	Salt Lake	†*60	†*35	.	Sept. '19, K	0.15
Standard Silver-Ld.	N. Y. Curb	*21	*19	*21	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	*10	*9	*9	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.45	2.45	2.45	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.05	2.02½	2.02½	Dec. '21, Q	0.05
Utah Apex	Boston	3½	3¼	3¾	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb	....	....	*2	Nov. '17,	0.01
VANADIUM						
Vanadium Corp.	New York	51¾	48½	48¾	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp.	Montreal	57	55	56	Apr. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	75½	75	75½	Apr. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	21¾	20⅜	21¼	Nov. '19, Q	1.00
Texas Gulf	New York	47	45⅜	47	Mar. '22, QX	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	66½	64¾	65	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	99	98	98	Mar. '22, Q	1.75
Am. Sm. Sec. pf. A.	New York	93	93	93	Apr. '22, Q	1.50
U. S. Sm. R. & M.	New York	44¼	42½	44	Jan. '21, Q	0.50
U. S. Sm. R. & M. pf.	New York	47	46½	47	Apr. '22, Q	1.75

NEW MACHINERY AND INVENTIONS

A Center-Feed, Screen-Discharge Rod Mill

Four-Compartment Machine Has Probable Application in Table-Concentration and Amalgamation Plants

By A. W. Allen

AN ESSENTIAL FEATURE of any efficient machine designed to crush ore should be the provision for a prompt discharge of all material that is ground sufficiently fine. In addition, repairs and renewals should involve no more than normal expense, and power consumption should not be prohibitive. The introduction of the trunnion-feed and trunnion-discharge ball mill, in place of the stamp mill or other machine, simplified operations to such an extent that the expense for extra power was considered as more than offset by the advantages accruing from continuity of operation and reduction in attention needed for operation, repairs, and renewals. Latterly, the cylindrical rod mill has displaced, to a considerable extent, the ball mill; this was due to more efficient operation and because of the texture of the product and its suitability for concentration purposes. A comparatively high power consumption is, however, still a feature of all cylindrical mills of standard type.

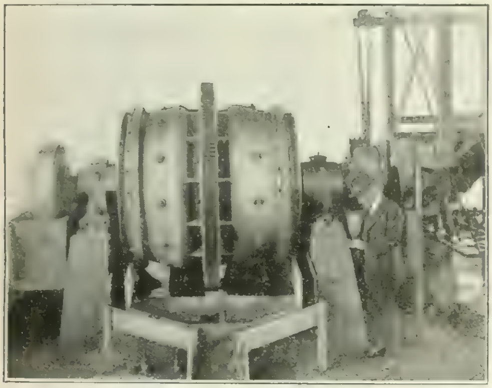

Fig. 1. Rexman mill, assembled and in operating position

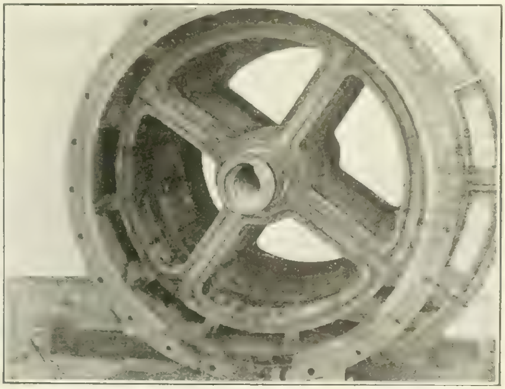

Fig. 2. Spider of Rexman mill, showing liners in place

The original Krupp wet-crushing ball mill was remarkably efficient as a grinder of hard ores, because of the enormous available screening area around the periphery and the prompt discharge of all particles of ore able to pass the screen aperture. It failed of general acceptance because of initial cost and complication of design. However, I am inclined to think that, had it been credited with the advantage that a carefully graded product was delivered without the need for outside classification and return apparatus, the fundamental idea would have found greater favor among millmen and those manufacturing ball mills.

Several engineers have attempted to evolve a balanced mill of the revolving type; but so far as I know only one serious effort has been made to incorporate with this feature others of equal importance. The machine to be described—a Western invention that has recently passed the experimental stage—is known as the Rexman mill, the credit for its design and development being due to H. S. Rexworthy and J. F. Behneman. It is manufactured by the Joshua Hendy Iron Works, San Francisco, Cal. I recently inspected it in operation and recognized that it possesses several distinctive characteristics that invite comment, features that will arouse the interest of millmen and engineers, particularly those who are concerned with the economical reduction of ores prior to amalgamation or table concentration.

A general idea of the design of the mill can be obtained by referring to the accompanying halftones and line drawing. The feed, of usual ball- or rod-mill size, together with an amount of diluent that reminds one of stamp-mill practice, is picked up at one or

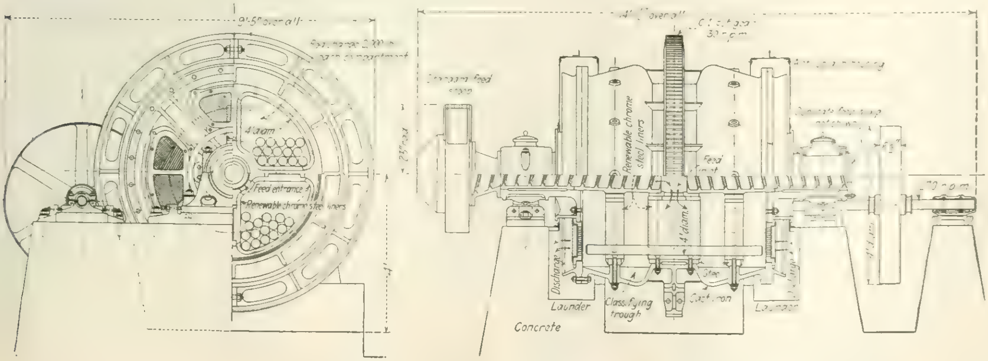

Fig. 3. The Rexman balanced rod mill

both heads of the mill by the usual type of feeder. The pulp is then passed, by means of a delivery tube with spiral lines, to the center of the mill, to a chamber with outlets to four compartments. These compartments, as shown in Figs. 2 and 4, are distinct only in so far as the rod load is concerned. The ore pulp is free to pass into any part of the interior of the mill, but the crushing rods are separated into four distinct batches by a spider that is equipped with appropriate liners. The rods impinge against the mill proper at three points, two comparatively narrow liners supporting them at a short distance from the ends of the mill and one comparatively broad liner taking the weight in the center.

The pulp discharges from the distributing chamber on to and between the falling rods, the revolution of the mill causing fracture and abrasion in the ordinary way, except that impact is the predominating action. One of the most important features of the mill is that the rods maintain a horizontal position, parallel to one another, at all times. This is the result of central feeding, which insures an even distribution of pulp. The tilting of the rods, usual in the ordinary type of mill, is avoided.

The ore as crushed passes to the bottom of the mill, beyond the rods and away from further and unnecessary comminution, where duplicate troughs are provided with lifter partitions at intervals; these troughs are shaped to insure some measure of classifying action. The finer material is carried by the flow of water toward the two ends of the mill, at each of which is arranged a series of four grizzly screens, to protect the finer punched or woven screens used for final separation. The oversize from the fine screens passes back into the mill for further reduction. The splash from the discharge openings is deflected into a launder by means of a light metal hood, which can be removed when required, thus permitting inspection of the screens, or, if necessary, of the interior of the mill.

Characteristic Features of the Rexman Mill

The width of the pulley shown in Fig. 3, as compared with the size and ruggedness of the mill, is indicative of the small amount of power required. As a matter of fact, the extra load at starting is negligible; no clutch is necessary; direct belt connection with the motor is feasible. Shafting, spur gear, and pinion are proportionately small in size and light in weight.

The ability to feed into the mill through two scoops permits a further refinement in balancing and allows the passage of a large tonnage of ore for reduction in size through a small ratio—the most economical method of crushing. Many failures with cylindrical mills have been due to an inability to deliver the required tonnage through a trunnion of normal diameter; other disappointments have resulted from an attempt to achieve too extensive a reduction in particle size during one passage through the machine.

The center delivery of pulp in the Rexman mill is significant, for it halves the distance between feed and discharge points, thus preventing much of the unnecessary grinding that occurs in cylindrical mills equipped with trunnion feed at one end, and with trunnion or open discharge at the other end.

The ability to make all renewals and repairs and to add rods to the interior of the mill through the openings provided essentially for the screen frames does away with the necessity for a manhole in the shell. This permits the placing of the spur wheel centrally—another refinement in balancing. The pinion engages the spur wheel at a point where no splashing from pulp is possible. The advantage of this is obvious.

The wear on rods has not been determined. Suffice to say that, after the passage of about 1,200 tons of rock through the machine, I could detect no signs of extra abrasion at the points where the rods impinge against the cradle liners. I predict that the wear of rod on rod may be slightly in excess of what it is in an ordinary cylindrical mill, in which the blows of the grinding media are cushioned by the thick pulp in all parts. Against this, however, the Rexman mill must be credited with the added efficiency resulting from the prompt discharge of material already ground sufficiently fine. It is also apparent that a saving in liner wear will result because of the fact that the amount of wearing surface exposed to abrasive action is at a minimum, in proportion to the weight of the rods.

A large number of tests on rock have been made, and the following data are typical:

Size of mill, 4 ft. diameter by 4 ft. 6 in. long.

Weight of mill, 19,400 lb.

Rod load, 8,562 lb.

Diameter of rods, 2½, 2¾ and 3 in.

Speed of mill, 36 r.p.m.

Size of feed, —½ +⅛ in.

Width of openings in punched screen, 1/16 x 2 in.

Character of feed, granite.

Ratio of water to dry feed, 2 to 1.

Quantity crushed, 182.4 tons per twenty-four hours.

The average power consumption during operations with full pulp load is from 19½ to 21 hp., or only about 2½ hp. in excess of that required for movement at normal speed and rod load but without pulp feed.

Owing to the positive classifying and screening actions in the mill, the new machine should find especial application in those instances where a graded product is desired and where unnecessary comminution should be avoided. Owing to the freedom with which ore constituents such as pyritic concentrate and free gold can escape between the rods and out of the mill, without sliming in the one case or flouring in the other, the machine should find favor with stamp-mill operators who are looking for a more self-contained unit, one that will give a screened product and consume power in proportion to the work done. In the crushing of a gold ore I see no reason why the design of the classifying troughs should not be modified so that they could be made to act as amalgamators.

For the preparation of an ore for table concentration, the Rexman mill would seem to possess many attractive features, without the disadvantages of high power requirements and lack of ability to regulate closely the character of the ultimate product other than by methods involving external classification. One important point about the new machine is worthy of emphasis: it seems probably that it can be manufactured at a cost appreciably below that of the ordinary mill of the same size.

With an intimate knowledge of the operation of the original type of wet-crushing, screening, cylindrical mill, I am inclined to think that the arrangement for screening the product and returning the oversize constitutes a weak feature. It seems probable that better work could be done if provision were made so that the oversize reject from the final screens were bypassed into the mill by some channel other than by the one only available for the delivery of the mixed pulp to the screens. The provision of such a bypass was a characteristic feature of the early Krupp mill and added greatly to its effectiveness.

For the present, the Rexman mill has been designed to operate with an ample flow of diluent; it is not an all-sliming mill, nor could it be adapted for such work without modification in design. However, it is probable that the main idea embodied in the present mill will be used at a later date to evolve another of the same type, but provided for the direct discharge of ground pulp.

A New Automatic Sampler

Every ore-dressing plant of importance has some means for sampling the pulp at various stages of the process. This can be done neatly and automatically by a recently invented machine which is adapted to cut out a representative sample from a stream of either wet or dry material as it flows out of a launder or other conveyor. It is only necessary to adjust the driving mechanism to secure the sampling interval desired. The drive may be either by means of a pulley and belt from a convenient line of shafting, or a ⅛-hp. motor and housed-in worm-gear drive mounted as a unit to the frame may be employed. Either method is superior to the water-tipping box often used. The belt-driven machine sells complete, including the sample cutter, for $115, and the motor-driven apparatus for $165, the Galigher Machinery Co., Salt Lake City, Utah, being the manufacturers.

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Volume 113 New York, June 10, 1922 Number 23

The Ethics of Mining

THE WORD "ETHICS" is derived from a Greek word, as the word "morals" is derived from the Latin. Etymologically they both mean the same —customs, practice, habits. As is invariably the case, all these words have come to have different significance. Nevertheless, ethics is still the code of action which has been established by the test of much application, as the best to promote the welfare of society as a whole; a code beyond which one cannot go without injuring someone else. It is an analysis and inventory of the aphorism that a man's liberty finds its limits when it infringes on the liberty of his neighbor.

Thus, each group must formulate its own ethical code, although, indeed, there are general codes for all humanity, and it has been held that the Ten Commandments, or at least the Golden Rule, covers all cases. Nevertheless, there arises the question of ethics among mining engineers, not fully solved; of the ethics of business publications, woefully transgressed by some of our contemporaries in mining publication; and of the ethics of mine promotion, more honored, possibly, in the breach than in the observance.

There is an unwritten code in the U. S. Geological Survey that a member of the Survey shall not be actively interested in mining, nor do private geological work, even in his vacation, within the United States. This has long been observed; and other Government departments are as scrupulous. The geologist, however, may go to Mexico or Canada, for private work, in his vacation or on leave of absence without pay. The observance of this has been largely responsible for the fair name of the Geological Survey.

A consulting mining engineer is bound to safeguard from competing interests the information which he gathers from his employers. If the welfare of the state or the public is at stake, or his client turns out to be conducting a campaign menacing unfairly either the public or private interests, then, of course, he can no longer consent to be even a silent partner in wrongdoing.

A mining journal may not properly allow its pages to be bought or influenced by any interest whatever except that of the mass of its subscribers. It must not work as a partisan, paid or unpaid, with any financial group. It will not permit itself to be browbeaten. It will not blackmail.

A mining promoter should not state anything but the bold and naked truth, in endeavoring to raise funds. He must base his campaign on the cold-blooded opinion of responsible mining engineers, not on the testimony of druggists and politicians, nor must he paint glowing pictures which in his heart he acknowledges as being drawn to attract the "come-ons." Unless he walk this honest and straightforward path, he is outside the pale of the ethics of good promoters.

These are, in a desultory way, some of the problems of ethics, pertaining to different phases of the mining profession. After all, it all comes down to fundamental and universal qualities—honesty, honor, fairness, and generosity. With these qualities cultivated and encouraged, it is not so necessary to draw up codes, for problems bring their own solution. For a man may cleverly conform to the law, studying so as to adapt it to its desires; he may conform, according to all argument, to any code of ethics which can be devised, and still be crooked.

Promised Co-operation From the Non-Metallic Mineral Industries

MUCH INTEREST has been aroused by our editorial of May 6 wherein we discussed, in general, the apparent failure of the non-metallic mineral industries to keep abreast of the other branches of the mining industry in the utilization of improved methods and machinery and in the adoption of progressive economic policies; and, in particular, a report of the Bureau of Mines on conditions in one such industry, together with a criticism of the report by the manager of an important company producing and grinding the mineral concerned. For one thing, a number of men prominent in non-metallic mineral operations have declared their conviction that inefficient technical methods, obsolete machinery, and old-fashioned policies are too prevalent.

One subscriber who is developing a graphite deposit relates his experience in buying mill machinery in Philadelphia. The dealer has machines of various types, each of which has proved successful at some graphite mills and unsuccessful at others; but as to precise differences in conditions that accounted for the divergence in results, he has no information. His representatives had never been welcomed at the mills, and the operators who had found certain equipment unsatisfactory had declined to give their opinion as to the cause of the failure, but had come to Philadelphia and selected some other machine with which to experiment.

This instance may not be typical of the policies of graphite producers, but it does indicate an attitude on the part of some of them that is harmful—harmful to the graphite industry itself, not to anyone else. There may be significance in the fact that little publicity has been given to the technique of mining and "concentrating" graphite. It is disagreeable for any one to find that he has made a mistake in selecting machinery; but to refuse to give others in the industry the benefit of knowing why the machinery did not work seems to us to be short sighted. It is fair to assume that the engineers in charge of these operations collected accurate data on the performance of the different machines. Suppose that each of them had published his results, together with a description of the particular ore with

with which he had to deal and the particular product that he desired to make. The probability is strong that every one of them would have learned something that he did not know. If the domestic graphite industry is ever to revive, the most efficient and economical methods will necessarily be used, and by the development of these methods every one in the industry will benefit.

A producer of high-grade feldspar confesses that the criticism applies to his industry to a regrettable extent; he is impressed with the soundness of our observations and declares for a more enlightened policy among all those interested in the production and grinding of feldspar.

An engineer for the Bureau of Mines explains that the inquiry on which the report was based was undertaken at the solicitation of certain consumers in an effort to discover why they were unable to obtain a satisfactory material, rather than for the purpose of analyzing every phase of the industry. This accounts for the fact that no mention was made of any commendable practices. He also points out that before being issued to the public the report was subjected to careful scrutiny by a number of competent men, whose suggested amendments were incorporated in the final draft, so that the result represented more than the investigation of one man "for thirty days," as we remarked in the editorial. At the same time, it is true that an investigator with broad experience in work of a similar character frequently can, in a brief study, detect faulty methods that have been overlooked for years by the man who is in direct charge. The reason is that the manager's viewpoint is too close to his work. Our argument was that he should at least give careful consideration to the suggestions of the outsider.

Several letters have been received from engineers who commend our attitude and volunteer to give us accurate and reliable information on sundry non-metallic mineral operations. These were particularly gratifying. Naturally, if we are to be of service to the industries involved we must draw material from men who are engaged in them. We are anxious to help in the solution of the problems—technical, financial, and economic—that confront the producers and refiners of non-metallic minerals. We believe that honest and open publicity will help all concerned, and we are prepared to do our part by supplying that publicity. But we must have co-operation if our efforts are to be successful. For that reason it is particularly satisfactory to have the assurance of a desire on the part of our friends in the field to open to us the sources of first-hand information.

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Diamonds in Arkansas

RICH as North America is in valuable minerals, we do not associate the idea of its mineral wealth with diamonds. Diamonds come from Africa, in the popular mind; and, indeed, for all practical purposes, that is where gem diamonds come from, although the dark diamonds (or bort) used for cutting purposes in diamond drills come from Brazil; and there is also a certain amount of gem stones in parts of South America.

In most instances gem diamonds occur in a special very basic type of igneous rock—an olivine rock (or peridotite), intrusive, ordinarily, in pipe-like forms. This igneous rock has been profoundly altered to a clayey condition; and it is in this clay that the African diamonds occur.

In Arkansas, however, there is a diamond-bearing rock that conforms to the usual rule in that it is a peridotite, intrusive as a neck or pipe in sedimentary rocks. The age of the intrusion is probably post-Cretaceous. It is in this rock that the diamonds occur. They have long been known, and many diamonds have been produced, but practicable exploitation has proved to be a difficult problem.

The central motif of romance, adventure, murder, and burglary; the symbol of wealth and vanity; the favorite figure of the poets—these little grains of crystallized carbon (they differ from coal, wood, and the fizz of soda water, chiefly in the crystallinity), are likewise still somewhat of a mystery to geologists. They are found—though they are small—in meteorites, and so are shot to us from other and unknown world catastrophes.

Diamonds have been found in the glacial drift at many places throughout our northern states. The glacial current was, of course, from the north; and therefore, students of this phenomenon conclude that there was a source, perhaps, for all these diamonds, "somewhere north." Will it ever be found? Its erratic representatives indicate possibly an important primary source. Does it underlie some muskeg in the Hudson Bay country, or is it forever safeguarded by the waters of the Northern Ocean?

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Capital and Government

EUROPEAN matters seem to have approached a more satisfactory turn by Germany practically consenting to put her financial system under the supervision of the Allies, a concession which betokens good faith, and was so received by France as well as England.

Our advices from Germany are that the bulk of the people are loyal to the present German Republic, and to the general plan of republican form of government. Admittedly, however, this government, with a former saddle-maker as president, has a most difficult course to steer, considering the bankrupt condition of its fiscal system, and with the monarchists on the one side and the red communists on the other. By and large, the present German government should have our support, and will naturally have it if it acts in good faith.

Capital and labor are as great problems in Germany as elsewhere. In Germany the artisan and the white-collar man have completely reversed pre-war conditions; it is the former that has the luxuries, while the latter is driven to unheard-of economies. The wages of the former rise with the decline of value of the currency; but the government employee and all the great class of similar salaried office workers view a continually widening breach between income and outgo. The "rentiers," who live only on income from investments, are, of course, ruined. We have a marked similar tendency in this country, but pale by comparison. The workman who before the war received $2 a day, now receives $6. The carpenter receives $10 where he received $3; while the clerk who received $1,500 a year now receives $2,000—if he is lucky.

Thus, labor is relatively prosperous in Germany. Capital, also, according to our European correspondent, has found a way to flourish. Manufacturers can produce goods in Germany at low cost, and they can sell abroad at high profit; and these profits they invest abroad, so that they slip through the net of German taxes like water through a sieve, and evade the plans of the government for reparations. In other words, capital and the government are not working together; to speak colloquially, the former is double-crossing the latter.

We might take the situation as a text for a sermon on the necessity of co-operation between capital and government, as well as between labor and government—in fact, the necessity for harmony among all three. Antagonism between capital and government spells economic disaster. It is the great endeavor of Secretary Hoover to accomplish co-operation instead of the traditional silly and ruinous antagonism. To force capital to be antagonistic is to force it to be disloyal; to foster an element of economic treason in a form of government which has come to be essentially an economic union.

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Substitutes for Gasoline

THE MINING INDUSTRY shares with other industries an anxiety in regard to future supplies of motor spirit, especially when operations are being conducted at great distances from oil refineries. It is interesting to note, however, that during recent years the high cost of gasoline in isolated districts has acted as a spur to initiative in the discovery and the development of a cheaper and equally efficient substitute.

Much attention has been paid to the alcohol that can be produced from various classes of vegetal matter. It has been found, however, that the substitute can be made only at a prohibitive cost unless the new industry operates in conjunction with other industries. To make the venture a success, one of two courses must be adopted: the alcohol factory must be able to produce cheaply a salable byproduct, or the alcohol itself must be manufactured as a byproduct of another industry. In South America, for instance, considerable success has resulted from the use of alcohol as a fuel in internal-combustion engines.

Near Pernambuco, in Brazil, a large sugar mill is producing a spirit from the discarded cane, and at less than half the cost of gasoline. Excellent results are being obtained by the use of the new fuel in motor vehicles, but some trouble was caused at first by the rusting of certain parts of the engine, a disadvantage that has since been overcome by the addition of about 5 per cent of gasoline to the sugar-cane spirit. In another district of Brazil, alcohol is produced as a byproduct from a wood distillation plant, operated by the St. John Del Rey mining company. The efficiency of the spirit, which is used in the motors without the addition of any corrective, is not so high as that of gasoline, but according to reports, no damage to motor parts has resulted.

A considerable amount of success has resulted in South Africa by the use of a combination of alcohol and acetylene. Cattle food is obtained as a byproduct. The addition of acetylene is considered essential, for without it the local wood spirit possesses disadvantages that make it only partly efficient as a motor fuel. Unfortunately, however, the amount of acetylene gas that such spirit can absorb is small—only about six times its volume. However, in distilling the volatile products from wood another byproduct is made—acetate of lime, from which acetone is derived—and the process therefore has large commercial possibilities.

Germany imported large quantities of acetate of lime from the United States before the war. Among other uses of acetone is in the preparation of artificial rubber, which Germany needed so badly when her overseas supplies were cut off. Acetone was then obtained from the acetate of lime that resulted from the distillation of wood. Later, when increased supplies of rubber were needed, another method had to be adopted; and potatoes were allowed to ferment after a bacillus known as *B. acetoethylicum* had been added. The resultant decomposition produced acetone and alcohol, the former being successfully utilized in a process for making artificial rubber.

It has been found that acetone absorbs about twenty-five times its volume of acetylene, so the motor-spirit problem appears to have been solved by the suggestion that sufficient acetone be added to the wood alcohol. It has been found that 80 per cent of wood alcohol and 20 per cent of acetone is an excellent mixture in which sufficient acetylene may be absorbed to produce an efficient motor spirit. A number of natural products in South Africa are being tested as possible sources of acetone, waste corn cobs being favored on account of the quantity available; for maize, as corn is called there, is the staple food for the Kafirs. Tests have also been made in the United States, the results showing that 100 lb. of cobs can be made to produce about 2.7 lb. of acetone and 6.8 lb. of alcohol.

Experiments are being carried out in several other countries in an effort to obtain alcohol from Jerusalem artichokes. Results so far have been successful, and intensive cultivation may follow, all the more likely because it has been proved that the discarded stems can be manufactured into pulp for the making of certain grades of paper.

In Cuba there is strong indication that gasoline will soon be replaced entirely by wood alcohol, obtained, as in Brazil, from the waste product of the sugar mills. The average cost of gasoline in Havana is about 50c. per gallon. Alcohol costs about 35c. per gallon. Drivers of automobiles for hire who are using the substitute have found that they can reduce fares by one-third, and the price charged still permits a fair margin of profit after operating expenses are deducted.

The cost of gasoline in India has been so high that a factory has been established in Hyderabad for the production of alcohol from the flowers of the mahwa trees. The industry has already attained significant proportions, the daily output having reached 10,000 gallons. In little-known Papua, or New Guinea, there is an immense area of land that is covered with the nipa palm. Preliminary investigations and tests have shown that the tree will yield alcohol in sufficient quantity to justify the raising of capital for a plant that is to cost over $1,000,000, insuring employment for 1,500 natives and 60 whites. It is proposed to produce 3,000,000 gallons of motor spirit per year, as well as 500 tons of paper as a byproduct. In the Philippines the sap from the nipa palm tree forms the source of 90 per cent of the alcohol produced there. It costs under 10c. per gallon.

Necessity is the mother of invention; and invention in the present instance seems likely to discover a cheap source of power for motor vehicles and stationary engines that, unlike natural oil, is inexhaustible; for it is the product of vegetal growth, the continuance of which can be insured by scientific cultivation and control.

The Forecasting of Earthquakes

By T. A. Rickard

AN APPROPRIATION of $15,000 was made recently by Congress for the use of the U. S. Coast and Geodetic Survey, for the special purpose of repeating and extending the triangulation of the Pacific Coast region. This was done in response to a public demand, voiced by the Commonwealth Club of San Francisco and the Local Section of the American Institute of Mining and Metallurgical Engineers, and in recognition of public interest in the creep of the earth's crust as observed and recorded in California. We who live on this coast have a more than academic interest in movements of the earth's crust; we have witnessed the effects of terrestrial unrest; but most of us are unfamiliar with the remarkable phenomenon of surficial creep as proved by the change in latitude of a given locality. Astronomers long ago predicated a variation of the earth's axis in consequence of the seasonal differences in the weight of snow and ice deposited over the land areas of the northern hemisphere and the periodic variation in the pressure of the atmosphere. In 1880 Küstner discovered that the latitude of a point on the earth's surface actually does vary, owing to the 'wobbling' of the Pole. His survey led to systematic observations of fixed stars from five international stations on the same parallel of latitude. One of these points of observation was established at Ukiah, in California.

Investigation has shown definitely that in 17 years, from 1900 to 1917, the latitude of Ukiah has been increased by a northward trend equivalent to 28 centimeters per annum. Since then the direction of the trend has been reversed. Professor A. C. Lawson, of the University of California, has given special study to the subject. He found evidence in the record to show that besides the variation of latitude due to the vacillation of the Pole there is a movement due to the creep of the earth surface. From him I learn that Mount Tamalpais, overlooking the Bay of San Francisco, moved 3.04 metres northward between 1854 and 1900 by reason of this strain-creep and then 1.97 metres southeastward by rebound in 1906, the year of the great Californian earthquake. It will be seen at once how difficult it is to measure the displacement caused by an earthquake when the datum-points themselves are shifting appreciably. The whole system of triangulation has been vitiated thereby. Professor Lawson draws the conclusion that the local movement of the earth's crust is not confined to the sudden disturbance rendered evident by an earthquake; on the contrary, the energy let loose, for example, on April 6, 1906, accumulates as an elastic compression, and the sudden release of it, when the limit of strain is reached, is expressed by the break or rift that constitutes the line of the faulting. Thus we have the theory of elastic rebound, which the Professor noncommittally calls "a good working hypothesis".

The geodetic surveys prove that there is a creep of the earth's crust; the inference being that the region affected is subject to an elastic strain, which occasionally reaches the limit, whereupon a slip occurs, accompanied by the vibrations we call an earthquake. However, even if the theory of elastic rebound were to be established, it would not enable the scientist to give the public the date of an impending disaster. The factors detrimental to accurate prediction are numerous; the difficulty of positive measurement of movement is only one of them. By use of the data obtained at points of observation near San Francisco at this time one prediction would give an interval of 58 years between the last big earthquake and the next one; another would give 35 years as the time when the strain in this region would exceed the elasticity of the rocks and cause another big slip; a third prediction would place the estimate at 46 years. These three estimates might be averaged, giving the figure 45, but to do so would be unscientific, because the errors in the datum-line and the local variation in strain-creep, for example, do not permit a confident forecast. The final test of a scientific theory is that of prediction. Professor Lawson exhibits the true spirit of science in declining to apply a theory to practical affairs until it has been demonstrated to be true. It is more than likely that any attempt by geologists to forecast an earthquake would do more harm than good, apart from the unsafeness of their dictum, because the anxiety caused by the anticipation of the event might do more harm than the shock itself.

To the miner the subject has a special interest because he is familiar with the evidences of crustal slippage in the shape of faults, which break the continuity of his ore-channels and otherwise complicate the structure of the rocks in which he delves. He is impressed with the enormous extent of the dislocations to be seen in deep natural sections of the earth's crust, and he compares such breaks—measurable in miles—with the geologically small rift that made all the trouble in San Francisco sixteen years ago. If the bigness of the slip be proportioned to the elasticity and strength of the rocks, then there seems no reason to suppose that the big faults are peculiar to a remote geologic past; on the contrary, we are driven to the conclusion that a big fault—of 10,000 feet, for example—represents the sum of many small movements taking place during a long period of time. The San Francisco earthquake represented the movement of a block of rock 270 miles long, 50 to 100 miles wide, and 20 miles deep. The movement of this block was that of a piece of brittle crust over a viscous mass; it was due probably to the shifting of weight caused by erosion, thereby creating an unstable condition, which had to be rectified. This is the doctrine of isostasy. In 1906 in California local strain was relieved by a movement that was expressed by a maximum horizontal shift of 21 feet and a maximum vertical displacement of 1½ to 2 feet. The vertical component was small, compared, for example, with that of the Inyo earthquake of 1872, which followed the line of the great fault of the Sierra Nevada. That earthquake was accompanied by a vertical movement of 20 feet; and it would have been terribly destructive if it had passed through any large centre of population. The calamitous effects of the earthquake of 1906 in San Francisco were due chiefly to the complexity of our material civilization, for the damage was done by the conflagration, caused by the fracture of gas-pipes and the short-circuiting of electric wires, which started numberless fires at a moment when the water-mains had been ruptured by the movement of the surface.

DISCUSSION

How Should Depletion and Depreciation Be Charged?

Advantages of Uniformity, Clearness, and Completeness in Publishing Statements of Mining Companies, With an Example of Cost Computation

THE EDITOR:

Sir—In your issue of May 5 there appears an article with the above heading. This article brings out the lack of uniformity in determining costs, especially by the copper mines, and shows that even in the case of one mine certain items are included in the published cost per pound for one year and omitted in another year.

In this article the statement is made that the amount paid as Federal income and profit taxes should be included in the production cost, but as depreciation and depletion are bookkeeping entries, there might be some doubt as to whether or not such charges should be included in the published cost.

There is no doubt as to the great need for standardization in the recording and reporting of costs, as well as the need for a standard form of profit-and-loss statement and balance sheet. The stockholders of the numerous mining companies and the investing public are beginning to demand greater uniformity and clearness in the published reports showing costs, statements of earnings, and the condition of the business, and it is only a question of time when the published costs and general accounting statements of the larger mining companies will be standardized the same as has been done by the railroads, the public utilities, and others.

However, answering the question, What justification is there for applying depletion and depreciation as a production cost instead of the income and excess profits taxes? I will say that depletion and depreciation should always be included in the production cost; though there is some doubt whether or not the Federal income taxes should be included in the production cost.

As to the depreciation and depletion charges: There is no reason for the apparent misunderstanding of the depletion charge. The depletion charge in mining is the same as the "cost of goods sold" in merchandising, or "cost of raw materials used" in manufacturing. In merchandising, the "cost of goods sold" can be accurately ascertained as a rule, but there is some difficulty in determining the exact depletion charge in mining, although in the case of a proven mine of large tonnage it is much simpler than some believe.

As the Federal tax law allows the depletion charge against gross income to be based on the value as of March 1, 1913, there is added a further complication in the determination of depletion as a cost when the value as of March 1, 1913, is in excess of investment value. However, when this is true, the depletion charge should be divided into "depletion of investment" and "depletion of appreciation," and only the depletion of investment charged as a cost.

Charges against production for depletion of investment in mine property and for depreciation of investment in equipment are in the nature of deferred charges, as the expenditures for these investments were made in prior years, or probably prior to the beginning of production. Of course, the yearly depletion and depreciation charges may be more or less an estimate, but when based on cost and the amount of exhaustion, represent an actual expenditure as much as the current year's disbursements for production labor and supplies. Therefore, the charges for depletion and depreciation of mine investment should be included in the cost of production without any more doubt than there would be about including the "cost of raw materials used" in determining the cost of a manufactured article.

As to the charge for Federal income and profits taxes: There is no substantial reason for including such charge in the production cost. The Federal taxes are a profit-and-loss charge and not a production charge, and are determined by the amount of taxable income and the tax rates in effect. The taxable income will fluctuate principally according to general business conditions. The men in direct charge of production are not interested in the amount of Federal taxes, which may be influenced as much by the amount of outside investments as by any increase or decrease that may occur in efficiency or production.

As a suggestion, I offer the following statement of cost:

	Cents per Pound
Total operating cost	10.00
Depreciation and depletion of operating investment	1.50
Total production cost	11.50
Operating production credits	1.00
Net production cost	10.50
Net investment credits (or charges)	.25
	10.25
Federal taxes	.25
Total profit and loss cost	10.50

The manager and those under him are interested in the operating expense and credits that make up the net production cost. The directors and stockholders, in addition to their interest in the net production cost as it compares to the average selling price, are also intensely interested in what is the net investment return per pound of produced metal, what the amount of Federal taxes, and what may be expected to be the net profit-and-loss cost per pound.

At the present time there is certainly a lively interest in costs and desire for uniformity, clearness, and completeness in published statements. Investors, the public, and the law-making bodies are beginning to find out that statistics compiled in the past are more or less worthless, due to lack of uniformity and completeness in the published facts of industrial concerns. Therefore, the Government has now recognized the value of trade associations organized for the purpose of obtaining co-operation and uniformity in production and cost data.

Bisbee, Ariz. T. O. McGRATH.

Sulphatizing Roasting of Copper Ores

The article "Sulphatizing Roasting of Semi-oxidized Copper Ores," by Percy R. Middleton, published in the *Engineering and Mining Journal-Press* of April 15, 1922, was exceedingly interesting. As somewhat similar work was done under my supervision some years ago on a full-sized unit scale, I think the results obtained might also be of interest in this connection.

At the Panuco mine, belonging to the Continental Mining Co., and situated about forty miles east of Monclova, Coahuila, Mexico, on the old Mexican International R.R., is a copper deposit consisting of a chimney of ore about 200 ft. in diameter in a syenite country rock. The inside of the chimney or cylinder is entirely filled with brecciated vein material consisting of mica, quartz, feldspar, and pyrites, coarsely crystallized, and copper principally in the form of bornite, with some chalcopyrite, a small amount of oxides, and also copper sulphate where recent oxidation has taken place.

The ore averages 3 per cent copper, and approximately one-third of the copper content is copper sulphate soluble in water. The formation of the copper sulphate has taken place since the mine was opened up by numerous workings, where high-grade pockets and bunches of ore were extracted by "buscones" in the earlier years. The oxidation was started by a fire which burned the old timbers of the mine, and oxidation is still continuing.

An average analysis of the ore gives 15 per cent iron, 13 per cent sulphur, and 55 per cent insoluble, but it varies widely from this average in different parts of the mine.

After numerous experiments and investigations to work out a method of treating the ore at the mine, it was decided to put in a Wedge mechanical furnace for roasting the ore to produce sulphate of copper and then leach the calcine with water and deposit the dissolved copper on scrap iron. One furnace was erected, with the necessary crushing plant and leaching plant, and an absorption tower was added to catch as much sulphuric acid as possible from the roasting gases, in order to aid in the leaching. The furnace was 20 ft. in diameter, with five hearths, muffle fired on the four upper hearths, and used Mexican oil for fuel.

The furnace was in operation from February, 1912, to May, 1913, and was then closed down on account of the revolution. Unfortunately, the detailed records of the work done were destroyed by the revolutionists, as the mine had to be abandoned on short notice and the books and records could not be removed to a place of safety. As a consequence, the information given here is largely from memory.

The upper four hearths of the furnace were equipped with Bristol pyrometers, so as to be able to control the roasting temperatures. The furnace was down-drafted, the gases passing through a small dust flue, then through a brick absorption tower packed with tile, and finally through a lead fan and out of the stack. It is my understanding that the down-draft feature is patented by the Wedge Mechanical Furnace Co.

It was found impracticable, with the down-draft, to heat the ore sufficiently from the muffles to get the roasting started on the upper hearths, so three direct-fired oil burners were installed on the top hearth. With these in use it was found unnecessary, except on occasions when the sulphur content of the ore was unusually low, to fire the burners in the muffles. Whenever the sulphur content of the ore became higher than 10 to 12 per cent, it was found that the temperatures became too high, with a resultant poor sulphatization of the copper. However, we did find a good use for the muffles during high temperatures, as under those conditions we pulled out brick in the outer walls of the muffle, letting in cold air and thus reducing the temperature of the ore on those hearths. The temperatures which were found to give the best results were about as follows:

First hearth	500 degrees Fahrenheit
Second hearth	700 degrees Fahrenheit
Third hearth	900 degrees Fahrenheit
Fourth hearth	1,050 degrees Fahrenheit
Fifth hearth	Cooling

About 6,000 metric tons of ore was treated altogether. With ore running less than 12 per cent sulphur the furnace would treat thirty metric tons of ore per twenty-four hours, with an average extraction of 85 per cent of the copper in a solution from the absorption tower, and 80 per cent water-soluble copper. The solution from the absorption tower ran about six grams per liter in H_2SO_4 content.

It was found that the strength of the solution in sulphuric acid did not have much effect on the extraction. What was needed was a sufficient quantity of H_2SO_4 in weak solution, and we did not obtain the needed quantity from the absorption tower. The extraction with the tower solution on the best days reached 95 per cent, and on one run of three successive days on which I happen to have the record the extraction was 91 per cent.

The furnace was attended by Mexican laborers picked as the most intelligent from the labor gang on construction work, and it was not difficult to teach them how to control the temperatures with the oil burners.

The down-drafting of the furnace causes the SO_2 gases to pass over the hot iron oxides in the lower hearths, and no doubt some catalytic action takes place, as the SO_3 content of the escaping gases is much higher when the gases are down-drafted than when they are up-drafted.

An ordinary absorption tower, using water as a scrubber, will recover only a small proportion of the SO_3 in the form of a weak sulphuric-acid solution. There is, however, little doubt that a Cottrell plant would recover nearly all the SO_3 from the gases after they had passed the scrubber tower, and thus had been cooled and moistened.

The higher percentage of SO_3 in the down-drafted gases no doubt aids the sulphatization of the copper, especially if some of the sulphate already formed is broken up by too high a temperature in the upper hearths, in which case the oxide of copper formed is at least partly resulphatized on the lower and cooler hearths where it comes in contact with the SO_3 in the gases.

The ore after roasting had a high rate of percolation in the leaching tanks, although it had an extremely slow rate when raw.

The cementation was carried on intermittently in three redwood tanks, 20 ft. in diameter and 4 ft. deep, heating the solutions with steam so as to cause a circulation of the solution in the tanks and hasten the precipitation of the copper on the iron by both the heat and circulation. The consumption of scrap iron was 1.2 lb. of iron per pound of copper, and by the method used practically complete precipitation of the copper in the solutions was obtained. The cement copper ran 57 per cent copper. **ARTHUR L. TUTTLE.**

Campo Morado, Guerrero, Mexico.

Sulphur Resources of Chile

Deposits of the Chilean Cordillera Form an Important Part of the World's Known Reserve of the Mineral—Industry Still in Its Infancy—Production in 1918 Totaled 19,557 Metric Tons—Operations Require Systematizing

By Herbert G. Officer

THE SULPHUR DEPOSITS of Chile are little known. They are on the volcanic peaks of the Andes, and the high altitudes and remoteness from railways have retarded development. Production is comparatively small; the greater part goes to supply domestic demands. Only in recent years has the country exported any sulphur, and then only to neighboring South American republics. The export business is capable of expansion.

There is little danger of competition to the Gulf Coast producers of Louisiana and Texas, so far as their markets in the Eastern States are concerned. However, if the Chilean deposits were properly financed, equipped, and managed, the product might successfully compete with the Gulf Coast sulphur in the markets on the Pacific Coast of the United States. The principal present interest in the Chilean deposits lies in the immense reserves and the possibility of their being some day called upon to supply the markets of the world.

TABLE 1. STATISTICS ON THE SULPHUR INDUSTRY IN CHILE PRODUCTION, IMPORTATION, EXPORTATION, AND CONSUMPTION
(Metric Tons of 2,204 Pounds)

Year	Production	Imports	Exports	Consumption
1909	4,507	193	None	4,700
1910	3,822	1,400	None	5,222
1911	4,451	4,013	None	8,464
1912	4,431	4,451	None	8,882
1913	6,647	1,961	None	8,608
1914	10,008	526	None	10,534
1915	9,769	711	None	10,480
1916	14,879	1,080	None	15,959
1917	18,942	47	3,555	15,434
1918	19,557	None	6,406	13,151

The sudden increase in consumption in 1916 was due to the purchase by the Chile Exploration Co. of from 4,000 to 5,000 tons per year for the manufacture of acid for use in leaching copper ores at Chuquicamata.

TABLE 2. EXPORTS OF SULPHUR FROM CHILE

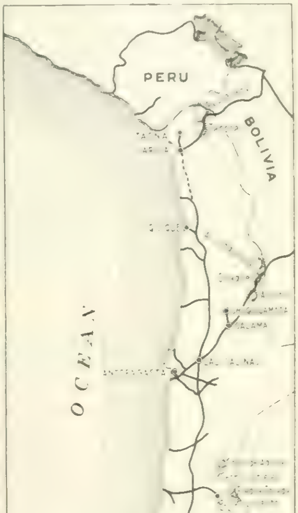
	1917		1918	
Country	Metric Tons	Value in U. S. Dollars	Metric Tons	Value in U. S. Dollars
Argentina	1,976	$106,720	3,028	$241,500
Bolivia	41	2,224	54	3,670
Brazil	1,227	66,276	2,873	157,300
Uruguay	248	13,371	260	23,000
Totals	3,555	$191,968	6,406	$446,270
Average value per metric ton placed in port		$54.00		$69.66

TABLE 3. STATISTICS OF PRINCIPAL PRODUCERS OF SULPHUR IN 1918

Producer	District	Number of Men Employed	Average Wage, U. S. Equivalent	Tons of Fuel Yareta Used	Metric Tons of Sulphur Produced
E. Dondero	Tacora	50	$0.70	2,000	2,000
J. Carrasco	Ollague	80	1.70	4,500	6,200
Espada Bros	Tacora	160	0.80	3,000	5,200
Muecke & Co.	Tacora	125	0.75	5,300	2,220
Paucarany Co.	Tacora	42	1.00	1,950	1,600
Vaccaro Bros.	Tacora	70	0.80	4,800	2,100
Totals and average		527	$0.93	21,550	19,320

Chile is bounded on the east by the crest of the Andes Mountains—one might almost say "by a wall of extinct volcanoes." There is an unbroken chain of volcanic peaks from Arica in the north as far south as Coquimbo. Still farther south they are more scattered, but they extend all the way down to Tierra del Fuego. Some of the volcanoes in the south of Chile are still active—notably, Chillan, Villarica, and Calbuco. Those volcanoes that bear sulphur deposits are indicated on the accompanying map.

The sulphur deposits are all of volcanic origin and are found on the flanks and in the craters of old volcanoes. Usually, the only signs of volcanism are hot springs and fumarolic activity. In most of the deposits one finds unmistakable evidence that the deposition of sulphur is still going on. In others, such as Piedra Parada and Juncalito, there is no solfataric action, and deposition ceased long ago. At Paucarany, the volcano has been almost removed by erosion, and the sulphur deposit—of recent origin—occupies the porous area which represents the neck of the old volcano. The deposits usually occur in beds, near the surface. In exceptional formations sulphur is found filling large cracks and gash veins in the bleached country rock. In searching for the deposits one needs no "Guide to Prospecting." Wherever sulphur vapors have been liberated the surrounding rock has been completely leached of its femic minerals, and these bleached outcrops are visible for miles. A white mountainside does not necessarily mean the existence of a sulphur deposit, but the absence of bleaching implies the absence of sulphur. It is probable that early eruptions so shattered the mountain as to form innumerable small cracks and crevices. The sulphur-laden vapors, prin-



Map of Chile, showing the location of the principal sulphur deposits mainly SO_2 and H_2S, with much steam, escaped along these cracks. Upon nearing the surface the vapors lost high temperature and pressure, and sulphur was deposited according to the following reactions:

$$2H_2S + O_2 = 2H_2O + 2S$$
$$2SO_2 + 4H_2S = 3S + 4H_2O$$

Besides these there may be other reactions. Some sulphur may have been sublimed directly from its vapor. It is probable that the oxidation of hydrogen sulphide is the principal reaction in the formation of the deposits. If the surface of the mountain happens to be covered by volcanic ash or the fragmental materials of erosion, these may be sufficiently porous to contain the oxygen required for the reactions. In such circumstances the sulphur would build up around the particles of barren material as a cementing matrix. This is the usual occurrence of the sulphur: as a matrix for the granular, bleached products of erosion. Obviously, the percentage of sulphur in such an ore depends upon the solfataric activity and the rapidity with which the area is sprinkled with the rocky fragments. A hypothetical condition is illustrated in Fig. 1. First, there is the fractured rock upon which was deposited volcanic ejectamenta or products of erosion. A period of great solfataric activity deposited the sulphur in the loose material and upon it. Rapid deposition of sulphur would give a bed of high-grade ore. With a dying down of the solfataric action there would be a greater proportion of barren material mixed with the sulphur, and consequently an ore of lower grade would be formed. Ultimately, solfataric action ceases and the surface is composed of barren, bleached products of erosion.

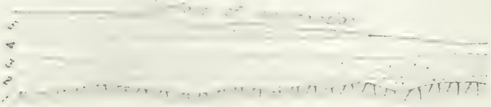


Fig. 1. Ideal conditions of deposition

1. Fractured rock of mountainside.
2. Layer of fragmental material.
3. Layer of ore, 50 to 75 per cent sulphur.
4. Layer of ore, 75 to 95 per cent sulphur.
5. Layer of low-grade material 5 to 25 per cent sulphur.

Beds May Be Thirty Feet Thick

In some deposits the bed may be 20 to 30 ft. thick and of [illegible] per cent ore. The thickness of the covering of loose barren material may be 20 ft. or more; or it may attain great thickness and then be removed by erosion, leaving the sulphur bed outcropping. Obviously, a great variety of conditions may exist. The fractured masses of country rock through which the vapors have escaped to the surface contain from 5 to 10 per cent of sulphur, which has been deposited along the fracture planes. This material is not of economic importance.

In exceptional instances, fractures in the rock, several feet wide, have been formed, and are filled with practically pure sulphur. It is doubtful if the sulphur in these "veins" will extend more than 30 or 40 ft. in depth. Chupiquina Mountain shows a number of these "veins," which provide a large part of the production of one company operating there.

To summarize, a typical deposit today is the result of the following conditions:

1. Volcanic activity sufficiently violent to have thoroughly fractured the body of the mountain.
2. A period of relative quiescence, with perhaps occasional eruptions of ash, but no flows of lava.
3. Abundance of sulphur vapors finding outlet to the surface through cracks in the flanks of the volcano. Deposition of sulphur, at or near the surface.
4. Climatic conditions such as to preclude rapid erosion.

Climatic Conditions Complicate Mining

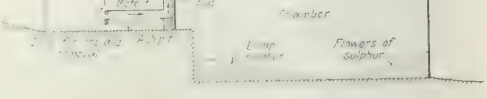
The deposits range in altitude from 13,000 ft. (Salar de Aguilar) to 20,000 ft. (Piedra Parada). At 20,000 ft. elevation respiration, at normal rate, supplies the blood with less than half the oxygen supplied at sea level. The average individual can exert himself no more than to get on and off his saddle mule. Even the Chilean miners, accustomed to altitudes up to 10,000 ft., are unable to accomplish much at altitudes in excess of 16,000 ft. The Bolivian Indians, reared to such conditions, are the only people who can stand the hardships. The extreme cold at such altitudes also reduces efficiency of labor. Imagine working in a place where the maximum mid-day temperature ever recorded was 4 deg. C.! Add to this extreme cold a wind which never ceases and usually assumes hurricane force between noon and sunset, and the human being, whose vitality already has been reduced by lack of oxygen, suffers severely.

Tacora District Accounts for Most of the Output

Tacora and Chupiquina are twin mountains situated about six miles west of Ancara station on the Arica-La Paz railway. There are three producing companies operating on Tacora. On Chupiquina there are two, one of which is among those operating on Tacora. The mines on Tacora are larger and more accessible than those on Chupiquina. On Tacora the deposits occur as beds of sulphur conforming in slope to the surface of the hill and overlain by 1 to 2 m. of barren, loose, bleached material. The workable beds vary in thickness from 24 in. up to 8 ft. and the grade ranges from 50 to 90 per cent sulphur.

Mining Methods Are Primitive

There is no system to the mining. The producers purchase per hundredweight of ore, of a specified grade, delivered to their loading yard or refinery. The miner selects a likely looking place, and proceeds to "dig himself in." He throws his waste where he wills, and recovers about 50 per cent of the ore. He may come along a week later and rehandle his waste so as to get at ore that should have been removed first. All ore that breaks fine is lost. The "method" seems to have been transplanted, intact, from the nitrate fields.



Sketch showing arrangement of a typical refinery

The ore is sorted by hand in the diggings and when a miner has a sufficiently large pile it is sacked, loaded on llamas, and taken to the yard to be weighed. The "patron," to be safe, deducts 10 per cent. The Indian, placidly chewing his "coca," is pleased that it isn't more.

Sulphur miners at Piedra Parada, in Chile. The elevation is 19,500 ft.

Sometimes the mine catches fire. It may be quickly smothered by throwing on more sulphur. If it gets out of control thousands of tons may either burn or melt and run down the hillside.

It is probable that on Tacora Mountain there are 205 acres of ground underlain by sulphur ore. Assuming an average thickness of 3½ ft. and average grade of 50 per cent would give a total of 1,500,000 tons of 50 per cent ore. These figures are set down only to convey an idea of the size of the deposits, and are not an attempt at an exact estimate.

On Chupiquina Mountain there are bedded deposits like those on Tacora, and also "veins" of sulphur. The total sulphur-bearing ground on Chupiquina may be estimated at 125 acres. The vein deposits in this area probably contain 180,000 tons of 80 per cent sulphur ore. The bedded deposits contain probably 350,000 tons of 50 per cent ore. The combined tonnage would be around 530,000 tons of 60 per cent ore.

REFINING IS A PROCESS OF DISTILLATION

In the refining process two products are obtained: flowers and granulated sulphur. The flowers, used in disinfecting vineyards, bring a much higher price than the equally pure granulated sulphur. The refiner naturally aims to produce as high a proportion as possible of flowers.

With one exception, all refiners use the same process. This consists of placing a charge of sulphur ore in a cast-iron retort, excluding air, and by applying external heat volatilizing the sulphur in the charge. The vapors pass to a condensing chamber, where they yield the finely divided amorphous powder known as flowers. As the chamber where sublimation takes place has no circulation, the temperature near the point of entrance of the vapors is usually above the melting point of sulphur (115 deg. C.). About 50 per cent of the sulphur coming from the retort forms in the chamber as a liquid, which runs down and covers the floor near that end of the chamber. Later, this is broken up and sold as granulated sulphur. Both products are equally pure—99.7 per cent S being a typical assay.

CAST-IRON RETORTS ARE USED

The retorts are of cast iron, 6 ft. long, 3 ft. wide, and 18 in. high. The bottom is flat, and the top is rounded to an arch. They are similar in shape to the ordinary muffle furnace for assaying. In the center of the top there is an opening for charging. At the back end there is an opening to the flue which carries the volatilized sulphur to the condensing chamber. In the front is a door through which the unburned residue is removed after each run. Once charged, the openings in front and on top are sealed, the fires are quickened, and volatilization proceeds. The firebox is arranged to give two passes of the hot gases in contact with the retort. The first passage is under and to the rear. The gases then pass to the front along the sides and top of the retort. Flues conduct the gases to the stack. The sketch on the preceding page shows, in a general way, how the treatment is conducted.

Above the retort is a funnel-shaped hopper which holds one charge for the retort. This is filled with ore, and the heat from below melts the sulphur and prepares it for introduction into the retort as the next charge. Along the top of the line of retorts is a track by which the ore is brought in small cars to the charging hoppers.

The unburned residue of the ore, and also the ashes from the fixebox, are dumped into wheelbarrows and taken to the dump. Each charge is about 500 lb.; eight charges can be run in twenty-four hours. *Yareta* is used for fuel. One ton of charge requires 1,250 lb. of *yareta*.

The chambers are opened at intervals of four or five days. The flowers are sacked for shipment without further treatment. The lump sulphur is crushed to about 2-in. size and also sacked. The plant operates in two twelve-hour shifts, and requires eight men per shift.

Fig. 3. Section showing [illegible] deposit of sulphur at Ollague, Chile

The cast-iron retorts require replacing every twelve months, this being the principal item of maintenance cost.

COST DELIVERED AT TIDEWATER IS $23.12 PER TON

The detailed cost per ton of producing sublimed sulphur under the conditions outlined is as follows:

[illegible]	$2.56
[illegible]	7.68
[illegible]	3.52
[illegible]	3.52
[illegible]	$17.28
[illegible]	5.84
[illegible]	$23.12

Nothing is included in the above for depletion of ore or depreciation of plant.

The sulphur produced is half flowers and half granulated. The flowers sell in Arica for $50 per ton and the granulated for about $27 per ton. The average selling price for the product of the refinery is around $38.50 per ton, which yields a profit of more than $15 per ton. A properly equipped refinery and a narrow-gage railway to connect with the Arica-La Paz railway would increase the profit greatly.

MOTOR TRUCKS USED FOR TRANSPORTING ORE

Muecke & Co., operating on Chupiquina, have been the most progressive of the operators in the Tacora district. They have a three-mile aërial tramway from the mine to the foot of the mountain. From the lower end of the tramway the ore is carried two and one-half miles in motor truck to the refinery. The refinery consists of two parts. One section uses the retort method already described. The other section refines by steam. The ore is charged into a vertical cylindrical retort about 12 ft. high and 5 ft. in diameter. The cylinder has hemispherical ends. In the lower end is a screen upon which are retained the impurities in the ore. The molten sulphur passes through the screen to the hemispherical lower end, which is steam-jacketed for keeping the sulphur molten. On a level with the screen is a door for the removal of the impurities retained on the screen. The charging door is at the top of the upper hemisphere. The doors are steam-tight. Once charged the cylinder is filled with steam under 80-lb. pressure. The steam melts the sulphur, which runs to the bottom through the screen and collects in the steam-jacketed receptacle there. The molten sulphur is tapped periodically and run into moulds. The blocks are crushed and shipped in sacks as granulated sulphur.

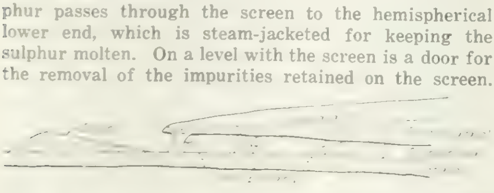


Fig. 4. Sections showing method of supporting workings by means of ice pillars at Aucanquilcha, Chile

The principal objection to this process is that all of the impurities are not removed. Another objection is that it produces only granulated sulphur, which sells for much less than the flowers. Attempts have recently been made to grind finely this steam-refined sulphur, and by air classification to obtain a product fine enough to be used as a disinfectant. It is claimed that these artificial flowers adhere better to plant leaves, but they do not contain the small amounts of free H_2SO_4 and H_2SO_3 which are said to be the beneficially active agents in the sublimed flowers. Also, any arsenic present in the ore will be found in the finished product.

DEPOSIT AT PAUCARANY IS COVERED WITH OVERBURDEN

About fifteen miles north of Tacora, at Paucarany, is a small producer. The ore comes principally from what was once the neck of a volcano. The volcano has been eroded on three sides, and the deposit is on a level with the surrounding country. It is a bedded deposit, formed after the erosion of the volcano. It is covered by from 10 to 30 ft. of overburden, the removal of which makes mining expensive. However, the relatively low altitude of the deposit (14,500 ft.) and the situation in a valley where there is abundant pasturage for the llamas, compensates for the greater mining cost. South of Tacora, in the order named, are the following volcanoes: Guallatire, Puquintica, Surire, Mulluri, Pumire, Isluga, Caraquima, Lirima, Cancosa, and Porquesa. All of these are reported as containing sulphur deposits, some of them extensive and of high-grade ore. At present, because of lack of transport facilities, these deposits are not being worked but they will be available if required in the future.

ONE PRODUCER IN THE OLLAGUE DISTRICT

In the Ollague district there are two mountains containing large sulphur deposits. These are Ollague and Aucanquilcha. Ollague volcano lies six miles east of the village of that name. Aucanquilcha is fifteen miles west of the same point. Ollague village is 437 km. from Antofagasta on the Antofagasta-Bolivia railway. Ollague volcano, with its column of steam, is a familiar sight to any who have traveled from Antofagasta into Bolivia.

The deposits on Ollague volcano are similar to those already described on Tacora Mountain. The area of the sulphur-bearing ground is about forty-two acres. The hillside is steep, averaging about 35 deg. The deposit is overlain by from two to six meters of overburden, but this does not interfere seriously with mining. The sulphur beds conform to the slope of the hill. The thickness of the bed is from one to three meters, and the average grade probably around 75 per cent.

Fifteen miles west of Ollague village is Aucanquilcha Mountain. The top of the mountain is 20,047 ft. above sea level. The mountain is irregular in outline, and is not at all suggestive of a volcano. The only signs of volcanism are the few sulphurous exhalations associated with the sulphur beds.

ICE PILLARS USED FOR SUPPORT IN MINE WORKINGS

The bed is from 3 to 15 ft. thick and averages about 90 per cent sulphur. As the ore is covered by weathered material and snow, mining is done underground. At mid-day, during the summer, the snow melts a little, and the water trickling into the workings is so controlled that when it freezes—which it does quickly in the mine—pillars of ice are built up for supporting the roof!

Most miners would be afraid of a thaw, but as the maximum temperature ever recorded in that locality was 4 deg. C. there seems no danger of the pillars giving way.

The refinery at Ollague is similar in general design and operation to the one at Tacora. Besides their refining business, the Carrasco Brothers, who own practically all of the sulphur ground on Aucanquilcha, have sold four or five thousand tons of 85 per cent ore to the Chile Exploration Co. each year.

The llama of the Bolivian Indian. Llamas are used to transport sulphur ore in Chile

The Ollague district has somewhat less tonnage than the Tacora district, but the ore is of better grade. Judging from areas, exposures and the grades being produced, the combined tonnage of the two mountains may be estimated at 2,000,000 tons and the grade as around 75 per cent.

The next deposits of importance begin at Llullaillaco volcano and extend to Cerro Copiapo. In this distance of 125 miles are found the deposits of Llullaillaco, Lastarria, Salar de Zufrera, Salar de Aguilar, Cerro Infieles, Piedra Parada, Juncalito, and Copiapo. Because of their remoteness from rail transportation none of these deposits have produced sulphur in commercial quantities.

At Piedra Parada is a large deposit which has been prospected by the Andes Copper Mining Co. of Potrerillos. The sulphur beds are similar to those on Tacora Mountain, which have already been described. The deposit is on the top of the mountain at an elevation of about 20,000 ft. It was systematically prospected by test pits and tunnels, and an accurate tonnage estimate was made. The difficulty of carrying an exploration work fifty-five miles from a base of supplies and at 20,000 ft. elevation can be appreciated.

The Piedra Parada deposits are relatively older than those of Tacora and Ollague. Deposition has entirely ceased, there is no solfataric action, and erosion has proceeded far enough to remove the sulphur beds in certain areas.

South of Coquimbo the next known deposit is at Tinguiririca. This leaves a stretch of 300 miles of Cordillera in which no sulphur deposits are found. Tinguiririca is ninety miles south of Santiago, and is east of the San Fernando station on the Chilean state railways. The volcano is in an inaccessible region and the difficulties of transport are enormous. Alfred P. Tupper, one of the veteran explorers of the Andes, has described Tinguiririca as one of the greatest sulphur deposits of Chile. I inspected what were claimed to be the best areas on the mountain, and decided that they were not at all comparable with the deposits farther north.

The Cerro Azufre of Chillan is on the flank of an active volcano. All around the base of the volcano are numerous vents giving off vapors. Sulphur is actively being deposited, but erosion is keeping pace with deposition, and no large deposits are found. The deposits have never been worked. They are at 8,000 ft. elevation. Here climatic conditions preclude the existence of a large deposit.

Sulphur-bearing ground at Salar de Aguilar, Chile. The white shows the bleached surface

The sulphur industry in Chile is in its infancy, and as yet production is comparatively small. It is amply protected by tariff and is already a profitable business. Markets in Argentina, Brazil, and Peru are capable of great expansion. Fairly complete information on the greater part of the Chilean Cordillera is available, but the deposits between Guallatire and Porduesa have not been developed, and little is known of their potential output. It is quite possible that one or two of these little-known sulphur deposits may prove to be as large as Tacora.

Until more is known of the Guallatire-Porquesa deposits a complete estimate of Chile's sulphur resources will be impossible. There are, however, sufficient data on the rest of the deposits to show the large reserves of the country. I have estimated the various deposits as follows:

TABLE 4. ESTIMATED AVAILABLE SUPPLY OF SULPHUR IN CHILE

Locality	Amount of Ore, Tons	Average Grade, Per Cent	Sulphur, Tons
[illegible]	[illegible]	50	750,000
[illegible]	[illegible]	60	318,000
[illegible]	[illegible]	75	1,500,000
[illegible]	[illegible]	60	600,000
[illegible]	[illegible]	50	250,000
[illegible]	5,530,000	62	3,418,000

These estimates are only approximate, and probably err on the side of conservatism. With the gradual but inevitable exhaustion of the deposits of Japan and Sicily, there remain only two large known sources of sulphur —namely, those of the Gulf Coast and those of the Chilean Andes. The development and large-scale exploitation of the Chilean deposits is only a question of time.

Platinum in the Quartz Veins of Southwest Oregon

Traced in Some Cases to Lode Deposits— Blue Quartz in Highland Mine Yielded High Per Cent

By A. E. Kellogg

PLATINUM, like chrome, in southwest Oregon is closely associated with serpentine. The native alloy of platinum, iridium and osmium, in which platinum is found in nearly all the gravel deposits of this region, is apparently derived from the serpentine. That is, these metals are believed to be the primary constituents of the igneous rock, which have altered to serpentine. It is also believed that the ultimate source of the gold placers in this region, like those of California, is in the serpentine and the olivine-bearing rocks of the Sierra Nevadas and tributary ranges, which are in a part of the drainage basins of the streams.

The platinum that is associated with the gold in the placer workings of the district has in but a few instances been traced to lode deposits containing the metal in the native form. A roughness of the platinum, and in some specimens a black or a brownish coating, which is apparently iron oxide, indicate proximity to its source.

In the Riddle Quadrangle, the serpentines have resulted chiefly from the decomposition of the peridotites and the pyroxenites, but in some areas they are probably derived from the decomposition of the basic phases of the greenstone. Much of this serpentine shows shear zones and slickensided surfaces.

The great serpentine dike extending from Siskiyou County, Cal., first makes its appearance in Oregon in the Upper Applegate district. This area is occupied largely by old Paleozoic sedimentary rocks, with interbedded sills and flows of andesitic character. In places these bedded rocks are penetrated by dikes of dark igneous rocks and also large irregular masses of tonalite. The sediments in general strike about north 20 deg. east and dip at an high angle to the east. They have perhaps been overturned, so that the oldest beds now lie above the younger. On this basis the oldest Paleozoic rocks are the argillites and sandstones, containing limestone lenses near Watkins. They have been intruded by andesite and serpentine dikes, and, in some places, are highly altered. They are also modified by intrusions of tonalite. Serpentine, derived in part from dunite, is abundant on Red Mountain, which obtained its name from the color of the thoroughly oxidized soils derived from it and similar highly ferruginous rocks. The serpentine is cut by seams, some of which are occupied by chlorite and other talc. On the eastern part of this mountain, some of the serpentine is derived from the alteration of amphibolite. These dikes are found in many places in this part of the state.

In 1916 the manager of the Highland mine, in the Gold Hill district, was puzzled at the smelter report on a shipment of concentrates. Besides containing 14.12 oz. of gold and 3.24 oz. of silver, it also contained 0.32 oz. of platinum. The ore giving this result was taken on the 100 level of the mine. The foot wall of the vein showed schist and granite, and the hanging wall is made up of serpentine, schist, and granite.

According to Parks and Swartley, of the Oregon Bureau of Mines, the Highland group of mines is situated twelve miles southwest of Gold Hill, on the right-hand fork of Foots Creek, at an elevation of 2,600 ft. It was first worked about twenty-five years ago. The present workings are confined to the oxide zone, the old workings being more extensive. The vein strikes northeast and dips south 35 deg. east. The country rock is a micaceous sandstone.

The owners of the mine, in an attempt to discover the source of the platinum, found in the shipment sampled the walls of the vein but no trace of platinum. They then looked to the vein matter for the source. The vein matter is mingled with quartz of three hues—rose, amber, and blue. The blue quartz, more dense in its composition than the others, is pitted throughout with small cavities, which are lined with a sooty black mineral and filled with decomposed ferrous matter. In crushing and panning this blue quartz, it invariably yields a high per cent of platinum, and assays give a higher per cent. The rose and amber quartz show no platinum.

Surprising values in platinum quartz were found two years ago in Curry County, running from 10 to 20 oz. per ton. It is claimed that these deposits have been traced for nearly twenty miles from northeast to southwest, ending in the vicinity of the mouth of the Sixes River. Diller[1] wrote of the platinum possibilities of the Sixes River district in a paper published nearly twenty years ago.

Some experienced mining men were slow to believe that the reported finds were realities, declaring that platinum had never been found in ore and that the mineral that caused the excitement in Curry County was something else than platinum, this despite the fact that all of the placer diggings in the region were productive in platinum.

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[1] U. S. Geological Survey, Folio 89, p. 6, 1903.

Friction Factors in Ventilating Pipe

Results of a Series of Experiments at the University of California— Little Difference Between Metal and Wood Pipe

By Walter S. Weeks, Wesley P. Goss, and George H. Warren

A SERIES of experiments was recently made at the University of California to determine the friction factors in metal, wood, and canvas ventilating pipe. We use the term "friction factor" instead of "coefficient of friction" because the latter term has a distinct and special meaning in mechanics.

The formula in common use to express drop in pressure in a ventilating duct is

$$P = \frac{KSV^2}{A} \qquad (1)$$

P = drop in pressure in pounds per square foot.
K = friction factor.
S = rubbing surface in square feet.
V = velocity in feet per minute.
A = cross-sectional area of duct in square feet.

This formula is derived from the Fanning formula for turbulent flow, which is

$$h_f = \frac{4 f l v^2}{d 2 g}$$

h_f = drop in pressure in feet of head.
l = length of pipe in feet.
v = velocity in feet per second.
d = diameter in feet.
g = acceleration due to gravity.
Let w = density in pounds per cubic foot.
v = velocity in feet per minute.
A = area in square feet.

Then $h_f = \frac{P}{w}$

$$\frac{P}{w} = \frac{4 f l v^2}{d 2 g \, 3600}$$

If we multiply numerator and denominator by $\frac{\pi d}{4}$

$$P = \left(\frac{f}{3600 \times 2 g}\right) \frac{w S V^2}{A}$$

Let $\frac{f}{3600 \times 2 g}$ be represented by a new factor, C, then simplify

$$P = \frac{C w S V^2}{A}$$

It is seen that the factor K is in reality a factor C multiplied by the density. Investigators who publish values of K should give the density at which it is determined or else divide K by the density and give the factor C. An extremely accurate description of the duct should also be given.

The friction factor, whether K or C be used, cannot be expressed in units. The factor C is a variable, and its value is affected by the diameter of the pipe, the specific gravity of the gas, the velocity, and the pipe surface.[1]

The condition of the pipes used in mine work varies so much that the calculation of the factors for different velocities and diameters would be a useless refinement. The formula for drop in pressure is used for determining the water-gage pressure on a pipe when a given amount of air is flowing, so the simplest procedure is to determine the factor in one of the commonly used smaller diameter pipes with low velocity. Any increase in diameter or velocity will make the factor smaller, so we shall be on the safe side. If the pipe is dented or extremely rough, a larger factor must be assumed.

A study of metal and canvas tubing was made at the same time. The canvas tubing was connected to the fan and the metal pipe was arranged in series with it, so the same air passed through both. It was found necessary to restrict the flow of air at the end of the metal pipe by an orifice in order to hold sufficient pressure in the canvas tubing to keep it inflated. A diagram of the apparatus is shown above.

The fan used was a multivane No. 2 exhauster directly connected to a shunt-wound motor. Accurate speed control was obtained by a sliding rheostat in the armature. Speed was indicated by a Weston electrical indicating speed counter attached to the motor shaft.

The drop in pressure was measured by a specially designed inclined manometer which could be accurately set to the nearest minute of arc. With a 20-to-1 slope the pressure could be read to 0.0005 in. of water.

At the points where pressure readings were to be taken, pin-hole tubes were inserted. Small lead pipes connected these to the manometer. The single manometer was used for all pressure determinations. The velocity was measured with the pitot tube at the point X. Vertical and horizontal traverses were made with a total of twelve readings for each velocity.

Description of Procedure for Tests

The procedure in taking a set of readings was as follows: The manometer was set at a 20-to-1 slope. Drop in pressure between any two points could be measured by connecting those points to the opposite legs of the manometer.

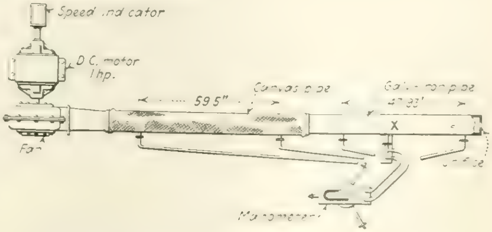

Diagram showing arrangements of apparatus

Drop in pressure in both metal and canvas pipes was first measured. Then the traverses for velocity were made. The readings were then repeated. Next the slope of the manometer was changed to 10 to 1, and the above procedure repeated. The speed was held constant during the test. The density of the air inside of the pipe was calculated from barometric, hygrometric, and temperature determinations.

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[1] "The Flow of Fluids Through Commercial Pipe Lines," Robert E. Wilson, W. H. McAdams, and M. Seltzer, *Journal of Industrial and Engineering Chemistry*, February, 1922.

The canvas pipe had an internal diameter of 10.9 in., and was in 20-ft. lengths. The outside was painted with an asphalt paint to stop leaks, and the joints were taped. The metal pipe was in 14-ft. lengths, with slip joints. A length was made from five sections riveted together. The pipe was dipped, and all joints were taped and painted. The average internal diameter was 11.8 in. The factors for steel and canvas tubing are given in Table 1. Each of these factors is the average of four determinations.

TABLE 1. FACTORS FOR STEEL AND CANVAS PIPE

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	C	K = C × Density
1	[illegible]	[illegible]	[illegible]	[illegible]	0.0000000206	0.00000000156
2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00000000211
3	[illegible]	[illegible]	[illegible]	0.0760	[illegible]	0.00000000145
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.00000000198

WOOD, METAL, AND CANVAS PIPE USED

The wood pipe used for determinations was a standard wire-wound wood-stave pipe with slip joints. The inside diameter was 12.5 in. One hundred feet of pipe was connected to the fan. The drop in pressure was taken over a length of 86 ft. There were seven joints in this 86 ft. The factors were determined for different velocities of air obtained by varying the speed of the fan. No orifice was used on the pipe. A 10-to-1 magnification was used on the manometer. The results are shown in Table 2.

TABLE 2. FACTORS FOR WOOD PIPE

[illegible]	[illegible]	[illegible]	[illegible]	C	K = C × Density
1	[illegible]	[illegible]	0.0762	0.0000000189	0.00000000144
2	[illegible]	[illegible]	[illegible]	[illegible]	0.00000000136
3	[illegible]	[illegible]	0.0761	[illegible]	0.00000000134
4	[illegible]	[illegible]	[illegible]	0.0000000175	0.00000000133

A study of Table 1 shows that the factor for canvas tubing is 1.36 times the factor for metal pipe. A study of Table 2 shows clearly that the factor decreases with the increase of velocity. To compare the factors of metal and wood pipe we must use the results obtained with nearly the same velocity.

Test 3 of Table 1 is comparable to Test 1 of Table 2. This comparison shows that there is little or no difference in the factors of wood and metal pipes.

To determine quickly the drop in pressure in a pipe through which a given amount of air is flowing, some sort of chart is necessary. The chart[2] printed in the American Blower Co.'s bulletin, "Fan Testing," is the most convenient one, in our opinion. Let us see how the friction factor used in the calculation of this chart compares with the factor which we have determined for metal pipe.

The formula used in the calculation of this chart is

$$F = \frac{kSv^2}{a}$$

F = drop in pressure in inches of water.
k = friction factor.
S = rubbing surface in square feet.
v = velocity in feet per second.
a = cross-sectional area in square inches.

This formula may be derived from the formula (1) given at the beginning of the article. The factor used in the A. B. C. formula is 100,000 times the factor K used in this paper. The k used in the building of the A. B. C. chart was 0.0002. This factor would be 0.000000002 if used in our formula (1). Comparing this with K for steel pipe, it is seen that the factor used in the chart is about 33 per cent higher than is shown by our experiments. Considering the fact that the pipe used in our experiments was in excellent condition, this does not seem an unreasonable allowance for less favorable conditions.

Accordingly, for metal and wood pipe it would seem reasonable to use the A. B. C. chart directly. For canvas tubing the drop in pressures taken from the chart should be multiplied by 1.4. If it is desired to allow for higher density, the figures for drop in pressures taken from the chart should be multiplied by the factor, "actual density ÷ 0.076." In metal pipe that has been much dented or where constrictions are made in the canvas tubing, much higher factors may be necessary.

The nominal diameters of the pipes are not always accurate, and therefore the pipe should always be measured and the drops calculated for the actual diameters. If satisfactory results are to be obtained with ventilation by pipes, all leaks must be stopped.

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[2] "Selection of Fans for Pipe Ventilation," by Walter S. Weeks, *Engineering and Mining Journal-Press*, May 13, 1922, p. 816.

The Sierra de Ramirez, Durango

BY ALBERTO TERRONES

The Sierra de Ramirez is situated in the San Juan de Guadalupe district, in eastern Durango, Mexico, about three miles from Rivas Station of the old Central railroad. The country is arid.

The orebodies occur in a bedded limestone, where big bonanzas have been found. The principal mineral is cerargyrite. The ores of the district are, generally speaking, easily smelted.

Only the upper orebodies have been exploited up to the present, development having been by means of adits and drifts. No shafts have been sunk in the limestone formation, for which reason the lower part of the mineralized country remains unknown. Winzes have been sunk not deeper than fifteen meters. The unaltered sulphide zone has not been touched.

The country rock is soft, though hard enough to make timbering unnecessary. The ores contain up to 50 per cent of lime, and could be easily graded or cleaned before shipping.

The mines are dry. Ancient mining methods have always been employed. Exploration by boring would be ideal in this country. As already explained, the natives follow the narrow streaks until they strike the orebodies, which in the great bonanzas have produced ore assaying from 20 kg. to 500 kg. of silver per metric ton. At the Calaverita mine, the richest ore, containing up to 75 per cent silver, was found to the amount of eighteen tons. This ore was easily reduced to sheets by hammering, being called by the natives *metal de teja*, and was so sectile that instead of being broken it was cut in mining.

From Symon Station to the mines a good wagon road has been built. Freighting costs 3.50 pesos per ton. Ten kilometers of broad-gage railroad have been recently built from Rivas Station to the mines, which will facilitate the shipping of the ores to either the Torreon or the Aguascalientes smelter. The low-grade ores are now sold to the smelters at a profit by reason of the lime contents and the absence of insoluble.

Ajo Enterprise of the New Cornelia Copper Co.—II

Calculations Based on Diamond-Drilling Proved Exceptionally Accurate and Disclosed Over 100,000,000 Tons of 1.5 per Cent Ore — Acid Leaching and Electrolytic Precipitation Adopted After Exhaustive Research by Metallurgists

By A. W. Allen
Assistant Editor, *Engineering and Mining Journal-Press*

As MENTIONED in the previous article, the holdings of the original Ajo Consolidated Copper Co., the successors to the Rendall Ore Reduction Co., had been developed to such a state that they were sold to the New Cornelia Copper Co., in 1917, for 200,000 shares of New Cornelia stock, and notes for $500,000, due in six and twelve months, with interest at 4 per cent. The exploratory work done by the Ajo Consolidated Co. was considered so thorough and so satisfactory that only a few drill holes were made to check the estimates. The ore reserves thus added to those of the New Cornelia company aggregated 21,000,000 tons, averaging 1.55 per cent copper.

The work of developing the Consolidated property had been placed in the hands of competent engineers and a reliable firm of drilling contractors; and it is interesting to note that a great saving was afterward effected by the avoidance of a complete resampling of the property. Questionable and slipshod methods of ore estimation often have been responsible for an appalling waste of time and money, because of an unnecessary duplication of labor and wastage of supplies. In mining work a guarantee of probity is worth much to the buyer and more to the seller; the Ajo Consolidated company profited as a result of this, and deservedly.

Developing New Cornelia Orebody Started in 1911

An intensive campaign of diamond drilling was begun late in 1911 to develop the New Cornelia orebody. This was for the purpose of estimating (1) the respective amounts of oxidized and sulphide ores that were available for mining by steam shovel, (2) how much had to be removed by other methods, (3) the copper content of the ores, and (4) the amounts of gold and silver present. The work of diamond drilling was placed under contract with the E. J. Longyear Co., of Minneapolis, the contractors that were engaged by the Ajo Consolidated Co. for a like purpose on the adjoining property.

Collecting Sludge for Sampling

R. D. Longyear comments, in a recent A. I. M. E. bulletin, on the sampling methods employed. The most reliable plan to adopt to collect the sludge, he says, is to see that all the water pumped down is returned, preferably to a tub, allowing the overflow to settle afterward in three or more barrels placed in series. As soon as one of these is full the overflow pipe is deflected to a second barrel, and so on. When the ore has settled sufficiently in the first barrel, the clear supernatant liquor is siphoned, and the vessel is filled again with pulp, this procedure being continued until the sample is complete. When sufficient water has been decanted from all the barrels, the sample is concentrated in one of these, in which further decantation is practiced until the pulp is of such consistence that it may be removed and dried. Both core and sludge are then assayed, and the results are averaged in proportion to their original weights.

At Ajo less than 50 per cent was recovered as core. To facilitate calculation, the engineers of the Longyear company devised a table, shown herewith, by the use of which it is possible to estimate quickly the correct average as soon as data as to weight of core and sludge have been obtained. The bit used at Ajo was such that a 1½-in. core resulted. The chart used[1] can be extended as desired to include any type of bit and to cover any possible character of deposit. The accuracy of the system depends on the hole being of uniform size, for the results would be vitiated if the presence of softer material led to the enlargement of the bore or to local collapse of the walls. It is, of course, assumed that all the sludge and core is recovered.

Drilling and Channel Sampling Checked Closely

The Longyear method of calculation proved to be unusually accurate so far as the Ajo orebody was concerned; for, when test pits and drifts were made to check the results, it was found that the channel sample of the test pits in the carbonate ore checked the result of the drilling to within 0.005 per cent, being that much lower; in the case of the sulphide ore the test pits and raises were within 0.05 per cent of the drilling estimate, being also that much lower; and the drifts in sulphide ore averaged only 0.02 per cent higher than did the estimate obtained by diamond drilling the corners of the blocks. This work was described[2] in detail by Ira B. Joralemon, who, as geologist for the Calumet & Arizona Co., was one of the engineers associated with the parent enterprise and in charge of development operations. From this account the following condensed statement has been prepared: The ground considered as ore-bearing was co-ordinated with east-to-west and north-to-south lines that were placed at 200-ft. intervals, the diamond-drill holes being made at the intersections. The work was begun late in 1911 and was finished in September, 1913, when eighty-four holes had been bored, varying in depth from 200 to 1,000 ft. and totaling 23,097 ft. in length. Of these, nineteen were stopped while still in ore.

After six months of diamond drilling, the checking of results was begun by means of test pits, each of which was 4 by 6 ft.; these were sunk, using Mexican and Indian labor, by means of windlass and hand drill. Letting this work on contract proved so satisfactory that up to a depth of 50 ft. it was found to be cheaper than diamond drilling. Every tenth bucketful hoisted from each hole was taken for a sample; then, after the pit was completed, it was again sampled in 5-ft. sections, by cutting a rectangular groove 3 in. deep and 6 in. wide, the product from which aggregated 500 lb.

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[1] *Eng. and Min. Journ.*, March 21, 1914.
[2] *Trans.* A. I. M. E., 1914, Vol. 49, p. 605.

of weight for each 5-ft. section. This so-called channel sample proved to contain 0.15 per cent less copper than did the bucket sample; the lower of the two estimates was taken as final.

The number of test pits sunk was seventy-seven, of a combined depth of 3,955 ft., 3,606 ft. of which was in carbonate ore and 349 ft. in sulphide ore. Of this, 1,059 ft. served to check the results of holes drilled in carbonate ore; 175 ft. checked the results in sulphide ore, and 2,721 ft. of test pitting was done in advance of drilling operations.

Drifts were run on co-ordinated lines from the bottoms of two of the deepest test pits to check the diamond drilling in the sulphide zone, raises from these drifts being used to check the estimate obtained by drilling. The material broken on each round was hoisted separately, dumped on an iron plate, mixed, and shoveled to waste after every tenth shovelful had been reserved to form the basis of a sample to be reduced subsequently. The total length of drifting in sulphide ore amounted to 1,513 ft., and the combined sinking and raising on drill holes in sulphide ore was 307 ft. At the conclusion of this development work an estimate of ore available within the zone of exploration, based on a minimum of 1 per cent copper, was as follows:

	Tons	Copper Per Cent
[illegible]	40,258,000	1.51
[illegible]	32,481,200	1.54
[illegible]	7,776,800	1.40
[illegible]	2,308,400	0.63

As stated previously, the purchase of the Ajo Consolidated property in 1917 resulted in the acquisition of an additional 21,000,000 tons of ore averaging 1.55 per cent copper. Early in 1919 a large and rich body of sulphide ore, which contained from 4 to 77.7 per cent copper, was opened on the 360-ft. level of this ground. It was planned to ship the high-grade ore to the smelter at Douglas, retaining the low-grade material for treatment in a flotation plant that will supersede or will operate concurrently with the existing leaching plant. The value of the gold and silver in the low-grade ore amounts to about 35c. per ton; the gold and silver in the carbonate ore are not recovered. Much of that in the sulphide ore can be recovered by the flotation of the ore and the smelting of the concentrate produced.

It is doubtful whether the inception of any other important metallurgical operation has exceeded in thoroughness, care, and technical skill the preliminaries to the design and erection of the existing leaching plant at Ajo. The contributions to contemporary technical literature in this connection, particularly in reference to the leaching of copper ores, have been unusually varied and complete; all of these have appeared in the *Transactions* of the Institute. This was to be expected, for Dr. Ricketts was the president of that organization in 1916; and, in addition to his manifold activities for the betterment of the profession and the advance of technology, he was and is a member of the committee dealing with copper refining, the purpose of which is to obtain papers of high merit for the *Transactions* of the society. The published articles describing the experimental treatment of the ore at Ajo have become standard works of reference, and to disregard any of them would be to ignore the opinions and experiences of those who are exceptionally well qualified to speak with authority; therefore they will be quoted fully in the summary that follows:

TABLE OF PERCENTAGES OR MULTIPLIERS FOR DIAMOND-DRILL SAMPLES

No. In of Core	E Extra Heavy Bit		E Medium Bit		E Standard Bit		E Mesaba Bit		A Bit		N Bit	
	Cuttings	Core	Cuttings	Core	Cuttings	Core	Cuttings	Core	Cuttings	Core	Cuttings	Core
1	99.6	0.4	99.5	0.5	99.4	0.6	99.4	0.6	99.4	0.6	99.2	0.8
2	99.2	0.8	99.0	1.0	98.9	1.1	98.9	1.1	98.8	1.2	98.3	1.7
3	98.8	1.2	98.5	1.5	98.3	1.7	98.3	1.7	98.2	1.8	97.5	2.5
4	98.3	1.7	98.1	1.9	97.8	2.2	97.7	2.3	97.6	2.4	96.6	3.4
5	97.9	2.1	97.6	2.4	97.2	2.8	97.2	2.8	97.0	3.0	95.8	4.2
6	97.5	2.5	97.1	2.9	96.6	3.4	96.6	3.4	96.4	3.6	94.9	5.1
7	97.1	2.9	96.6	3.4	96.1	3.9	96.0	4.0	95.8	4.2	94.1	5.9
8	96.6	3.4	96.1	3.9	95.5	4.5	95.5	4.5	95.2	4.8	93.2	6.8
9	96.2	3.8	95.6	4.4	95.0	5.0	94.9	5.1	94.6	5.4	92.4	7.6
10	95.8	4.2	95.1	4.9	94.4	5.6	94.3	5.7	93.9	6.1	91.6	8.4
11	95.4	4.6	94.7	5.3	93.8	6.2	93.8	6.2	93.3	6.7	90.7	9.3
2	94.9	5.1	94.2	5.8	93.3	6.7	93.2	6.8	92.7	7.3	89.9	10.1
3	94.5	5.5	93.7	6.3	92.7	7.3	92.6	7.4	92.1	7.9	89.1	10.9
4	94.1	5.9	93.2	6.8	92.2	7.8	92.1	7.9	91.5	8.5	88.2	11.8
5	93.7	6.3	92.7	7.3	91.6	8.4	91.5	8.5	90.9	9.1	87.3	12.7
6	93.3	6.7	92.2	7.8	91.0	9.0	90.9	9.1	90.3	9.7	86.5	13.5
7	92.9	7.1	91.7	8.3	90.5	9.5	90.4	9.6	89.7	10.3	85.1	14.3
8	92.5	7.5	91.3	8.7	89.9	10.1	89.8	10.2	89.1	10.9	84.8	15.2
9	92.1	7.9	90.8	9.2	89.4	10.6	89.2	10.8	88.5	11.5	84.0	16.0
20	91.7	8.3	90.3	9.7	88.8	11.2	88.7	11.3	87.8	12.2	83.1	16.9
21	91.3	8.7	89.8	10.2	88.2	11.8	88.1	11.9	87.2	12.8	82.2	17.8
2	90.8	9.2	89.3	10.7	87.7	12.3	87.5	12.5	86.6	13.4	81.4	18.6
3	90.4	9.6	88.8	11.2	87.1	12.9	87.0	13.0	86.0	14.0	80.5	19.5
4	90.0	10.0	88.3	11.7	86.6	13.4	86.4	13.6	85.4	14.6	79.7	20.3
5	89.6	10.4	87.9	12.1	86.0	14.0	85.8	14.2	84.8	15.2	78.9	21.1
6	89.1	10.9	87.4	12.6	85.4	14.6	85.3	14.7	84.2	15.8	78.1	21.9
7	88.7	11.3	86.9	13.1	84.9	15.1	84.7	15.3	83.6	16.4	77.3	22.7
8	88.3	11.7	86.4	13.6	84.3	15.7	84.1	15.9	83.0	17.0	76.4	23.6
9	87.9	12.1	85.9	14.1	83.8	16.2	83.6	16.4	82.4	17.6	75.6	24.4
30	87.5	12.5	85.4	14.6	83.2	16.8	83.0	17.0	81.8	18.2	74.7	25.3
31	87.1	12.9	84.9	15.1	82.6	17.4	82.4	17.6	81.2	18.8	73.9	26.1
2	86.7	13.3	84.4	15.6	82.1	17.9	81.9	18.1	80.6	19.4	73.0	27.0
3	86.3	13.7	83.9	16.1	81.5	18.5	81.3	18.7	80.0	20.0	72.2	27.8
4	85.8	14.2	83.5	16.5	81.0	19.0	80.7	19.3	79.4	20.6	71.3	28.7
5	85.4	14.6	83.0	17.0	80.4	19.6	80.2	19.8	78.8	21.2	70.5	29.5
6	85.0	15.0	82.5	17.5	79.8	20.2	79.6	20.4	78.2	21.8	69.6	30.4
7	84.6	15.4	82.0	18.0	79.3	20.7	79.0	21.0	77.6	22.4	68.8	31.2
8	84.1	15.9	81.5	18.5	78.7	21.3	78.5	21.5	77.0	23.0	67.9	32.1
9	83.7	16.3	81.0	19.0	78.2	21.8	77.9	22.1	76.4	23.6	67.1	32.9
40	83.3	16.7	80.5	19.5	77.6	22.4	77.3	22.7	75.7	24.3	66.3	33.7
41	82.9	17.1	80.1	19.9	77.0	23.0	76.8	23.2	75.1	24.9	65.4	34.6
2	82.4	17.6	79.6	20.4	76.5	23.5	76.2	23.8	74.5	25.5	64.6	35.4
3	82.0	18.0	79.1	20.9	75.9	24.1	75.6	24.4	73.9	26.1	63.8	36.2
4	81.6	18.4	78.6	21.4	75.4	24.6	75.1	24.9	73.3	26.7	62.9	37.1
5	81.2	18.8	78.1	21.9	74.8	25.2	74.5	25.5	72.7	27.3	62.0	38.0
6	80.8	19.2	77.6	22.4	74.2	25.8	73.9	26.1	72.1	27.9	61.2	38.8
7	80.4	19.6	77.1	22.9	73.7	26.3	73.4	26.6	71.5	28.5	60.4	39.6
8	80.0	20.0	76.7	23.3	73.1	26.9	72.8	27.2	70.9	29.1	59.5	40.5
9	79.6	20.4	76.2	23.8	72.6	27.4	72.2	27.8	70.3	29.7	58.7	41.3
50	79.2	20.8	75.7	24.3	72.0	28.0	71.7	28.3	69.6	30.4	57.8	42.2
51	78.8	21.2	75.2	24.8	71.4	28.6	71.1	28.9	69.0	31.0	56.9	43.1
2	78.3	21.7	74.7	25.3	70.9	29.1	70.5	29.5	68.4	31.6	56.1	43.9
3	77.9	22.1	74.2	25.8	70.3	29.7	70.0	30.0	67.8	32.2	55.2	44.8
4	77.5	22.5	73.7	26.3	69.8	30.2	69.4	30.6	67.2	32.8	54.4	45.6
5	77.1	22.9	73.3	26.7	69.2	30.8	68.8	31.2	66.6	33.4	53.6	46.4
6	76.6	23.4	72.8	27.2	68.6	31.4	68.3	31.7	66.0	34.0	52.8	47.2
7	76.2	23.8	72.3	27.7	68.1	31.9	67.7	32.3	65.4	34.6	52.0	48.0
8	75.8	24.2	71.8	28.2	67.5	32.5	67.1	32.9	64.8	35.2	51.1	48.9
9	75.4	24.6	71.3	28.7	67.0	33.0	66.6	33.4	64.2	35.8	50.2	49.8
60	75.0	25.0	70.8	29.2	66.4	33.6	66.0	34.0	63.6	36.4	49.3	50.7

Note: The values of the separate assays made for cuttings and core in a 5-ft. run should be multiplied by the respective percentages found in the column headed by the size of the bit used, opposite the number of inches of core recovered. The results are to be added and divided by 100 for the average assay for the sample.

A description of the experimental work undertaken may be prefaced best by referring to a paper[3] by Dr. Ricketts, in which he discussed the various problems that were given consideration by the technicians and engineers in control of the metallurgical destinies of the New Cornelia company, with particular reference to the treatment of the immense available amount of low-grade and soluble copper ore. In this article Dr. Ricketts emphasized the fact that the metallurgical field of the copper industry has expanded greatly during recent years; copper ores are usually lean and diverse in character and must be treated on a large scale. The operating and consulting staffs of the principal mining companies have been enlarged and organized, and no great capital expenditure is now sanctioned until the subject has been given exhaustive consideration and until recommendations have been made by a highly organized force of specialists.

VALUE OF TECHNICAL PUBLICITY DEMONSTRATED

Dr. Ricketts' ideas on technical publicity may be summed in the statement that "for the advancement of our art we should deliberately discuss subjects among ourselves, in order to do away with the idiosyncracies of the individual and in order to gain a comprehensive view representing the best thoughts of many men." This sentiment forms the keystone of the policy of the New Cornelia company in regard to the development of a suitable process for the treatment of the ore at Ajo. The past history of the companies that a decade or so ago controlled the deposits was too bizarre to convey a lesson to an intelligent engineer; but there would be fewer metallurgical fiascoes, not only in the base-metal but also in the precious-metal industries, if engineers and capitalists would emulate the attitude taken by Dr. Ricketts when he said that "no matter how beautiful the process, simplicity and lowness of operating costs are the main features that appeal to me; complexity and higher costs must promise an increased yield that will more than offset the added expense; for, given the grade, the maximum profit per ton is demanded."

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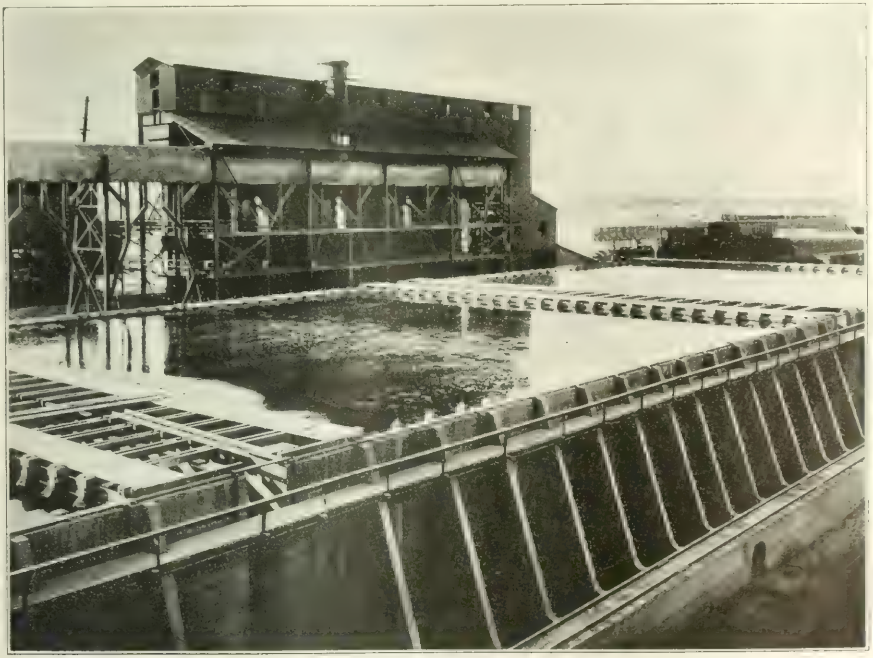
[3] *Trans.* A. I. M. E., 1915, Vol. 51, p. 737.

Preliminary, Downward-Leaching Tests

Owing to the comparative cheapness of operation, the high efficiency of displacement, and the ability to handle the material on a large scale, attention was directed from the start to the possibility of employing a gravity-percolation leaching process. The use of chlorine compounds was dismissed as undesirable and impracticable, and consideration was paid to the possibility of the extraction of the soluble copper by means of a dilute solution of sulphuric acid, followed by the precipitation of the metal by means of iron. The preliminary work was entrusted to Stuart Croasdale, who was assisted by Henry A. Tobelmann and James A. Potter, both of whom were afterward in charge of important work when the large plant was in operation at Ajo. This preliminary experimental work was performed at Douglas, where the Calumet & Arizona company had a smelter and now has, in addition, an acid-making plant. The ore used came from the test pits and underground workings that were opened to Ajo to check the results of diamond drilling, and the investigations were begun in July, 1912. This phase of the work has been described in detail by Mr. Croasdale.[4] He prefaces his remarks by discussing an important factor in leaching operations—the evaporation of water from the surface of large vats. During the months of June and July, 1913, the evaporation at Ajo amounted to 10.72 in. and 14.8 in., depending on whether the water was contained in a concrete or in an iron tank. Although this may appear high, it is interesting to note that it indicates only a small fraction of the evaporation occurring on the Chilean pampa, where a large-scale copper-leaching plant was erected by the Chile Exploration Co.



Leaching vats and sulphur-dioxide plant

Stuart Croasdale's Researches

Mr. Croasdale, who carried out extensive volatilization tests on oxide and sulphide ores, details the consideration paid to the Henderson process of roasting with salt; of Utley Wedge's modification of a sulphatizing roast in which only a small amount of salt is added; and of Frederick Laist's idea of giving the material a preliminary roast before adding the salt.

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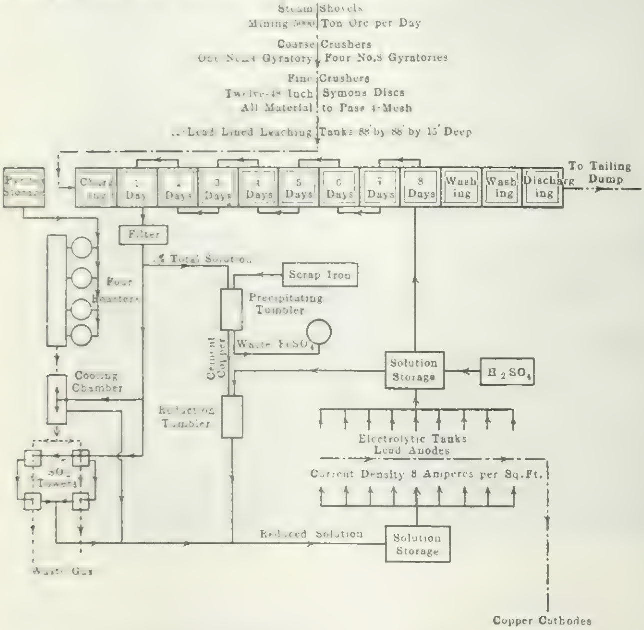
[4] *Trans.* A. I. M. E., 1914, Vol. 49, p. 610.

By adopting the chloridizing roast treatment, all ores from the Ajo deposit—sulphide, oxidized, and mixed—could be treated together, the extraction would be high. It was realized that the necessary crushing would be costly if not prohibitively expensive. Gravity-percolation of the roasted material would be feasible only with shallow depths; a supply of salt at a reasonable price would be essential.

The experiments showed that with the oxidized ore a chloridizing roast with salt, after crushing to 40 mesh, resulted in 86.5 per cent of the copper being chloridized and made soluble; with sulphide ore the amount was increased to 93.2 per cent. At the same time tests were made on mixed ores by the Wedge Mechanical Furnace Co. It was found, in conclusion, that mixing was advisable to secure an excess of sulphur, that crushing need not be carried beyond 20 mesh, and that from 5 to 10 per cent of salt was a suitable amount. Under these conditions an extraction of 90 or 91 per cent was anticipated in practice.



Flow sheet proposed for the 5,000-ton plant

The idea of fine crushing and roasting, however, was discarded, and attention was concentrated on the practicability of leaching the oxidized ore with a weak solution of sulphuric acid, the solvent needed at Ajo to be produced cheaply by the parent company at Douglas. A small amount of acid would be regenerated during the process if electrical precipitation were used; and the total first cost of the plant promised to be less than if fine crushing and roasting were adopted. It was proved that sufficient ferric iron would be in the solution at all times to dissolve metallic copper formed according to the equation, $Cu_2O + H_2SO_4 = CuSO_4 + H_2O + Cu$. On the other hand, it was realized that sulphuric acid would dissolve little of the copper existing as sulphide, only half of the copper in the form of cuprite, and a doubtful amount of that occurring as silicate. None of the silver and gold would be recovered by such a process. Iron and aluminum salts would pass into solution and would interfere with precipitation by electrolysis. This raised the question whether the excess acid consumed would be counterbalanced by the amount regenerated. A proportion of the iron in the ore existed in the ferric state, and this would assist in the solution of the copper minerals.

LEACHING TESTS AT DOUGLAS

The preliminary tests conducted by Mr. Croasdale were performed in small jars, and comparison was made between results obtained after crushing to 8 mesh and 4 mesh; in both tests a 10 per cent sulphuric-acid solution was used. After a circulating period of twenty-four hours it was found that 88.6 per cent of the copper in the 8-mesh material had been extracted, with a consumption of 3.5 lb. of acid per pound of copper dissolved. On the 4-mesh material, the extraction was 85.7 per cent, 2.8 lb. of acid being consumed per pound of copper dissolved. It was found that circulation increased the extraction without materially increasing the consumption of acid, and that crushing to 8 mesh increased the consumption of acid without materially increasing the extraction of the copper. The time of leaching was then extended to ninety-six hours and the material crushed to 2 mesh, the results, with a 10 per cent acid solution, being as good as those obtained when the material had been crushed finer.

The use of a strong acid solution permits reduction in the time necessary for treatment. However, it was not Mr. Croasdale's intention to recommend the use of 10 per cent acid in practice, but it was realized that some acid is consumed almost immediately by the lime and iron in the ore, as well as by the copper. Most of the iron compounds in the oxidized ore have resulted from the slow oxidation of pyrite; they are more in the nature of precipitated ferric hydroxide or ferric oxide than of hematite or of magnetite. Consequently, the iron passes into solution almost as readily as does the copper. This is not true in respect to the alumina, although the soluble alumina is the product of a kaolinization of the porphyry by the acid formed by the oxidation of the pyrite.

Tests were then carried out on a larger scale and more in conformity with operating conditions. A pipe was used, 10 in. diameter and 18½ ft. long. In the bottom of this was placed a screen on which a natural gravel "filter" was arranged. The conclusions reached after tests had been made on ore crushed to pass 4- and 2-mesh screens were: (1) That the height of column had no retarding effect on downward percolation, and (2) that upward submergence followed by downward percolation was indicated as desirable. Subsequent investigation and decision on the part of other research engineers were such that Mr. Croasdale's recommendation in regard to downward percolation was overruled; upward submergence, however, was adopted.

Experiments were then made on materials to be used for the construction of the leaching vats, and various acid-resisting substances were tried. Five experimental vats were equipped with different types of lining; in these about 300 tons of ore from test pits and shafts was treated, all of which passed a 2-mesh screen, except that used in one test. These experiments indicated that leaching was practicable; but in the test in which the ore had been crushed to pass a 4-mesh screen, the fine material in the charge interfered so much with lixiviation and washing that a low extraction resulted. The average rate of percolation is given as 78 in. per hour. Mr. Croasdale favored precipitation on iron, being of the opinion that electrical precipitation, using insoluble anodes, had not been proved successful on a commercial scale. He contended that the recovery of acid during electrolytic precipitation at Ajo could never develop into an important item, because of the small percentage of copper precipitated from the solution during each passage through the cells and the relatively large amount of acid consumed by the iron, lime, and alumina. It was recognized that the stronger solutions only are amenable to electrolytic precipitation; anyway, such a method amounts to little more than a skimming process, although in the aggregate a large amount of copper is recovered, and in a refined condition.

Production of Sponge Iron Practicable

Mr. Croasdale considered various kinds of sponge and pig iron as a precipitant, but the experiments were not concluded by the time a decision was made to adopt electrolytic precipitation. However, a quantity of information had been obtained concerning the production of sponge iron, which Mr. Croasdale still considers can be made easily and cheaply from hot calcine or from other sources. At the time of the experiments at Douglas the intention was to consider the utilization of the calcine from the roasting furnaces in the acid-making plant. It was found an easy matter to produce the sponge iron by an intermittent process, but this was not considered desirable. In this connection it is interesting to note that the Chino Copper Co. is reported to have developed an efficient and economical process for making sponge iron from the magnetite extracted from tailing. It is probable that the use of such a precipitant will attract further attention when a satisfactory method of continuous manufacture is perfected.

Rate of Percolation

The conclusions reached as to a desirable rate of percolation are of interest. To have attained the velocity reported in some of the tests indicates washing rather than percolation; and even if the material were thoroughly mixed and evenly distributed in the vat it is difficult to conceive how the equilibrium of distribution of fine and coarse could be maintained with such a rapid flow of liquor. This view is supported by the circumstance that trouble resulted when 4-mesh material was used in one of the tests, for it is difficult to understand why ore of such a character and fineness should not leach satisfactorily at a normal rate of flow. The small-scale tests made at Douglas were performed on material that was crushed in an unsuitable machine, and it is probable that a large amount of fine was produced. However, the practice of ultra-rapid percolation was adopted in all subsequent experimental work and ultimately also when the full-sized plant was put in operation. It is obvious, therefore, that the advantages resulting are more than sufficient to compensate for any possible disturbance of the equilibrium of the charge, and movement of slime in the direction of percolation.

Notable Results of Croasdale's Research

The experimental work done by Mr. Croasdale at Douglas resulted in a tailing that averaged 0.32 per cent from an ore that contained 1.43 per cent copper. The depth of column utilized was about 12 ft. The trail leading to successful accomplishment had been blazed—Mr. Croasdale was complimented by Dr. Ricketts in the *Transactions* of the Institute for having "ably conducted a long series of most valuable experiments"—and the scene of action was moved to the mine. In the meantime, F. L. Antisell, the superintendent of the Raritan Copper Works, had sent Andrew D. Jamieson to Douglas to supervise the construction of a test plant and to control its operation according to plans devised by Mr. Antisell. The proposed process, in brief, consisted of crushing the ore to pass a 3- or 4-mesh screen, upward percolation with a solvent consisting of dilute sulphuric acid, electrolytic deposition of the copper in the solution, reduction of the excess of ferric iron by sulphur dioxide, and the use of a special anode that had been developed and patented by Mr. Antisell. Except for the substitution of lead for the patent anode, this process is remarkably similar to the one that was adopted ultimately by the New Cornelia company. Tests had been made with the Antisell patent anode at Douglas between January and August, 1914.

Pope-Hahn Leaching Process

Still another process attracted attention about that time, having been developed by Dr. Frederic Pope and Albert W. Hahn, both of whom went to Douglas in April, 1914, then to Ajo in August, remaining there until the latter part of the year. The Pope-Hahn process, as it was called, possessed several distinctive and attractive features. The ore was leached with two solutions. The first effluent, carrying but a small amount of impurity, was sent direct to the electrolytic cells, the second being neutralized with roasted concentrate and agitated with air and steam. The pulp was then filtered, and this solution joined the first effluent, going also to the electrolytic cells. The idea apparently originated from the process of Ottoker Hoffman, in which a solution containing iron, alumina, arsenic, and antimony may be freed of its impurities by the addition of some form of copper oxide. The Pope-Hahn adaptation of this process was sound, both in theory and in practice.

The experimental work at Ajo was continued by Henry A. Tobelmann, James A. Potter, Andrew D. Jameson, and J. S. Olmstead, all of whom went there from Douglas in July and August, 1914. The results obtained during this period have been condensed from a joint paper[5] by Dr. H. W. Morse, research engineer for the Western Precipitation Co., who went to Ajo in August, 1915, and by Mr. Toblemann, afterward metallurgist for the New Cornelia company.

Mr. Croasdale's conclusions on leaching with dilute sulphuric acid were taken as the basis for further experimental work of a similar nature. His conclusion in regard to fouling—that the amount of deleterious substances taken into solution was small—suggested the possibility of a closed leaching cycle with electric deposition, and a regeneration of some of the acid required. Iron, dissolved from the ore and oxidized during electrolysis, was recognized as constituting a troublesome factor that might militate against the successful adoption of electrical precipitation. Three remedies were considered: (1) The use of a diaphragm; (2) the use of a depolarizer; and (3) the purification of the liquors before electrolysis.

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[5] *Trans.* A. I. M. E., 1916, p. 389.

ENLARGING THE EXPERIMENTAL PLANT AT AJO

The tests at Ajo soon confirmed Mr. Croasdale's results as to the economic practicability of leaching with dilute sulphuric acid, but further investigation was needed to determine the precise degree of crushing advisable, and also the amount of fouling that might take place in the solution after repeated use. The construction of an additional experimental plant, of forty-ton unit capacity, was finished in February, 1915, and this was operated concurrently with the one-ton unit plant.

The problem of fouling became more insistent as the work proceeded, the ferric content of the solution rising to such an extent that the efficiency of electrolytic deposition became undesirably low. With the coming of cool weather the pipes in the plant became clogged with deposits of crystals of iron-copper sulphate. To remedy this Mr. Tobelmann suggested that a proportion of nearly neutral solution be isolated from circulation, passed over scrap iron to produce cement copper, and then returned to the main circuit. This innovation proved to be practicable; it solved the difficulty and was adopted, the ferric iron being reduced to the ferrous state and the copper being dissolved again in pregnant solution high in ferric iron, the resultant liquor being then returned to the electrolytic circuit. This feature was, perhaps, the most important development during this phase of the investigations. The remedy was simple; it provided a cheap method of avoiding fouling. It was arranged that the bulk of the solution from the leaching plant should go to reduction towers, where it would meet sulphur dioxide to be produced during the roasting of pyritic ore in mechanical furnaces, and by which it was expected that the amount of ferric iron in the solution would be lowered to less than 0.4 per cent.

CRUSHING THE ORE FOR THE EXPERIMENTAL PLANT

The earlier tests at Douglas were made on ore that had been passed through rolls. The final tests at Ajo were made on ore that was first crushed in a Blake breaker from 10 to 4 in., then passed through a 48-in. Symons horizontal disk crusher to reduce it to 1½ in., and lastly through a vertical disk crusher to reduce it to ⅜ in. The final product, according to the average of sizing tests on 290 head samples, representing 300 forty-two-ton charges, aggregating 12,000 tons, was as follows:

[illegible]	[illegible]	[illegible] Per Cent	Copper Per Cent
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	1.17
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	4[illegible]	[illegible]	1.19
[illegible]	[illegible]	72.8	1.24
[illegible]	[illegible]	78.8	1.28
[illegible]	4.2	83.0	1.37
[illegible]	[illegible]7.0	100.0	[illegible]
[illegible]	[illegible]		1.40

Many mechanical problems had to be solved before making a final decision on a number of details. Exhaustive experimental work was performed so that no mistake would be made in the final choice of a material for anodes. Lead had given good results during one year's service, but it was realized that the use of graphite promised a higher efficiency per pound of copper deposited, as well as a greater regeneration of acid. However, a number of pertinent considerations militated against the adoption of graphite; it was found that control must be so exact as to make its use almost impracticable. Lead, on the other hand, provided a fool-proof material for the purpose, and it was recommended for final adoption.

After continuous research for nearly twelve months with the one-ton and forty-ton experimental units, during which time about 15,000 tons of ore had been treated and nearly 190,000 lb. of copper had been produced, a final report of recommendations was submitted in January, 1916, signed by H. W. Morse, H. A. Tobelmann, and J. A. Potter. The proposed plan of operations is outlined graphically in the accompanying flow sheet, taken from the Morse-Tobelmann paper[6] on the work of testing the ore.

A summarized statement of conclusions indicated that operation on a full scale, 5,000 tons per day, would result in an extraction of 82 to 83 per cent of the copper in a 1.4 per cent ore; that the consumption of sulphuric acid would amount to 3 lb. of pure acid per pound of copper, that the "bleeding" and purification of 1 per cent of the total solution was necessary to prevent fouling; that the power efficiency obtainable by using lead anodes would be 1 kw.-hr. per pound of cathode copper produced; and that the rate of circulation adopted in the test plant, which amounted to two gallons per minute per ton of ore, was undoubtedly much higher than was necessary.

To be continued

A New Antimony Ore Producer in Australia

Antimony ore from the Costerfield mine, in Victoria, is being used by the Antox Syndicate, Ltd., of Sydney, for the manufacture of oxide of antimony, according to the London *Times Trade Supplement.* The product is being marketed as a non-poisonous substitute for white lead, and complete success is claimed for it. The Costerfield mine is said to be one of the largest antimony mines in the world, with practically inexhaustible supplies. Gold also occurs in the ore in small quantities, and is extracted by a separate process.

Antimony oxide is volatilized from a suitable furnace and the vapor condensed in a series of cooling chambers. In the first, the heat is about 300 deg. F. After going through two more chambers, the fume passes to a baghouse, the temperature then being about 120 deg. F. Careful temperature control is necessary, the color of the product varying from a pure white to a dull orange shade, depending upon the temperature at which the process is conducted.

As a result of eight months of operation, the Antox Syndicate, Ltd., declares that the oxide can be manufactured cheaper in Australia than in Europe, largely owing to the development of a contrivance by which the oxide is withdrawn from the chutes.

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[6] *Trans.*, A. I. M. E., 1916, p. 380.

CONSULTATION

The Identification of Carnotite and Radioactive Minerals

"I wish you would tell me, if you can, what the ore which is called carnotite looks like, or what family or group of minerals it belongs to. I have the platinum family of minerals here and I may have radium if I knew what to look for and how to test them."

Carnotite, according to Dana, belongs to the uranite group of minerals and has the approximate composition $K_2O.2U_2O_3.V_2O_5.3H_2O$, a compound containing potash, oxides of uranium and vanadium, and water. It is mined not only for its uranium and vanadium but also for the slight amount of radium which it contains. Carnotite has an earthy appearance, and is a canary to lemon yellow in color. It may occur as a powder or in masses, and is comparatively soft, its hardness being about equivalent to that of gypsum or talc. Large amounts of the mineral are mined in Colorado and Utah and shipped to reducing plants. We have never heard of the association of radium with platinum.

The prospector who thinks he has discovered radium-bearing minerals should send his samples to a competent laboratory, either government or privately owned, for a qualitative analysis. The detection of radium is a simple matter, although not readily performed in the field. One of the simplest means of determining whether a mineral is radioactive or not is to subject it to a test with an electroscope. Radioactive minerals have the power of discharging an electroscope, and under suitable conditions the rate of discharge is proportional to the amount of radioactive substance in the mineral. J. F. McClelland has described an electroscope used by engineers and prospectors to detect radioactivity and to make a quantitative test. He states that radium is obtained solely from uranium ores, the amount of radium bearing a constant relation to the amount of uranium present; normally one unit of uranium is accompanied by 3.3 x 10-7 units of radium—an infinitesimal amount. Thorium compounds and minerals also discharge the electroscope.

This simple electroscope was suggested by B. B. Boltwood, and can be made in the field from a five-cent piece, a quarter dollar, or an iron washer as a base, on which is placed a drop of sealing wax or candle grease to hold in an upright position a long wire nail or a piece of tin about 2¾ in. long, flattened at its upper extremity. One end of an aluminum leaf about 0.1 in. wide and 1⅞ in. long is attached to the tip of the upright with mucilage or paste, and the apparatus is ready to be used. The bottom of the upright nail or wire must be insulated from the iron washer or quarter used as a base by the piece of sealing wax, and the wax must not be touched with the fingers after it is in place. If no aluminum leaf is available, a piece of tissue paper both sides of which have been covered with graphite by rubbing with a lead pencil will serve as a substitute. An inverted tumbler is used to protect the apparatus from air currents.

The electroscope is charged by touching the upright with a piece of hard rubber—a fountain pen will do—which has been electrified by rubbing on one's sleeve. A protractor placed behind the electroscope enables the angle to be read between the leaf and the upright after charging, and the rate at which the electroscope will discharge itself by leakage can readily be ascertained. The mineral to be tested is placed inside the tumbler: radioactivity is proved by a rate of discharge faster than that due to natural leakage.

A series of tests made by H. G. Mead with this apparatus shows surprisingly accurate results on quantitative tests if handled carefully.

Aluminum leaf is much more satisfactory than paper but requires greater skill and patience in manipulation. For quantitative work a small sample of ore of known uranium content is required to standardize the electroscope; unknown samples may then be tested. Much care must be taken to avoid salting the containers used. A portable electroscope with reading device is made by the Denver Fire Clay Co., of Denver, Col.

Wireless Telephone Apparatus

"I was much interested in your recent editorial on the wireless telephone and am anxious to learn where I can obtain the apparatus for receiving the broadcasting service which you describe."

Hundreds of places in New York and vicinity sell radio equipment, although we understand that certain parts are difficult to secure, on account of limited manufacturing facilities and excessive demand. Without doubt a great deal of apparatus sold is not suited to the buyer's needs, and for much of it unduly extravagant claims are made.

Before purchasing any equipment, you should familiarize yourself with some of the fundamentals of the science. To this end we would suggest a book recently issued by the U. S. Signal Corps, "The Principles Underlying Radio Communication," second edition, obtainable from the Superintendent of Documents, Washington, D. C., for $1. You might also subscribe to the *Radio Service Bulletin*, issued monthly by the Bureau of Navigation, Department of Commerce. The subscription price is 25c. per year, from the Superintendent of Documents, Washington. There are also several magazines devoted to radio communication, which carry the advertisements of a large number of dealers in wireless equipment. Among these are *Wireless Age*, a monthly, 326 Broadway, New York; price, $2.50 a year; *Radio News*, a monthly, 236 Fulton St., New York; price, $2; and *Q. S. T.*, a monthly, 1,045 Main St., Hartford, Conn.; price $2. There is also the bi-monthly *Proceedings* of the Institute of Radio Engineers, College of the City of New York, New York City, the subscription price of which is $9 per year. Harper Bros., New York, have recently published a book by Verrill which sells for 75c., which describes how to make a home-made receiving set.

THE PETROLEUM INDUSTRY

Freight-Rate Reductions Should Readjust Oil Industry in Southwest

Inequities of Former Transportation Charges Seriously Reduced Production and Resulted in Discrimination Against Interior Refineries

IN CONNECTION with its recent decision ordering a horizontal reduction in freight rates amounting to about 10 per cent, the Interstate Commerce Commission analyzes the situation in the petroleum industry as follows:

In the United States 469,639,000 bbl. of crude oil was produced in 1921, an increase of 5.9 per cent over 1920, and 125,000,000 bbl. was imported from Mexico. The crude oil refined in 1921 aggregated 443,000,000 bbl., an increase of 2.2 per cent over 1920, and the total amount of gasoline, kerosene, fuel, gas, and lubricating oils shipped was 405,204,000 bbl., an increase of approximately 1 per cent.

Exhibits introduced by shippers indicated that the crude oil moved by rail in 1921 was 25 per cent less than in 1920, and that in 1921 only 6.6 per cent of the crude oil received at refineries came by rail, compared with 9.9 per cent in 1920. According to reports of carriers on file, the tons of crude oil originated on Class I carriers in 1920 were 6,435,074, and in 1921, 5,044,513 tons, or 22 per cent less. According to shippers, the number of carloads of petroleum products shipped by rail in 1921 was 735,000, or 8.5 per cent less than in 1920. The number of tons of petroleum products originated on Class I carriers as appearing in their reports was 29,615,954 in the year 1920, and 27,216,185 tons in 1921, a decrease of 8 per cent.

IMPORTANCE OF PETROLEUM PRODUCTS TO BASIC INDUSTRIES

Fuel oil, gasoline, and other petroleum products are important elements of cost in mining, agriculture, and industry, being used as fuel or motive power for mine machinery, irrigating plants, tractors, and trucks. Petroleum loads heavily, moves in large volume with little loss or damage, and shippers usually furnish the tank cars. They say that their compensation from the carriers for use of the cars is less than cost. The carriers pay at the same mileage rate on empty as on loaded cars, and the movement empty is practically 100 per cent of the loaded movement.

In August, 1918, at the solicitation of the petroleum industry, the Director General of Railroads substituted a flat increase of 4.5c per 100 pounds in all carload rates on petroleum and its products for the 25 per cent increase previously applied under his General Order No. 28. This resulted in comparatively small percentage increases in long-haul rates, but the percentage increases in short-haul rates were greater than on commodities generally and in many cases ranged from 100 to 200 per cent. Shippers stated that as a result most short-haul rates upon petroleum, especially upon crude and fuel oil, are greatly out of proportion to the cost of transportation.

Petroleum and its products are consumed generally throughout the country, but the greatest consumption is in the states east of the Mississippi and north of the Ohio and Potomac rivers. At one time most of the refineries were situated in the eastern group. In recent years many refineries have been constructed in the Southwest and at Atlantic Gulf and Pacific Coast points. In 1921 there were approximately 250 refineries in the Southwest, of which 130 were shut down. Less than 50 per cent of the total capacity of the interior Southwestern refineries was in operation during that year, but refineries on the Gulf Coast and east of the Mississippi River were operated at approximately 85 per cent of capacity. Some of the Southwestern refineries appear to be of inferior construction, but nothing of record indicates that, capacity considered, most of them are not as efficient in operation and equipment as refineries generally.

AUGUST, 1920, RATES A HEAVY HANDICAP

Shippers urged that the greater extent to which interior Southwestern refineries were idle in 1921 was due to the percentage increases in rail rates on petroleum products from these refineries to Northern and Eastern markets, which had widened the spread in transportation charges to the disadvantage of Southwestern refiners. For example, the rates from Tulsa, Okla., and Wood River, Ill., to Cleveland, Ohio, prior to the increase of 1920 were 45c. and 25c. respectively, a difference against Tulsa of 20c. That increase resulted in rates of 62c. and 35c. respectively, increasing the difference to 27c. The record indicates that although more than 55 per cent of the crude petroleum produced in the United States in 1921 came from wells in the Southwest, less than 20 per cent of the total crude produced was refined by the interior refineries in that region; and that, of the crude produced in the Southwest, 57 per cent moved either by pipe lines to refineries elsewhere, or by pipe lines and tank vessels to Atlantic ports, thus depriving the rail lines of much revenue. Shippers say that such readjustments as the carriers have made since August, 1920, instead of lessening the burden placed upon the Southwestern refineries by the percentage increases, have augmented that disadvantage to the extent of 3.5c. per 100 lb., the amount of a flat reduction in rates between points in central territory and from central to trunk-line territory. Following that reduction, the advantage of Wood River over Tulsa in reaching Cleveland became 30.5c.

Rail lines are not obtaining as great a proportion of the total movement as they did in former years. This is due chiefly to the rapid development and increased use of other forms of transportation, notably pipe lines, motor trucks, tank vessels, and accessorial storage facilities. While transportation by these other forms of carriage is undoubtedly in many instances more economical than by rail, and while rail lines may not expect to retain the entire traffic, use of the other forms of transportation is enhanced by the existing level of rail rates. The increases in many short-haul rates over the 1917 basis are now from 5 to 6.5c. per 100 lb., which in themselves would be high rates in many cases. Many short-haul rates are materially higher than on other commodities of like transportation characteristics. The rail lines are losing some short-haul traffic which they might retain at lower but still remunerative rates. Self-interest would seem to dictate revision by them of their short-haul rates.

Shippers of petroleum throughout the country have agreed upon a plan contemplating reductions in and readjustments of practically all petroleum rates on the following basis:

1. In official classification territory: Readjustment to rates of Jan. 1, 1917, plus 40 per cent.
2. In New England: 4.5c. per 100 lb.
3. Between trunk-line territory and New England: 4.5c. per 100 lb., with 90 per cent of fifth class as a maximum.
4. Between central freight association territory and New England: Readjusted to basis of 2c. per 100 lb. over the New York rates (No. 1 above).
5. Southern and Western classification territories, except Pacific Coast: (1) Local rates—15 per cent, plus a specific reduction of 4.5c. per 100 lb. (2) Proportional rates—15 per cent, plus 2 or 2.5c. per 100 lb., whichever was authorized in freight rate authority No. 96.
6. Pacific Coast territory: 15 per cent, plus specific reductions of 4.5c. per 100 lb.
7. All territories: Application of any minimum rate for short hauls eliminated.

It is not necessary to discuss this plan in detail. Little specific information was presented relative to its effect upon existing rate structures or the revenues of the carriers. Evidently important changes in relationships and decrease in revenue would result from its adoption, unless accompanied by an increase in tonnage hardly to be anticipated. In official classification territory the reduction would be about 30 per cent and carry the rate level below that obtaining immediately prior to August, 1920. The rates could be made effective only by recomputing all existing rates and re-issuing the schedules. This would take much time.

The percentage increase of 1920, coupled with the subsequent reduction of 3.5c. in central territory, has tended to lessen the rail movement of refined products and fuel oil from Southwestern refineries to Northern and Eastern markets and to increase the movement of crude oil by pipe line from Southwestern producing territory to Northern refineries, and also to Gulf Coast refineries from which the movement is by water to North Atlantic ports and thence by short rail hauls into the interior. As a result the Southwestern refineries are suffering while other refineries are operating more nearly at capacity.

This situation appears to clearly fall within the class of readjustments contemplated when the increases of 1920 were authorized. Carriers should promptly revise their rates from the Southwest to the Eastern group in order to lessen the spread as compared with rates between points in central and trunk-line territories. This should not be construed as requiring re-establishment of the precise differences which existed immediately prior to the increases of 1920.

Only 25 per Cent of Russian Oil Production Can Be Exported

Special Correspondence

Much international attention is being paid at present to the Russian oil industry, and the following data are therefore of general interest: Up to the outbreak of the war the production of mineral oil in Russia amounted to about 20 per cent of the world's production, and decreased in 1921 to 3.7 per cent. In spite of this, the oil production of Soviet Russia still occupies the third rank in the world. During the year 1920 the production amounted to 25,400,000 bbl., and in 1921 to 28,500,000 bbl. In the district of Baku the production in 1921 amounted to 155,000,000 poods (36 lb.), and during the year 1919 the production in this district amounted still to 215,000,000 poods and in 1920 to 175,000,000 poods. During the last two years named the oil fields were exploited by the British.

In the district of Grosny the monthly production during the second half of 1921 amounted to 6,100,000 poods, and in January, 1922, to 7,100,000 poods. On account of lack of bore material new borings cannot be made. The machinery in the refineries as well as the pipe lines are in bad condition. According to the regulations of the Soviet government adopted at the beginning of the present year, concerning the grant of mineral oil concessions, 30 per cent of the produced oil is reserved to the state and 45 per cent must be reserved for the home demand. Only 25 per cent can be exported, and all export orders must pass through the official mineral-oil office. Payments for export orders are to be effected by means of the State Bank or the oil office, and all payments are to be in foreign values.

Freeport Sulphur Co. Brings In New Well in Gulf Oil Fields

Special Correspondence

The most recent development in the Gulf Coast oil field is the completion of a producing well at Stratton Ridge, Brazoria County, Tex., by the Freeport Sulphur Co. This well, the No. 9 Dannenbaum, is on the northeast side of the dome, and was drilled to a depth of 4,368 ft. The oil is coming from a stratum a little above this depth, and at the rate of 1,500 to 2,000 bbl. daily. This well will force drilling in adjoining leases held by the Texas, Humble Oil & Refining, Sun, Empire, and other companies. Stratton Ridge will be, apparently the next coastal oil field.

At High Island, in Galveston County, one of the most prominent, topographically, of the salt domes, a shallow cap-rock well, 155 ft. deep, has been drilled, and is now standing full of oil. Desultory drilling has been done here for many years, but hitherto without the discovery of oil in paying quantity. This well may point the way for further successful development work.

In two of the older producing salt-dome fields, wells have been brought in. At West Columbia, the Humble Oil & Refining Co.'s No. 1 Badge well was completed at 3,400 ft., making 4,000 bbl. of oil. This well is in what is now called the northwest extension of the field, and adds a large acreage of oil-bearing land to the field reserves. At Blue Ridge, Fort Bend County, the Kirby Petroleum Co.-Oil Producers' Association joint test No. 2 Blakely was recently completed at 4,001 ft., making 4,000 bbl. of light-gravity oil.

John Ballot

An Appreciation by Edward H. Nutter

IN AN EFFORT to characterize John Ballot as he was known to his friends I wrote out a list of what seemed to me to be his principal attributes, with the idea of discussing them. The list itself, however, presents a picture of him in somewhat rugged outline that may of itself be interesting. He was possessed to an unusual degree of a strong will, of great determination, of relentlessness in a fight, of honesty and sincerity, of loyalty to his friends, associates and employees, of thorough-going patriotism, great kindliness, unusual generosity, a sense of humor, a far-seeing and penetrating mind, and a philosophic serenity of disposition. Perhaps his most salient characteristics, aside from his far-seeing and penetrating intelligence, were his determination and his kindliness.

John Ballot

John Ballot was born in Cape Colony, in British South Africa, in 1861. He died in New York on April 1, 1922, of a lingering illness due to heart disease. He was a man of strong scientific curiosity; he was among the first to appreciate the possibilities of the deep leads on the Rand, and wrote a paper pointing them out, which attracted much attention in the early days. The altitude of the Transvaal, however, was hard on his heart, and he removed to London about 1900. He became interested in the selective attraction of oil for certain minerals and began the investigation of processes involving this phenomenon. He purchased certain patents, optioned others, and financed thorough-going research investigations of this property of oil with a view to developing a commercial process. This research, which led up to the discovery of the froth flotation process as now known, he personally followed closely, and largely directed it. The steady purpose with which he pressed it through for a number of years and until success was obtained, and then the grim relentlessness with which he fought through the litigation in protection of his companies' rights, testify most eloquently to his will and to his determination. This litigation is so fresh in the public mind that it hardly needs recapitulation. Briefly, however, it was (1) the suit of the Elmores against Minerals Separation, Ltd., which was finally decided in favor of Minerals Separation, Ltd., by the House of Lords in England; (2) the suit of the Elmores against the Sulphide Corporation, a licensee of Minerals Separation, Ltd., which was finally decided in favor of Minerals Separation, Ltd., by the Privy Council, the "Supreme Court" of the British Empire; (3) the litigation in the United States, which has been twice through the Supreme Court, and has only recently been settled out of court. This American litigation lasted practically eleven years, and was directed throughout by Mr. Ballot and his associate and friend, Dr. Gregory.

To his employees and subordinates John Ballot was more like a father than an employer, and his loyalty to and consideration for them induced for the most part a corresponding loyalty to him and to his companies. This affection is perhaps best shown by the fact that in his will he remembered generously each member of the Mineral Separation staff. He was devoted to his wife, who survives him, and was in all his personal relations most kindly and lovable.

Mr. Ballot was a man of great acumen and intelligence, which is shown by the fact that the companies he was instrumental in building have survived the stress and turmoil of the last ten years and that without any so-called war profiteering. He had an unusual instinct for avoiding possible pitfalls or untenable positions, which his opponents abundantly learned months and years after he had foreseen and avoided them.

Many attempts were made after the United States had entered the war to utilize against the Minerals Separation companies the pre-war agency contract with a German metal firm, and it developed that Mr. Ballot, at an early stage of the war, had laid the complete situation before the British Board of Trade and that the Minerals Separation companies were working in close adherence to rules then laid down for them by the Board of Trade.

It was no small contribution, either, that Minerals Separation was responsible for by way of war effort. Hundreds of thousands of additional tons of war metals, such as copper, zinc, lead, and molybdenum, were produced by flotation at a time when civilization so sorely needed them. Had Mr. Ballot not started the investigations when he did that led up to the discovery of present-day flotation, the very least result would have been a delay in its development that would have substantially affected the fortunes of the Allies.

As all know, the flotation process itself which Mr. Ballot was so largely responsible for has proved to be one of the few revolutionary metallurgical processes that have been devised. The economies and savings resulting from its use can be estimated in terms of hundreds of millions of dollars.

Mr. Ballot was possessed of a quiet but keen sense of humor. One time he and I were lunching in the Dominion Hotel in Globe, Arizona. A torrential rain was falling in the street outside. It was before national prohibition, but after Arizona state prohibition was in force. He sat carefully drafting what I thought was a telegram. When he handed it to me it proved to be a verse of clever doggerel contrasting his internal dryness with the outside wetness.

Mr. Ballot regretted that his years and health were such that it did not seem worth while for him to become an American citizen. He told me once that he had formerly had a wrong idea of the United States and its people, and that if he were a younger man he would like nothing better than to make his home in the West and help to build and develop it. The potentialities of the West, its resources and possibilities, which he clearly saw, and the character of its people, greatly attracted him. During the last few months of his life he hoped that he might recover his strength sufficiently to enable him to make the trip to California, where he had felt so invigorated by a previous visit.

Mr. Ballot was not a churchman, but he most profoundly respected the things of religion and the sincere religious convictions of others. The atheist's laugh found no response in him.

He was of Huguenot and English ancestry, and his earlier years were spent on the veldt, where he studied everything within his physical and mental vision from the stars to the rocks. After he had removed to London he soon made himself an important man in the City; and a life-long friend, J. H. Curle, who has traveled everywhere and knows nearly everybody, once told me that there was not a brain in the City of London that could be compared with John Ballot's. In a recent eulogy Mr. Curle wrote of him, "Where shall I find his like again?" Another friend, Alexander Gray, wrote "Such a rare nature can ill be spared"; while another friend wrote, "In John Ballot South Africa has lost another of her most brilliant and most sympathetic personalities, a man who in many ways will never be replaced."

It is no mean person who has moved his friends to say such things about him, and as time goes on it seems certain that John Ballot will be more and more recognized as one of the major figures that can be claimed by the mining industry.

Fluorspar Producers Improved Their Mines and Mills During 1921

During 1921 the concentrating mill of the Rosiclare Lead & Fluorspar Mining Co. at Rosiclare, Ill., was redesigned and rebuilt to improve mill practice. The additions include a large dewatering machine to dewater the mill feed and to separate the siliceous slime; a larger and more complete screening and sizing system, to assist the jigs in making cleaner separation; and tables to handle the fine sand spar, heretofore handled on jigs. Provision has also been made for handling spar middlings and re-treating them, to help keep down the tailing losses and to produce a better grade of gravel from the jigs. At the Eichorn mine, near Rosiclare, the shaft was sunk to a depth of 200 ft. and crosscuts were made to the vein at both the 100 and 200 levels. Drifts are being run at the 200 level, and some fluorspar has been taken out. Work upon a small milling plant has been started. Construction and development work at the Hillside mine and mill, near Rosiclare, was continued throughout the year, and it is expected that this modern plant will be put in operation at an early date. Exploration work was done at two openings on the property of the Spar Mountain Mining Co., near Cave-in-Rock.

The Ohio-Kentucky Fluorspar & Lead Corporation has recently taken over the Klondyke and Royal mines, near Smithland, Ky. It is reported that the Klondyke mine is now fully developed and has a 10 ft. vein at the 160 level, and that an up-to-date 100-ton mill is to be built during 1922. The shaft at the Royal mine, which has not been fully developed, is said to be about 400 ft. deep. A mill having a daily capacity of 250 tons is planned.

The new mill of the Great Eagle Fluorspar Co., in Grant County, N. M., was completed and put in operation during 1921, and a small quantity of ground fluorspar was shipped. Another new mill, that of the Ore Production Co., near Rincon, was also put in operation, and at the Tortuga mine of the Tortuga Fluorspar Co., near Mesilla Park, Dona Ana County, a jig has been added to the mill, which now has a capacity of fifteen tons of ground fluorspar every twenty-four hours. It is reported that a vein of fluorspar carrying 97 to 98 per cent of calcium fluoride was opened at the Tortuga mine.

According to the U. S. Geological Survey, authority for the above, reports from steel manufacturers who produce about two-thirds of the basic open-hearth steel made in the United States show that they consumed 46,341 tons of fluorspar in 1921, as compared with 80,545 tons in 1920. This group of steel manufacturers also reported stocks of fluorspar on hand Jan. 1, 1922, amounting to about 19,800 tons, as compared with 45,125 tons on Jan. 1, 1921. These reports therefore show that these steel plants consumed only 1,216 tons of fluorspar more than they had in stock at the beginning of 1921.

Back Beyond Methuselah

BY KIRBY THOMAS

Man's interest in the things which are in the earth must have begun early in human history. The Bible record on this subject is interesting. In the second chapter of Genesis reference is made to the "land of Havilah, where there is gold: there is also bdellium and the onyx stone." The philologists differ as to the meaning of the word "bdellium," some holding that it means balsam or resin, and others that it refers to a product from the earth, either a carbuncle (a precious gem) or crystal or pearl. Be this as it may, there are soon found other references to the point. In the fourth chapter of Genesis is the following: "And Zillah, she also bare Tubal-Cain, an instructor of every artificer in brass and iron." In the forty-fourth chapter is the passage: "and put my cup, the silver cup, . . . "

Jeremiah records in the seventeenth chapter: "The sin of Judah is written with a pen of iron and with a point of a diamond." Ezekiel says in the twenty-eighth chapter: "Thou hast been in Eden, the garden of God; every precious stone was thy covering, the sardius (cornelian), the topaz, and the diamond, the beryl, the onyx, and the jasper, the sapphire, the emerald, and the carbuncle, and gold." Ezra sets forth in the eighth chapter: "And twenty basons of gold, of a thousand drams, and two vessels of fine copper, precious as gold." Timothy, in chapter four, says: "Alexander the coppersmith did me much evil." In Genesis, the eleventh chapter, is found mention of still other earth products: "Go let us make brick and burn them thoroughly. And they had brick for stone and slime had they for mortar." In Deuteronomy reference is made to "a land whose stones are iron and out of whose hills thou mayest dig brass."

SOCIETIES, ADDRESSES, AND REPORTS

Engineering License Not Applicable to Mining Engineers

Committee on Registration So Decides At Council Meeting of F. A. E. S.

A council meeting of the Federation of American Engineers was held in Pittsburgh, May 26 and 27. Dean Cooley, president of the federation, in recounting the aims and ideals of the organization, said that despite the fact that engineers generally are idealists, have great public spirit, and perform inestimable public service, their work is not done in such a way that the people as a whole can recognize its origins.

Thirty societies are now supporting the federation, with individual members numbering about 60,000. The Canadian Institute of Engineers has taken steps to join, and much interest in the progress of the federation is being taken by societies on other continents.

One of the most important acts of the board was the adoption of the report of the committee on registration of engineers, of which Colonel Arthur S. Dwight, of New York, is chairman. The report as adopted contains the statement "that the reasons which justify the registration of engineers responsible for public work do not apply to mining engineers." It follows:

"In considering matters of government as affecting the engineering profession of the United States, the ancient principle which states 'that country is governed best which is governed least' has been accepted by your committee as representing ideal conditions, and it holds that in an ideal social organization, where man can be left free to follow the trend of his individual bent without resulting injury to his fellow, each should be free to follow such calling as he may adopt, without state interference or regulation.

"Engineering in the United States, under absolutely untrammeled conditions in the past, has developed effective skill and a high degree of constructive ability among its practitioners, during which period the provisions for safety have been adequate under average conditions, and the failures which may have occurred have not been rated serious enough to demand legal control. Within the past few years, however, a widely supported movement had appeared, resulting in the passage of laws, requiring licensing or registration of engineers in various states, and attempts at similar legislation in others. It is, therefore, a condition and not a theory which is before the engineering profession for consideration, and the F. A. E. S. should decide whether it will lend the weight of its advice upon principle only or will accept and travel with tendencies.

"The registration or licensing of engineers, with consequent elimination from practice of all not registered, can be supported upon only two grounds: (a) the benefit of the profession; (b) the good of the public.

"Your committee has grave doubts whether licensing can benefit the profession enough to justify the cost and annoyance of the proposed measure. Further, your committee holds it should be beneath the dignity of engineers to fence themselves against qualified competition by the artificial barrier of a statute.

"Your committee, while recognizing that required registration might not have been recommended *ab initio*, believe that the plan has now reached such development as to deserve consideration and possible direction by the F. A. E. S. (or A. E. C.)

"Therefore, your committee recommends to the A. E. C. (F. A. E. S.) an expression of opinion that such legislation may properly cover engineers and architects charged with responsibility for public works. Your committee is agreed that the reasons which justify the registration of engineers responsible for public works do not apply to mining engineers. Your committee is unable to agree as to the wisdom or unwisdom or registration of engineers engaged in other classes of work. Registration laws should provide reciprocity of registration admitting to practice engineers registered in other states and should further provide for the admission to practice of properly accredited engineers from states having no registration laws.

"Registration laws should provide for classified registration, that the certificate may indicate those branches of engineering in which the registrant is qualified to practice."

In adopting the report of its committee on public affairs, headed by J. Parke Channing, of New York, the executive board of the council determined, in the event of the failure of the President's efforts to bring about greater economy and efficiency in national affairs by a regrouping of Federal functions, to press independently a nation-wide movement for establishing a Department of Public Works.

Mine Signaling Discussed by Electrical Engineers

The Utah Section of the American Institute of Electrical Engineers held a meeting on May 26 at the Salt Lake City Commercial Club. A paper on "Mine Signaling" was read by Abner R. Wilson, electrical engineer at the Utah Apex mine.

Institute of Metals Meets With Foundrymen's Association

The Institute of Metals Division of the A. I. M. E. held a joint meeting with the American Foundrymen's Association at Rochester, N. Y., June 5 to 9.

SOCIETY MEETINGS ANNOUNCED

A Western mining conference of the **American Mining Congress** will be held at Denver, Col., on June 20 and 21. The discussion will be devoted exclusively to problems which confront the Western mining industry.

The annual convention of the **National Lime Association** will be held June 14 to 16, at Hotel Statler, Cleveland, Ohio. The activities of this convention will deal with the technology of the uses of lime and the industrial problems of manufacturing and marketing lime.

The **International Mining Convention** will be held at Nelson, B. C., July 3-7. S. S. Fowler, of Riondel, will preside, and Lieutenant Governor W. C. Nichol will formally open the convention. An address is to be given by T. A. Rickard, of the *Engineering and Mining Journal-Press,* on "English Speaking People." The Hon. William Sloan, Minister of Mines, will speak on "British Columbia's Mineral Resources and Industrial progress."

OBITUARY

George Lincoln Heath died at Houghton, Mich., May 27. Mr. Heath was graduated from the Massachusetts Institute of Technology in 1888. For thirty years he was chief chemist of the Calumet & Hecla Mining Co., at Hubbell, Mich. Since last September he has been connected with the chemistry department of the Michigan College of Mines. He was a fellow of several scientific societies and in 1916 published "The Anaylsis of Copper, Its Ores and Alloys."

William R. Cox, associated for over ten years with the Mason Valley Mines Co., of Nevada, died from heart failure at San Francisco on May 23. He was born at Cape Breton, Nova Scotia, Canada, in 1864. He came to the United States in 1883, working for three years in Montana. In 1896 he went to South Africa as a member of the staff of the Simmer Deep. After three years on the Rand he went to Western Australia, afterward returning to Africa. Since 1910 he had been in the United States, in Arizona and Nevada.

MEN YOU SHOULD KNOW ABOUT

S. J. Kidder, of Mogollon, N. M., was recently in San Francisco.

E. C. Warrener, of New York, has been visiting Cobalt and Kirkland.

N. E. Dowell is at Woodbury, Conn., doing field work in ground-water geology.

R. S. Knappen is engaged in oil and gas work in the Big Horn Basin, Wyoming.

E. H. Mott is now general foreman of the U. S. Metals Refining Co., at Chrome, N. J.

Thomas Riggs, former Governor of Alaska, is in Porcupine, after visiting Cobalt and Kirkland.

Edwin E. Chase, of Denver, is making mine examinations in the White Hills district of Arizona.

Dr. John H. Finley delivered the Class Day address at the Michigan College of Mines on June 9.

George H. Garrey has returned to Tonopah from a several weeks' examination trip in California.

F. H. Moffit sailed from Seattle on June 7 to make geologic surveys in the Chitina region of Alaska.

J. A. Carpenter has been appointed superintendent of the Randsburg Silver Mining Co., Randsburg, Cal.

Karl C. Parrish, mining engineer of Barranquilla, Colombia, is in New York for a visit of several weeks.

A. E. Fath, on leave of absence from the U. S. Geological Survey for several months, has sailed for Europe.

O. C. Ralston, of the U. S. Bureau of Mines, has returned to Berkeley from Arizona and the Eastern states.

Samuel W. Cohen has returned to Montreal after a four months' trip to California and other Western states.

M. R. Campbell left Washington June 2 for Wyoming, where he will examine coal claims for the land classification board.

Noah A. Timmis, president of the Hollinger Consolidated, of Porcupine, will soon visit the Elbow Lake, Manitoba, mining camp.

William G. Mather, president, and **S. Livingstone Mather**, secretary, of the Cleveland-Cliffs Iron Co., spent the week on the Marquette Range.

A. F. Buddington is sailing from Seattle on June 10 to investigate the mineral deposits of the Wrangell district of southeastern Alaska.

H. J. Evans, recently engineer on the staff of the Oriental Consolidated Mining Co., has arrived in San Francisco from Unsankinko, Korea.

Major Julius M. Cohen, of Montreal, consulting engineer of the Elbow Lake Mining Corporation, has gone to Elbow Lake to inspect the company's property.

J. P. Bickell, president of the McIntyre-Porcupine Mines, Ltd., is at the Blue Diamond coal mines, in Alberta, in which the McIntyre holds a half interest.

T. W. Vaughan lectured recently to the Naval Medical School of Washington on "The Study of Earth Science; Its Objects and Interrelations with Medicine."

E. P. Mathewson

E. P. Mathewson has been invested with the Third Order of the Rising Sun by the Japanese government. This was given Mr. Mathewson in recognition of his services in helping the developing of the mining industry of Japan. He has also been elected honorary member of the Mining Institute of Japan. Mr. Mathewson sailed for England June 6 on the Mauretania for a month's trip in connection with his recent visit to the Burma Corporation, in India.

Dr. S. C. Lund, superintendent of the rare and precious metals station of the U. S. Bureau of Mines, in Reno, has returned to Reno from a two months' trip through Eastern states.

Harry C. Dudley, president of the Ahumada Lead Co., has returned to Duluth after several months in the Southwest and Mexico on business relative to his mining properties.

N. H. Emmons, 2d, has just returned from Mexico, where he has been for the last six months on professional business. He visited mines in the states of Jalisco and Oaxaca.

Frank W. Davis, of Philadelphia, has been engaged by the U. S. Bureau of Mines as a metallurgist at its Minneapolis station. He will begin work on ferrous metallurgy on July 1.

E. C. Vigeon, managing director of the Bede Metal & Chemical Co., Ltd., at Hebburn-on-Tyne, England, is making a visit to this country. He will spend most of his time in the Western states.

J. E. Tiffany, an explosives engineer on the staff of the U. S. Bureau of Mines, has returned from an official visit to England, where he has been studying processes and results at the British explosive testing stations.

John C. Metcalf has been promoted to the position of chief mining engineer for Pickands, Mather & Co., filling the vacancy created by the promotion of **W. A. Rose**. Mr. Metcalf will make his headquarters in Duluth.

Dr. F. W. McNair, president of the Michigan College of Mines, was in New York last week attending a meeting of representatives of the Society for the Promotion of Engineering Education and the National Industrial Conference Board.

O. B. Smith, formerly superintendent of Granby operations, has just completed an exhaustive examination of the placer deposits in the Lillooet section, in British Columbia.

H. W. Edmundson has completed the installation of the new mill for the Asbestos Corporation of America at Eden, Vt. Mr. Edmundson leaves for Oatman, Ariz., to report on the Leland and Vivian groups of mines for the Vivian Mining Co., of Los Angeles.

Frank Corwin has just returned to Humboldt after a ten-month vacation, during which time he covered fifteen thousand miles by automobile and visited practically all of the mining districts of interest in the West. Mr. Corwin is now connected with the Consolidated Arizona Smelting Co.

E. C. Bowers, superintendent of the Wickwire Mining Co.'s mines on the Menominee iron range, has been advanced to the position of general superintendent of the Wickwire-Spencer Mining Corporation, with headquarters in Worcester, Mass., and will take up his new duties at an early date.

W. J. Loring, now in Washington, has been elected president and managing director of the Carson Hill Gold Mines and related enterprises. **Archie Stevenot** has been appointed general manager of the Carson Hill Gold Mines and Chapparral Hill group recently acquired by the Loring interests.

C. A. Bennett, general superintendent of the Rochester Silver Corporation, is leaving Rochester for Candelaria to become superintendent for the Candelaria Mines Co. **Ellsworth Bennett**, who has been in charge of the Tonopah School of Mines for several years, will succeed his brother as superintendent of the Rochester Silver Corporation.

Dean Thomson of the Idaho State School of Mines, accompanied by **Keith Horning**, president of the Associated Miners of the State University, was in the Coeur d' Alenes and other northern sections of Idaho during the latter part of May. Mr. Thomson was accompanied by a number of mining students from the university, and many underground inspections were made.

Mining and metallurgical engineers visiting New York City last week included: **A. C. Langdon**, of Palouse, Wash.; **J. B. Rhodes**, of Philadelphia, Pa.; and **A. T. Ward**, of Havana, Cuba.

Technical Papers

Rock Drill Sharpening—The May Bulletin of the Canadian Institute of Mining and Metallurgy (Room 603-604 Drummond Building, Montreal, Canada; price, 50c.) contains an article "Rock Drill, Bit, and Heel Sharpening at the Murray Mine," by E. Hewert. This paper includes a number of sketches and descriptive matter relating to the development of the bit that will be subsequently used, although the Murray mine is at present closed down. The sharpeners and furnaces that have been installed, and also the general arrangement of the various devices, are described.

Mining Industry of Idaho—Stewart Campbell, State Inspector of Mines of Idaho, has recently issued the twenty-third annual report of his department. This is essentially a directory of the mining companies having property within the state, 117 pages of the 154 in the report being devoted to a comprehensive list of this nature. The companies are classified by counties. An additional feature is a bibliography of the literature descriptive of the geology and mineral resources of each county. The report may be obtained from the Inspector of Mines, Boise, Idaho, on request.

Ontario Gold Deposits—Part 2 of the thirtieth annual report of the Ontario Department of Mines, Toronto, (free on request) is entitled "Ontario Gold Deposits, Their Character, Distribution, and Productiveness." The book does not contain detailed descriptions of the various properties, but gives a few words about almost every prospect and mine and describes general types of deposits, together with sketch maps of the various districts.

Fatigue of Metals—Publication No. 4 of the Engineering Foundation of United Engineering Societies, 29 West 39th St., New York City, contains a fifty-seven page paper describing research work carried on at the engineering experiment station of the University of Illinois on the fatigue of metals.

Mine Timber Preservation — In a paper, "The Preservative Treatment of Mine Timber," presented before the South African Institution of Engineers (appearing in the March, 1922, issue of the *Journal of the South African Institution of Engineers*, P. O. Box 4609, Johannesburg, S. A.; price, 2s.), L. D. Hingle reviews the various methods of wood treatment, the preservatives used, and the general results obtained. He also outlines practices adopted at the Rose Deep, Ltd., and the Consolidated Main Reef mines, on the Witwatersrand, where waste zinc sulphate liquor was used in preserving the timber. At the latter property, sodium chloride was added to the preserving bath, but this was found unnecessary.

Minnesota Mines — The "Mining Directory of Minnesota for 1922" has been issued by the Minnesota School of Mines Experiment Station, Minneapolis, Minn. It is a book of 156 pages, of handy pocket size, and is divided into four parts: Part 1 contains thirteen maps of the various mining districts; Part 2 a list of all mining properties that have shipped ore or are listed on the tax records as containing ore; Part 3 a list of the various mining companies that are identified with the iron ranges; also a list of officials, subsidiary companies, and the properties in which they are interested; and Part 4 a partial list of men associated with the mining industry of the state.

Prospecting in Quebec—Vast areas await the prospector in Canada, and there are some promising districts in Quebec. A five-page paper published in the *Bulletin* of the Canadian Institute of Mining and Metallurgy (603 Drummond Building, Montreal), describes briefly what has recently been done and suggests likely districts. The price of the separate is 25c.

Gold Metallurgy — Details of the treatment of a refractory gold ore mined at Prestea Block A, Gold Coast, Africa, are given in the *Journal of the Chemical, Metallurgical, and Mining Society of South Africa* (Johannesburg; price, 3s. 6d.). The paper describes practice existing during 1914 and 1915. The gold occurs both free and associated with refractory sulphides containing arsenic, antimony, and zinc. Carbonaceous schist is also present. The flow sheet described includes stamping, regrinding in pans, plate amalgamation, table concentration, roasting, and cyanide and sulphide treatment.

Osmiridium — In the journal mentioned in the previous note is also a short article of interest to chemists on the manipulation of osmiridium concentrate. Osmium and ruthenium offer difficulties in assaying as well as emitting dangerous fumes.

Germany and Russia—Those who are interested in economic trends and the condition of business in Germany and Russia will find a recent bulletin of the Chase National Bank, of New York, worth perusing. It is entitled "Germany and Russia—A Chapter of Uncertainties." The bulletin is of forty pages, and may be obtained on request to the bank mentioned.

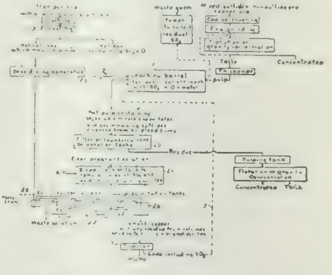
New Mexican Geology—Bulletin 726-E of the U. S. Geological Survey, Washington, D. C. (102 pages; free on request) is entitled "Geologic Structure of Parts of New Mexico." The bulletin has been prepared as a guide to the geologist in search of new oil fields.

Nickel-Copper Deposits—The *Canadian Mining Journal* for May 5, (Gardenvale, Que., price, 15c.) contains a two-page article descriptive of the Shebandowan nickel-copper deposits in western Ontario. The minerals are essentially pyrite, pyrrhotite, and chalcopyrite, and the deposits are thought to have economic possibilities.

Recent Patents

Flotation of Gold Ore—English patent No. 175,384, Nov. 11, 1920. H. L. Sulman, and Minerals Separation, Ltd. According to an abstract published in the *Journal* of the Society of Chemical Industry, crushed gold-bearing ore is treated by a known froth flotation process, preferably in a neutral or alkaline condition and using a tar oil containing phenol or cresol. A second separation is effected after precipitating a mineral compound (ferrous sulphide) in the pulp. Gold is separated with pyrites, and the recovery of pyrites may be taken as an index of the recovery of gold. The concentrate is treated subsequently by the usual cyanide process.

Sulphur-Dioxide Leaching—No. 1,410,936. E. S. Leaver and C. E. van Barneveld, Tucson, Ariz. A pulp containing a non-sulphide ore and water is subjected to hot sulphur dioxide and oxygen, producing metallic sulphate in solution. The metal is then precipitated and separated as is indicated in the accompanying flow-sheet.



Pulverized Coal for Blast Furnaces—No. 1,411,072. R. A. Wagstaff, Salt Lake City, Utah, assignor to American Smelting & Refining Co., New York. A solid stream of pulverized coal is mixed with air in a special device designed to introduce the mixture into a blast-furnace tuyère to the best advantage.

Magnetic Ore Separator—Canadian patent No. 217,084. H. W. Arnold, Vancouver, Wash. A water-proof drum inclosing a plurality of magnets for removing magnetic material from ore pulp. The drum revolves in a trough, into which the pulp enters, and means are provided for removing he non-magnetic tailing as well as the magnetic material from the face of the drum.

Electrolytic Nickel—Canadian patent No. 217,914. N. V. Hybinette, Christiania, Norway. The patent covers the use of a filtering diaphragm which depletes the solution in the cathode compartment, of acid ions. The electrolyte is fed to the cathode compartment and removed from the vicinity of the anode. Particulars of the use of the equipment in depositing nickel are given.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

SUIT for $500,000 has been brought by the Kennedy Mining & Milling Co. against the Argonaut Mining Co., its neighbor at Jackson, Cal., for damages resulting from the fire in the latter's property three years ago. The Argonaut company has filed a counter suit for $800,000 for damages caused by the flooding of its workings, which it attributes to the Kennedy's carelessness.

Merger of the Coniagas Reduction Co. with the Electric Gas Bleaching Co., of Niagara Falls, is being planned. The latter is said to have a cheap and efficient process for treating cobalt ores.

Plans for the consolidation of the Republic, Midvale, and Inland steel companies as the North American Steel Co. have been divulged.

In Guanajuato, a law has been passed permitting the state to take over a mine or factory if shut down because of a strike.

Smelting has been resumed by the International Smelting Co. at Tooele, Utah.

Coniagas Reduction Co. To Merge With Niagara Falls Company

Latter Has Developed Cheap Process for Treating Cobalt Ores—Chemicals Also Will Be Produced

It is understood that the Coniagas Reduction Co., of Ontario, is to be amalgamated with the Electric Gas Bleaching Co., of Niagara Falls. The Coniagas plant was built at Thorold to treat high-grade cobalt ores, but the collapse of the market for cobalt metal resulted in the plant being shut down, with large stocks of cobalt residues and speiss on hand. Still further supplies are being accumulated from the residues after the treatment of ores from the Coniagas mine.

The process for the production of cobalt metal and oxides was both complicated and expensive, but it is understood that the Electric Gas Bleaching Co. has evolved a simple and inexpensive method with the use of fluorine gas. If the companies are amalgamated, one will have the supplies of raw material and the other the process for treating them. In addition to cobalt metal and oxides, caustic soda, chlorine gas, and liquid chlorine will be produced.

Consolidated Mining & Smelting Will Build 1,000-Ton Mill

The Consolidated Mining & Smelting Co. of Canada, of British Columbia, has definitely announced its intention to build a 1,000-ton mill at its Sullivan mine. The cost is estimated at $1,500,000, and the plant is to be completed next year. The mill now in use at Trail, B. C., will handle the ore from the Rossland mines of the company. The works office of the company is at Trail. Its head office is 1202 C. P. R. Building, Toronto.

Guanajuato Law Permits State to Take Over Mine in Case of Strike

Some Companies May Close If New Measure Is Enforced

The Legislature of the State of Guanajuato, Mexico, has passed a law giving the governor power to take over any factory, ranch or mine, wherein the owner or owners attempt to close the same, in the event of a strike or other disagreement with the employees. This law has been put in effect in lieu of provisions under the articles of the Constitution enabling Committees of Arbitration to enforce their edicts. Laws that are similar now obtain in the states of Vera Cruz, Puebla and Michoacan, and an attempt is being made by the governor of Chihuahua to put one through. Mining companies operating in these jurisdictions look upon the legislation as threatening the life of their operations, and a number of important concerns claim they will be obliged to close if an attempt is made to enforce the new laws.

Representations have been made to the Federal authorities in Mexico City that this legislation is in violation of their pre-guaranteed rights, as well as opposed to common sense and the spirit of reform which the authorities desire to enforce.

Democrata Plant Burned

At Cananea, Sonora, the power house and warehouse of the Democrata Mining Co. was destroyed by fire on May 24, with damage of $250,000. The Democrata's property is close to Ronquillo, the Greene-Cananea smelter town, and is almost surrounded by its larger neighbor.

New Merger of Steel Companies Planned

Includes Republic, Midvale and Inland—All Terms Not Disclosed, It Is Charged

Plans for the consolidation of the Republic Iron & Steel Co., the Midvale Steel & Ordnance Co. and the Inland Steel Co. were announced on June 1. The Midvale company will take over the other two and will probably change its name to the North American Steel Co.

The terms of the plan are as follows:

"All existing obligations of the three companies are to be assumed by the unified company. Existing preferred and common stocks will be changed into preferred and common stocks of the unified company. The new preferred stock is to have a par value of $100 per share, is to be 7 per cent cumulative, and is to be redeemable at $115 per share and accrued dividends, and is to be convertible for twelve years into new common stock at the rate of five shares of new common for four shares of new preferred. The common stock is to be without par value.

"All assets of the three companies are to be owned by the unified company, except the Nicetown plant (the armor-making, ordnance and forging plant) of the Midvale Steel Co., which is to be transferred to a separate company with a capital of 500,000 shares without par value.

"Participation in the new stock will be as follows:

"Under the plan Midvale company stockholders are to receive 75 per cent in new common stock and 25 per cent in stock of the company formed to take over the Nicetown plant.

"Republic Iron & Steel preferred stockholders are to receive dividends in cash up to the date when the new preferred dividend begins to accrue, and 100 per cent in new preferred stock.

"Republic Iron & Steel common stockholders are to receive 170 per cent in new common stock.

"Inland company stockholders are to receive 25 per cent in new preferred stock, which is to be purchased from them at $95 per share, and 70 per cent in new common stock.

"It is intended to provide $20,000,000 additional cash working capital by the sale of common stock.

"Negotiations are pending for the acquisition of other properties, but, irrespective of the outcome of these negotiations, Midvale, Republic Iron & Steel, and Inland propose to proceed with the plan.

"Messrs. Kuhn, Loeb & Co. have agreed to act as bankers for the plan."

In addition to these terms, it is said that there are secret clauses in the agreement, by one of which Kuhn, Loeb & Co. was to be permitted to raise up to $20,000,000 "to make a market" for the stock of the new company.

International Starts Smelter at Tooele, Utah

Operations were resumed by the International Smelting Co., at Tooele, Utah, on June 1. The company is a subsidiary of the Anaconda Copper Mining Co. For some time it has been gathering and stockpiling ores. Contracts have been made for ore from most of the western mining districts. The Walker Copper Co., at Portola, Cal., which is controlled by the Anaconda company, is expected to furnish a large part of the copper ores, and a better rate has been made with the Western Pacific R.R. on ores from its property. Ores from the Utah Consolidated, at Bingham, and from the Vipont Silver Mining in Box Elder County, will also go to Tooele; likewise ores from the Judge and Park-Utah properties at Park City.

Dredging Plant Ordered for Work at Nome

W. P. Hammon and others have made an arrangement with the Pioneer Mining & Ditch Co., formerly the Pioneer Mining Co., to work dredging ground at Nome, Alaska, according to word from San Francisco. Contracts have been let by the Hammon interests to the Yuba Manufacturing Co. for the construction of two nine-cu.ft. dredges and a 1,200-hp. plant, all to be in operation in the summer of 1923.

Yukon Gold Co. Completing Dredges

The Yukon Gold Co. is exporting from San Francisco and New York machinery to complete tin dredges Malay No. 2 and 4 in the Federated Malay States.

Kennedy Company Sues Argonaut for Damage from Fire

Asks $500,000—Defendant Files Counter Suit for $800,000

Suit for $500,000 damages was filed May 27 by the Kennedy Mining & Milling Co. against the Argonaut Mining Co. Both companies have adjoining properties near Jackson, Cal., and are among the largest gold-mining companies in the West. Fire started underground in the Argonaut on March 27, 1919. The mine was sealed and the fire thought to be extinguished by the use of carbon dioxide gas, which was forced into the mine on April 3, 1919. The mine was reopened on April 12, and the fire broke out again on April 13. It was then bulkheaded, but later it was found necessary to flood both the Argonaut and Kennedy. Flooding of the mines started March 15, 1920. In May, 1921, both mines were unwatered, and were reopened last fall.

The owners of the Kennedy property contend that the fire in their property was the result of the destruction of a barrier wall between the two mines and that no attempt was made to check the progress of the fire into the Kennedy. W. E. Colby and John Partridge are the attorneys for the Kennedy.

The Argonaut Mining Co. has filed a counter suit against the Kennedy, asking for $800,000 damages. The Argonaut alleges that the Kennedy carelessly handled the fire and flooded both mines, causing the Argonaut to be shut down for more than a year.

Mill for Clifton Porcupine

Work has been resumed by the Clifton Porcupine Mines, Ltd., of Porcupine, Ont. A favorable feature of this promotion is the assurance that every dollar realized from the sale of stock will be spent on the property. A small mill will soon be built.

Grand Central Requires Large Expenditure

It is estimated that the Chief Consolidated Mining Co., of Eureka, Utah, will have to spend about $200,000 to bring the Grand Central Mining Co., at Mammoth, Utah, control of which it recently acquired, to a point where more economical operation will be possible. Items of this necessary expenditure are given by Cecil Fitch, manager, as follows:

Electrification and additions to hoist $20,000; additional compressor unit and motor, $12,000; general power supply, $5,000; additional tramway equipment, $4,000; additional underground equipment, $11,000; shaft repairs, $13,000; surveying, mapping, geological examination, and similar work, $10,000; total, $83,000. In addition, $100,000 will be required to initiate intensive development and efficient exploration. In the near future when development has reached water level, it is estimated $83,000 will be needed to install complete pumping equipment.

New Guinea Copper Mines Increase Capital

By Cable from Reuters to "Engineering and Mining Journal-Press."

Melbourne, May 25—The annual report of the New Guinea Copper Mines announces an increase in capital to £500,000 sterling. It also recommends the expenditure of £78,000 in development, including the erection of a smelter and converter and a three-mile aërial tramway.

Iron Ore Production in France Two-Thirds Normal

By Reuters Agency

The production of iron ore in France during 1921 amounted to 14,106,368 tons, as compared with 21,918,000 tons in 1913 and 13,871,187 tons in 1920.

Magma Copper Breaks Ground for New Smelter

Work has been started by the Magma Copper Co., Superior, Ariz., on foundations for the new smelter. The site is near the railroad station in lower Superior, about a quarter of a mile down hill from the main shaft. Four grading camps are working on the new broad-gage railroad. W. C. Browning, manager of the Magma, has made inspection of the company's Three R property near Patagonia.

Idaho-Maryland Company May Enlarge Mill

The Idaho-Maryland Mines Co., operating near Grass Valley, Calif., may enlarge its twenty-stamp mill, according to local reports. The company's office is 1213 Hobart Building, San Francisco.

Rhodesia's Gold Output

By Cable from Reuters to "Engineering and Mining Journal-Press."

London, June 2 — The production of gold in Rhodesia during April totaled 54,318 ounces.

Magma Chief to Reorganize

A special meeting of the Magma Chief Copper Co. will be held on June 15 at Mesa, Ariz., at which the stockholders will be asked to authorize the sale of the property to a new corporation known as the Magma Chief Consolidated Copper Co. The consideration will be $52,529.61 or 875,494 shares of the new company. Stockholders of the Magma Chief may either take their proportionate share of the money purchase price, or 3 cents per share, or else receive one share of stock in the new company for two shares of Magma Chief stock, subject to an assessment of 3 cents per share.

Magma Chief owes between $15,000 and $20,000. In addition to this, the company's Sombrero Butte property was sold last October on judgments amounting to $8,000. It has been acquired by the new company.

News from Washington

By PAUL WOOTON
Special Correspondent

60 Per Cent of Bureau's Funds for Work on Coal

Balance for Metals and Non-metallics—Mine Economist To Be Added to Staff

Of the $1,580,900 carried in the Interior Department appropriation act for the work of the Bureau of Mines about 60 per cent will be spent for work in behalf of the coal-mining industry. The remainder will be devoted to metal mining matters and work on other minerals. Particular attention is to be given mining problems in Montana during the fiscal year which begins July 1. The matter of ventilation in metal mines is to be accorded special consideration. Two metal-mining engineers are being transferred to Butte. Billings is to be made the headquarters of a deputy mineral supervisor. Increased attention will be given oil in that state.

The report that the Bureau's work in Utah will be curtailed during the next fiscal year is without foundation. There will be no reduction whatever in the amount expended by the Bureau in that state. The impression that there would be a reduction doubtless had its origin in the announcement that some of the ore-dressing work being done in co-operation with the University of Utah is to be discontinued. The intention, however, is simply to transfer that work for a year from the laboratory to the plants at several Utah mines.

A well-qualified research man is to be assigned to work on explosives exclusively. The demands for routine testing have been so great recently that comparatively little work could be done on explosive research, but an allotment of the appropriation for the next fiscal year will be made so as to allow the employment of a comparatively high-salaried man to devote all of his time to that work.

Though the Bureau is receiving a much larger appropriation for its supervisory work in connection with the mineral leasing act, this simply means the enlargement of the present force.

An allotment is being made that will permit the completion of the electrification of the Bureau's experimental mine at Pittsburgh.

A new policy with regard to the Bureau's surgeons is to be put into effect July 1. Under the existing policy the surgeons have been stationed on the mine rescue cars. In the future they will have headquarters at central points where they will be available, when not on duty at mines, for investigation work.

It has become increasingly apparent that the work on certain of the basic problems connected with the mining industry will have to be done at the well-equipped Pittsburgh station, regardless of the section of the country in which the problem arises. For that reason there will be some increase next year in the amount of money allotted to the Pittsburgh station.

A mine economist will be added to the Bureau's staff on July 1. Industries and other departments of the Government are calling more and more on the Bureau of Mines for economic deductions and forecasts in the field of minerals. For that reason arrangements are being made to handle such matters in a more uniform manner than heretofore.

Arrangements have been made for active co-operation with the Joseph A. Holmes Safety Association, the National Safety Council and other safety organizations. At least $6,000 will be made available for that purpose.

Since Congress declined to continue the appropriation for the non-metal work which the Bureau has been doing, it will be necessary to draw on the general appropriation for the funds necessary to draw up conclusions and make the results of last year's work available to industry.

Congress was sufficiently liberal to make it possible to continue at the present rate the amount of work being done in the cryogenic laboratory.

War Mineral Commissioner Needs Engineer's Advice

After an extended study of the claims which have been reopened, the War Minerals Relief Commissioner has begun the issuance of recommendations in considerable numbers. With the exception of the awards to the Whitmarsh Mining Co. and to George H. Crosby, which totaled over $300,000, it is apparent that Judge Robinson is not handing out largesse with a liberal hand. Those who are following the work of the War Minerals Relief Commissioner, however, see evidences of the lack of wisdom of designating an attorney to pass judgment alone on technical matters. There is a feeling in some quarters that the original plan of a commission with three members would be better in that it would make it possible to have an engineer as one of the members.

Mineral Rights Bill Introduced

A bill adjusting mineral rights on homestead and desert land entries designed to protect the homesteader has been introduced in the House by Representative Taylor, of Colorado. It affects homestead entries where subsequent to entry the mineral deposits are embraced in permits, leases or other mineral disposition. The bill provides that whenever the surface of public lands not classified or known to be valuable for minerals is entered under the homestead or desert land laws, the mineral deposits of the land shall not thereafter be embraced in any permit, lease, or entry unless the applicant for permit complies with certain conditions.

Duty on Manganese Ore Restored by Senate

Finance Committee's Amendment Placing It on Free List Rejected—Claimed Survey's Estimates Are Not Up to Date

Advocates of a duty on manganese ore were victorious in the Senate tariff debate when the Senate on June 5, by a vote of 19 to 35, rejected the Senate Finance Committee's amendment placing the product on the free list, and restoring the House duty of 1c. a pound on manganese ore or concentrates in excess of 30 per cent of metallic manganese. The amendment was offered by Senator Nicholson, of Colorado, who delivered a long speech in behalf of protection to the American manganese industry.

The debate largely revolved around the question as to whether American deposits of manganese were sufficient to meet the requirements of the steel industry. Reports of the Geological Survey to the effect that they were not sufficient were relied on by members of the Finance Committee in defence of placing the product on the free list. Advocates of the duty, including Senators Nicholson, of Colorado; Oddie, of Nevada; Bursum, of New Mexico; and Walsh, of Montana, contended that American reserves could supply all needs, and insisted that if the steel industry was protected on articles it produced it should bear a duty on the articles which it purchased, including manganese.

Though not criticizing the Geological Survey, advocates of the duty said that the Survey's reports as to manganese reserves were not up to date, owing to lack of funds. Senator Willis, of Ohio, who opposed the manganese duty, promised to aid in securing more funds.

Senator Willis said that though he did not object to a reasonable duty on manganese, he thought the proposed duty was prohibitive. Senator McCumber said that no other duty could be considered, as less than 1c. a pound was not sufficient, and he left it to the Senate to determine whether the duty should be imposed or not.

An amendment by Senator Poindexter, of Washington, increasing the duty on crude magnesite from $\frac{5}{16}$c. per lb. to $\frac{1}{2}$c. per lb. was adopted by a vote of 29 to 22. He explained this would increase the duty from $6.25 to $10 a ton, which, he said, was necessary to protect American producers.

An amendment by the Washington Senator increasing the duty on dead-burned and grain magnesite from $\frac{4}{10}$c. to [illegible] per lb. was also adopted and likewise an amendment increasing the rate on caustic calcined magnesite from $\frac{5}{8}$c. to $\frac{3}{4}$c. per lb. An amendment increasing the duty on magnesite brick from $\frac{4}{10}$c. to $\frac{3}{4}$c. per lb. was passed over until the brick duties in other schedules were passed on.

News by Mining Districts

London Letter

Geduld Proprietary to Enlarge Mill—Disposal of Ex-enemy Shares in South Africa.

By W. A. Doman

London, May 26—Last week I mentioned that the Geduld Proprietary Mines had decided to increase the capacity of its mill from 40,000 to [illegible] tons' monthly. The consulting engineer gives three reasons for recommending the enlargement: (1) Strong ore reserves position; (2) high-grade ore developed has for some years been equal to the requirements of the enlarged plant; and (3) the accumulation of two and a half million tons of low-grade ore, which it is estimated will yield a profit of 10s. per ton, as all charges in connection with its development have been met. The ratio of high-grade ore to low-grade for many years seems to have been 7.5 to 1. Apparently, the management intends to send ore to the enlarged mill in these proportions, the average value then being 7.2 dwt. Working costs are now [illegible] per ton, and it is hoped, in view of the improved industrial position, to get them down to 18s. per ton. At an average milling of 850,000 tons per annum—the actual capacity of the mill is about 12½ per cent in excess of the nominal—the reserves with devolopment rock would supply requirements for about eight years.

According to a cable dispatch received earlier in the week, a discovery of auriferous ore has been made at a place called Muriel Tank, about 300 miles northwest of Sydney, New South Wales. As usual in most gold finds, high assays are reported—up to 50 oz. to the ton, in fact. At present the news is received here with a good deal of skepticism, in view of the manner in which such finds have a habit of pinching out.

Nigerian tin-mining companies are anxiously looking forward to the time when the price of the metal will improve, for according to engineers' reports, some of the deposits are unusually rich. The Bisichi company's ground is said to contain an average of 3 lb., with an average depth of 21 ft. The Keffi company reports that it has proved an average of 3.1 lb. over an average depth of 37 ft. So far, [illegible] tons of tin has been proved by the Keffi company and values are extending both up and down the stream.

Apparently, the Custodian of Enemy Property in the Union of South Africa, in conjunction with the Public Trustee on this side, is about finishing his [illegible] so far as the disposal of ex-enemy shares in mining companies is concerned. The Consolidated Investment Co., otherwise Barnato's, have acquired from these officials the shares in their group of companies; the Union Corporation has acquired the shares of its group; the Central Mining and Rand Mines have acquired the respective shares in their group, and now it is announced that the Consolidated Mines Selection, together with the Anglo American Corporation of South Africa, have acquired the shares of the companies which they control. The numbers are not exactly known, but there are approximately 80,000 Brakpans, and 70,000 Springs Mines in question.

I gather from a conversation I have had with a technical man just arrived from Perth, that the outlook for the Hampton field is not particularly bright. He tells me that it is just "touch and go" as to whether the lode in the Celebration mine will continue in depth, but according to him it would have to persist a considerable distance before shareholders could expect to receive any return on their money.

The Golden Horseshoe Estates worked under abnormal conditions last year, only a minimum amount of development work being done, which necessitated drawing a large proportion of the ore mined from the higher grade stopes, and, naturally, this reduced the tonnage and value of the ore reserves. The mill ran to only about 60 per cent of its capacity. If one takes the cost of mining, excluding development on tonnage milled last year, there is a substantial rise of 6s. 2d. per ton, but if the costs are worked out at per oz. of fine gold, it is seen that the expense last year was £4 per oz., in comparison with £4 3s. per oz. in 1920. The per ton use is due, of course, to the milling of a smaller tonnage—104,226 tons, against 125,340 tons. Last year the ore sent to the mill was the lowest quantity since 1901.

SPAIN

Bilbao Iron Ore Consignments Show Increase

Madrid, May 20—During the first three months of 1922 the port of Bilbao consigned 392,363 tons of iron ore, against 262,721 tons in 1921.

Rand Gold Industry Normal by Fall, Smuts Says

By Reuters Agency

Capetown, May 22—In outlining the Government's industrial policy in the Union House of Assembly, General Smuts foreshadowed a new lease of life for the gold mining industry and pointed out that efforts were being made to secure an outlet for South African coal on the Indian Ocean. The gold industry, the Premier said, should be working normally by September, thus absorbing most of the unemployed, but provision must still be made for the semi-skilled and unskilled workers. The Government hoped by means of railway construction, irrigation and afforestation schemes to absorb all of them and the renewal of these men from the Rand was already proceeding steadily.

Johannesburg Letter

Many Still Unemployed—Operations Hampered by Loss of Natives

By John Watson

Johannesburg, May 2—Recent reports from various branches of the South African White Labor Bureau show a serious state of unemployment following the strike. The report of the Johannesburg branch showed close on 1,600 applications for work in March, being an increase of 400 as compared with February. Of these March applicants, work could be found for only 419.

Certain trade unionists complain of victimization as to the gold mines; the opinion is expressed, however, that these same men need to be reminded once more, that the strike which their leaders (or misleaders) precipitated, had the effect of causing an exodus of nearly 50,000 native mine-workers from the Rand to their homes. It will take several months of recruiting to restore that number; also certain low-grade mines suffered severe losses owing to the stoppage and dislocation. Recent figures show that about 5,000 white men are now employed underground by the gold mines as compared with 9,000 before the strike (excluding officials in each case). If surface workers and officials are included the total number of Europeans now employed is approximately 14,000.

The annual general meeting of the Witwatersand Native Labor Association, Ltd., was held on April 24, H. O. Buckle presiding. He referred to the serious loss of 56,000 natives from the mines caused by the recent strike. Such a loss would require considerable time and recruiting to make up. Roughly speaking, one European is employed on the mines for every ten natives. Mr. Buckle also referred to the ban on the employment of natives from north of latitude 22 degrees south of the equator, which still operates. Several commissions have recommended the removal of this ban, but, so far, our Government has not removed it.

In the report from Bloemfontein, a slight boom is indicated in alluvial diamond digging at Parys, on the Vaal River. It is, however, uncertain at present to what extent this proposition will be payable.

A promising discovery of gold has been made in the Gwanda district on the Insindi ranch, a mile north of the Insindi kopjes. The Abercoon Gold Mining Co. has secured an option. Several small workers in various parts of Southern Rhodesia are said to be making good monthly profits.

It recently transpired that a certain debris washer treating tailings heaps at Kimberley has recovered diamonds worth over £36,000 during the past 5¾ years. The city council has now prohibited such washing on heaps under its control.

Melbourne Letter

Construction Work at Hampton Plains —New Mill at Muir's Gold Reef Started—Planning Smelter in Papua

By Peter G. Tait

Melbourne, May 8—Matters are moving slowly in the Hampton Plains field, West Australia. The Celebration treatment plant is at work, but only fifty tons daily is being crushed. The White Hope is engaged on the erection of a small treatment plant. Hampton Properties is sinking a main shaft on Block 45 to prove the extent of the orebody developed by prospecting shafts. The erection of a power and treatment plant on this lease is under consideration. The Golden Hope is being developed north and south of the 100 level; the average value of the last 244 ft. is given as 44s. per ton.

The Western Australian government has appointed Captain William Jones as leader of a properly equipped prospecting party which is to be sent out under the scheme devised by the prospecting board. The scene of operations has not yet been announced but it will probably be in the Yilgram field beyond Hampton Plains and the back districts of Kalgoorlie.

The battery at Muir's Gold Reef's Mines, nine miles from Te Puke, New Zealand, was officially opened by the Prime Minister recently. Twenty head of stamps are operated, together with four tube mills. It has a capacity of 125 tons per day. J. R. Noble, the manager, reports that there is in sight sufficient high-grade ore, averaging 71s. per ton, to run for two years or more.

The New Guinea Copper Mines, Ltd., which is operating the Dubuna and Laloki mines, in Papua, is negotiating with the commonwealth government, which controls the territory, to take over the company's jetty and railway line (the only railway in Papua) for £45,000. If the negotiations are completed, it is understood, the company will raise additional capital to develop the mines and proceed with the erection of a smelter at Bootless Inlet. As the ore is a valuable flux for mixing with siliceous ores, it is anticipated that when the Australian copper mines are in a position to resume there will be an outlet for about 3,000 tons per month.

BURMA

Burma Corporation Reports Assays of High-Grade Ore

Bawdwin—The Burma Corporation reports assays of samples taken in its seventh level crosscut, in which high-grade ore was recently cut, as follows:

	Silver, Oz.	Lead, Per Cent	Zinc, Per Cent
4— 35 ft.	5	7	11
35— 50 ft.	10	14	6
50— 95 ft.	4	5	6
95—120 ft.	8	15	10
120—135 ft.	7	9	5
135—145 ft.	48	47	22
145—149 ft.	12	19	7

A deflected crosscut has been started so as to get the full section of the orebody.

CANADA

British Columbia

Twelve Dominion Geological Survey Parties to Work in Province

Victoria—Government mining engineers in British Columbia have addressed between three and four thousand prospectors or potential prospectors in lectures delivered during the past winter. In one district the engineer was called upon to speak to the children attending public schools. It is generally agreed that no more effective method could be found for stimulating interest in minerals and the mining industry.

The first of the vessels leaving British Columbia and Washington ports for Nome, Alaska, is on her way north. The season has opened, and mining operations there soon will be in full blast.

The extension of the Premier mine road, the construction of a trail into the Unuk country, the building of a over the Bear River, and the rebuilding of that over the Marmot, as well as considerable maintenance work, are some of the probable activities of the provincial government in the northwestern section of British Columbia this year. It is also suggested that a road should be built further up the Kitsault Valley than is reached by the Dolly Varden railroad, and that there should be a trail from Alice Arm to Stewart. The latter is rather an ambitious project, but the route will be surveyed this year.

There will be twelve parties of the Geological Survey of Canada working in British Columbia this summer. Nine of these will be on geological investigation and three on topographical surveys. Those who have been assigned to field work are: J. D. MacKenzie, head of the British Columbia office of the Geological Survey; George Hanson; M. F. Bancroft; W. L. Uglow; S. J. Schofield; Victor Dolmage; G. A. Young; W. A. Johnston; C. A. Cairnes; W. A. Cockfield; C. T. Shepherd, R. G. Bartlett and D. A. Nicholls.

If the Dolly Varden property passes into the hands of George Wingfield, of the Goldfield Consolidated, and associates, it is suggested that a new company will be formed for the further development of the mine and adjacent claims. The plan now proposed is the formation of a company in which will be represented other creditors of the Taylor company, shares being allotted them in proportion to their claims.

Ontario

Peterson Lake to Reopen Mill—Porcupine Crown Finds New Vein

Cobalt—No ore was shipped from Cobalt over the T. &. N. O. Ry. during the week ended May 26.

At the annual meeting of the Peterson Lake it was announced that the company's mill would be reopened. About 10,000 tons of 9-oz. ore is now on the dumps. Treatment of old tailings has been started by the Dominion Reduction.

La Rose is pumping out its La Rose Extension workings, which have been flooded for ten years. Considerable development work will be undertaken from the 350 level.

Engineers for the New York syndicate which recently took over the Colonial are on the ground preparing to start work.

Kirkland—Negotiations for the proposed merger of the Teck Hughes and the Orr are still pending, but nothing definite has been done. Negotiations for the purchase of Teck Hughes by English interests are also reported.

The Post and Wright claims, one of which adjoins the Tough Oakes, have been taken under option by New York people.

The Patricia property at Boston Creek is to be reopened. There is a small high-grade vein, partly developed.

Tough Oakes interests have taken an option on Kirkland, west of the Kirkland Gold, and will diamond drill it.

An examination is being made of the Boston Creek and R. A. P. properties in Boston Creek.

Arrangements have been made for the development of the Chaput Hughes from the workings of the Kirkland Gold.

During April the Lake Shore treated 2,320 tons of ore and recovered $47,112, an average of $20.30 a ton.

The new vein of the Wright Hargreaves recently found in the main shaft below the fifth level has shown 6 to 8 ft. of $13 ore.

The main shaft of the Sylvanite has reached 500 ft., and lateral work has been started.

The report of the Argonaut for the year ended Jan. 31, 1922, states that the new mill should be in operation by next September. Developments to date on the 200 level indicate ore of $15 grade, and on the 350 level, ore of $20 grade. Current assets over liabilities are placed at $24,529.

The Highland Kirkland has completed is first 1,000-ft. diamond-drill hole, and has started another.

Porcupine—A new vein has been found on the 500 level of the Porcupine Crown near the Hollinger boundary. The new plant on the company's Larder property has been completed, and underground work has been resumed.

It is stated that to finance the Vipond properly about $200,000 additional cash will be needed, and this will probably necessitate a reorganization. Cash on hand will not carry operations beyond next fall.

The Canadian Pacific Ry. will build a short spur line from a point near Glendower station to the feldspar mines situated near Thirteen Island Lake, the construction of which is expected to increase the production of feldspar, which has hitherto been limited owing to transportation difficulties.

MEXICO

Mining Industry Depressed, with Exceptions—Awaits Clearer Defining of Political Future

Mexico City—Almost at the close of the fiscal year, the mining industry throughout Mexico finds itself, with notable exceptions, in the doldrums. Because of geographical conditions there is naturally more activity along the northern frontier and the west coast where transportation is not so much affected by prices or distances. Metal prices have been more favorable recently but increased railway rates, and bolshevik tendencies in state legislation, combined with a general tendency to hold all important enterprises until the future of political conditions (pending recognition by the United States) has been more clearly defined.

The same conditions hold good with oil development. While new leases are being made and exploring parties are covering the country, actual production may be looked to decrease rather than increase, until the legal status of the oil investments is made more clear and more certain. So many obstacles are placed by local officials in the way of getting drilling permits, that no new wells are planned except in cases where the leases oblige. With recognition, and some sort of a mutual agreement between the two governments, the obscure clauses in the oil legislation would be cleared up, and great activity might be expected. Recent decisions of the Supreme Court have been favorable to contentions of foreign oil companies, and are excellent, so far as they go, but they fail to cover many mooted points, and investors feel they are still lacking in essential guarantees for large further outlays.

ARIZONA

United Verde to Start Second Reverberatory

Jerome—A reverberatory and a blast furnace are working at the Clarkdale smelter of the United Verde Copper Co. and a second reverberatory is to be started. The plant resumed work with an initial consumption of 700 tons of ore a day and with 300 employees. The first unit of the Cottrell smoke-treatment plant and a water-softening system are to be operating this month. Concrete is being poured on the foundations of the crushing plant.

Oatman—E. L. Ransome, of the U. S. Geological Survey, is working on a report on the Oatman district of Mohave County, Arizona. A brief digest will be printed soon, it is told, but the main report is likely to be delayed for a year or more. Mr. Ransome, who has done much similar work in other camps of the Southwest, is said to disagree with other geologists in his theory concerning the deposition of gold at Oatman.

Drilling is being done by fifteen Oatman mining companies, with as many more sinking their shafts to greater [illegible]

CALIFORNIA

'49 Celebration at Sacramento Cuts Kennedy's Working Force

San Francisco Correspondence.

San Francisco—A rich gold strike has been made by James Walsh in an abandoned mine at Donnelly Gulch near Lewiston, Trinity County. At French Gulch, Shasta County, a satisfactory clean-up was made at the Washington. The Brunswick, the Sybil, the Gladstone, and the Milkmaid mines are operating their mills.

The New York and Arcadia mines near Greenville, Plumas County, are being reopened by W. Parsons. The Surcease mine, at Las Plumas, is being equipped with a mill and a mine plant. Preliminary work has resulted in a sufficient tonnage of ore to warrant further operations. The property is operated by the Gruss Mining Co.

At Grass Valley, the Idaho-Maryland is drifting from the bottom levels of the old shaft, with satisfactory results. Local reports state that the company will start its main shaft in the summer and that it will probably enlarge its mill. The Golden Center Mining Co., which formerly operated in the Grass Valley district, has developed a number of oreshoots in its Blue Mountain property, thirty miles from Porterville. Arrangements are being made to operate a five-stamp mill and secure electrical power for the mine plant. The driving of the tunnel at the Bullion mine, in Secret Canyon, near Downieville, has been resumed. Gold nuggets are being found in the Placer Gold Lead mine, at North Bloomfield, and expectations of cutting the pay channel are high. Gravel from the Malikoff strike has been washed with satisfactory results.

The Vandalia mine, near Shingle Springs, El Dorado County, has been leased, and operations are to be started. Equipment is being installed at the Rich Flat mine near Ringold.

Work has been started at the Shotgun mine, near San Andreas. G. F. Snyder, of the Moore mine, at Jackson, is president of the company.

At Jackson, the Kennedy Mining & Milling Co. operated as many as eighty stamps recently but is now down to twenty stamps. The '49 celebration at Sacramento is responsible for the curtailment. When the miners return, it is expected that eighty stamps will be kept in operation.

The April output of the California Rand is stated to have approximated $175,000. Dividends for the first four months of 1922 aggregated $640,000. The boom in the Randsburgh district continues.

Russian Council To Lease Mines in Urals

By Telegraph to Engineering and Mining Journal Press"

Moscow, May 24—The Supreme Economic Council has decided to lease for a period of ten years the gold and platinum mines in the Urals.

NEVADA

Town of Manhattan Suffers Loss by Fire—Spanish Belt Mine to Resume

From Our Special Correspondent.

Virginia City—The Con. Virginia has decided to abandon all levels below the Sutro tunnel or 1,750 level. The pumping stations on the 2,050 and 2 250 stations are being dismantled.

The east crosscut from the north drift, started at 888 ft. from the Hale and Norcross tunnel, in Savage ground, is reported to have cut milling ore at 100 ft.

Battle Mountain—Construction material and machinery for the Betty O'Neal mill is beginning to arrive and grading for the mill will be started at once. The main drainage tunnel is in 1,740 ft,, with 210 ft. to go to connect with the vertical shaft. Progress is being made at the rate of 8 ft. per day. A new raise from the 150 level has passed through 15 ft. of vein matter, all of which is said to contain commercial values.

Tonopah—The Spanish Belt mine, 50 miles north of Tonopah, which has been closed during the winter on account of deep snow, is preparing to resume operations.

Manhattan—The mining town of Manhattan suffered a severe fire loss the night of May 26. The major portion of the business section was wiped out, with a loss estimated at $75,000.

Goldfield—To date twenty carloads of ore have been shipped from the Silver Pick lease in Red Top ground, and the extent of the orebody is still unknown. The length of the oreshoot, so far as developed and stoped, is about 85 ft. Recent shipments average $40 per ton. Three ore shipments have been made by Simpson and Porter from their lease on the Combination mine. The first two shipments ran $320 and $350 per ton, but the last is expected to run about $150 per ton.

IDAHO

Bonner County Mining Association Reorganized

Hailey—Development has been resumed on the War Dance mine, on Deer Creek, a property credited with a large output in the early days.

Sandpoint—The Bonner County Mining Association has been reorganized, and will be henceforth affiliated with the Sandpoint Chamber of Commerce. It will be known as "Bonner County Mining Bureau of the Sandpoint Chamber of Commerce" Officers elected under this arrangement are: M. B. Dunkle, president; W. F. Shutz, vice-president; J. C. Cranston, treasurer; H. L. Thomason and W. C. Ames, committeemen, F. O. Hagie, secretary.

Talache—The Talache mine now has a payroll of 150 men, 110 of whom are employed underground. Mill feed averages 110 tons per day, with a 95 per cent extraction. By the end of May the fifteenth car of high-grade concentrates was shipped.

UTAH

New Owners of Grand Central Plan Extensive Development

From Our Special Correspondent

Salt Lake City—The 10 per cent reduction in interstate freight rates ordered to take place July 1, as reflected in lowered prices for mining supplies, is expected to relieve Utah mines of some of the burden of costs, which are still much higher than in the pre-war period. The smelters deduct from ore settlements shipment charges paid on bullion from smelter to refinery, so these are borne by the shipper. When the freight rate reduction was made last fall, the reduction was transmitted by the smelters to the shippers.

In regard to intrastate rates on ores and on coal, these have been proportionally high, and for this reason were not increased when the flat rate increase of 25 per cent above the McAdoo rates of June, 1918, was ordered on Aug. 25, 1920. If the theory is followed that intrastate rates should be on a substantial parity with interstate rates, and the 10 per cent reduction can be gained on freight rates on ores within the state, it will be possible for Utah mines to ship lower grade ores to the smelters and so increase their output.

Eureka—Mines of the Tintic district shipped 209 cars during the week ended May 27, the largest output for one week in two years. Shippers were: Chief Consolidated, 61 cars; Tintic Standard, 54; Iron Blossom, 22; Colorado, 15; Victoria, 13; Grand Central, 12; Eagle & Blue Bell, 9; Gemini, 5; Mammoth, 3; Dragon, 4; Sunbeam, 3; Swansea, 2; Sioux Consolidated, 1; Centennial-Eureka, 1.

A report by the new interests in control of the Grand Central outlines an extensive plan of development. Minority stockholders in the Grand Central have been offered 60c. a share for their stock, the price paid the majority stockholders, when control was acquired by the Chief Consolidated Mining Co. or the privilege of exchanging their Grand Central stock for stock in the Chief Consolidated on a basis of ten shares of Grand Central stock for one share of Chief Consolidated stock. This is done in view of the fact that Grand Central stock is non-assessable, and to obviate difficulties in the way of financing operations. Up to April 30, since the acquiring of control by the Chief interests, $53,000 had been advanced to the Grand Central by the Chief, and notes taken. To bring the property to the desired point of economical and safe management, it is estimated that an expenditure of $200,000 may be needed.

The superintendent's report shows that 3,682 tons of ore was shipped from the time the mine was leased up to the end of the first quarter. This ore yielded, after payment of smelting, sampling, and transportation charges, $84,874. Net operating loss, after payment of all charges was $3,575. This did not include charges for equipment and for miscellaneous expense, which amounted to $40,206 involving an indebtedness to the Chief Consolidated for that amount, which, since the close of the quarter by additional expenditures has been raised to $53,411.

Park City — Shipments for the week ended May 27 amounted to 3,437 tons, compared with 2,410 tons the week before, and is the highest for any week in the last two years. The Ontario is adding to the output of the camp by shipments from its tailings dump to one of the valley smelters. Shippers were: Ontario, 1,214; Silver King Coalition, 808; Park-Utah, 707; Judge, Daly West, Daly, 707. In regard to the new find in the Ontario on the 1300 level east of the Ontario fault, the management states that the ore is of excellent grade but that not enough work has yet been done to determine its extent. Energetic development of the oreshoot is being done and the outlook is said to be most encouraging.

OREGON

Efforts Made to Finance Rebuilding of Sumpter Smelter

Baker—The mining future of Baker County depends to some extent upon the success met in financing plans for the rehabilitation of the smelter at Sumpter, a 300-ton capacity plant, which was built many years ago. Its operations were limited, owing to poor management and financial difficulties. The plant is in good condition, considering the long idleness and it is estimated that the expenditure of $30,000, chiefly for electrical equipment, will put it in running order. The promoters of the enterprise are hopeful of making financial arrangement so that operations will be resumed this summer.

The town of Sumpter, partly destroyed by fire four years ago, and near which the smelter is situated, is the center of an area credited with the production of considerable gold and silver. The lode gold was largely derived from free-milling ores, which, however, became sulphides at depth. The region is served, in a general way, by the Sumpter Valley Ry., a narrow-gage line, extending from Baker to the John Day country.

Bourne — Preparations are being made for resumption of mining and milling at the E. & E. mine.

Cornucopia District—The connecting raise between the long Last Chance tunnel and the upper workings of Baker Mines Co. is making rapid progress, having reached a point which is over 600 ft. above the Last Chance tunnel level.

Susanville—Work throughout this section has been hampered this season by the large amount of snow in the hills, which has exceeded all known records for this time of the year.

Homestead—After a short shutdown, due to necessity of raising money with which to put in pumping machinery, the Copper Syndicate, adjoining the Iron Dyke property, has resumed work with a small crew.

MICHIGAN

The Copper Country

Arcadian's New Baltic Opening Still in High-Grade—C. & H. to Run Ten Stamps at Calumet

By M. W. Youngs

Houghton—Copper is going out of the Lake district by rail as well as by water and final reports of May shipments should show an encouraging total. The outlook for June is equally as good, and if the present demand continues the local docks will soon be clear of surplus metal.

The rich streak in the south drift at the 1,100 level of Arcadian Consolidated's New Baltic shaft continues. It has now been cut for a distance of 75 ft. and the high values persist. The vein rock is charged with heavy copper and it is uniform throughout the breast. Good values also continue in the north drift at the same level. For the present all efforts will be centered on pushing the drifts in the 1,100 and 942 levels, but eventually the shaft will be sunk to much greater depth to test out the values in the lode.

Calumet & Hecla is preparing to resume work soon in the haulage level in its conglomerate department. At the same time, work will be resumed in the raise at No. 12 shaft, the southern terminal of the tunnel and the main supply, power and pump shaft. One thousand more feet of drifting will bring the tunnel to its termination. At the north end, the Red Jacket shaft will be used for hoisting. Eventually, all other conglomerate shafts will be abandoned and all mining of the conglomerate lode at depth will be from the haulage level.

With the resumption early in June of mining operations on a larger scale in Nos. 9 and 10 shafts, South Hecla, of Calumet & Hecla, more stamps will be needed in the Calumet mill. Eight now are in operation but two more are being overhauled preparatory for use.

Though work is proceeding satisfactorily on the construction of the new power plant at No. 2 Gratiot shaft, Seneca, there is no immediate necessity for the completion of the task, as the present hoist will be ample for some time. The shaft is bottomed at 1,500 ft., and the hoist has a capacity considerably greater than that. The improvement of the shaft has reached the thirteenth level, and repairs will proceed to the fifteenth before sinking is resumed.

Gogebic Range

Oliver Company Shipping Ore Hoisted from Eleven Shafts

Ironwood—The Oliver Iron Mining Co. started shipping the ore hoisted at its ten shafts in the Ironwood district and one in the Bessemer district on June 2. The shafts of the Tilden mine are served by the St. Paul railroad, and the company has not yet started shipping over that road. No announcement has been made as to [illegible] will be [illegible]

The Florida was the first mine of the Ogilvie, [illegible] stockpile shipping, the ore hoisted May 15 being shipped to the docks. Shipping from stockpiles stopped a few days later.

The coal strike has not directly affected the operations of the mines in the Lake Superior district. There is no shortage of coal on the docks at the head of the Lakes, and several cargoes have even been shipped back down the Lakes. In addition many operators have considerable coal at their mines remaining from last year. The effect on the steel business has, however, been reflected in some measure by the delay in shipping ore from the mines. This delay has been more largely due to the uncertainty of rail and lake freight rates.

MINNESOTA

Minnesota Steel Co. to Start Plant at Capacity

Duluth—The Minnesota Steel Co., a subsidiary of the U. S. Steel Corporation, has received orders to start its plant at capacity at the earliest possible moment. One furnace has been running at half capacity for several weeks making pig iron. Besides the two furnaces, five open hearths, the open pit, rail mill, merchant mill and the nail and wire mill will be put in operation. The plant when running at full capacity will turn out 40,000 tons of steel per month.

Mesabi Range

Biwabik—The Pickands Mather & Co. has started ore shipments from stockpile at its Belgrade mine. At the Biwabik mine, operated by the Biwabik Mining Co., it is anticipated that ore will be shipped soon.

Chisholm—Shipments from the stockpile of the Alexandria mine, operated by the Hanna Ore Co. are being forwarded daily to the G. N. docks at Allouez.

Nashwauk—Ore operations at the Harrison and Patrick open pits has been started by Butler Brothers and are being worked to capacity. The concentrating plants have also been placed in operation.

Vermilion Range

Ely—All shaft ore from the Pioneer, Sibley and Soudan mines, properties of the Oliver Iron Mining Co., is now being sent directly to the dock.

Cuyuna Range

Work To Be Started at Pennington Pit—Nine Mines Operating Full Time

Ironton—Work is to be started at once at the Pennington open pit. The pit is being unwatered, and will soon be in the shipping class again. It has been idle since November, 1920. Plans anticipate the production of 150,000 tons this season, a portion of which will come from the Inland Steel Co.'s Armour No. 1 mine, which is operated through the Pennington pit by the Todd-Stambaugh interests. It is estimated that ore available to steam shovel in these two properties will be exhausted in another year's operation, at which time underground methods will be adopted.

The opening of the Pennington brings the total number of mines operating full time on the Range to nine, out of a total of sixteen iron-ore properties.

Joplin-Miami District

Tulsa-Quapaw Company Buys Niangua Property—Over 100 Mines in Operation

By P. R. Coldren

Joplin—The Tulsa-Quapaw Mining & Investment Co., has purchased the concentrator and two mines of the Niangua Lead & Zinc Co., at Picher, Okla., for a cash consideration of about $50,000. The Niangua company developed the two properties in 1918. It first bought and developed the east twenty acres of the forty-acre tract, and erected a mill. Then it bought the Hare mill and mine on the West 20, and called it the Niangua No. 2. Some months afterward, the No. 1 mill burned, and mining afterward was carried on at the No. 2 concentrator, and the two mines were cut together underground, though unsatisfactorily.

The new owners say they will build a surface railroad connecting the mines and mill the dirt taken from the two properties, and also from a third property on a twenty-seven-acre tract adjoining on the east, at the No. 2 Niangua mill. It is understood the Niangua people paid $150,000 for the Hare property alone, and that they at one time were offered $300,000 for the forty-acre tract with the mills. Some months ago the company went into bankruptcy, and the mill has been idle for some time.

The Tulsa-Quapaw company is made up mostly of capitalists, including J. R. and C. C. Cole, who already are interested in several Picher mines, notable among them being the Dorothy Bill. The sale was made through George Moore, of Joplin, who retains an interest in the property.

No definite results have been announced from the recent hearing before the special Indian commission at Miami, respecting the estimation of values of mining lands on the Mary and Eudora Whitebird, Harry Crayfish, Slim Jim, and Sin-tah-hah-hah allotments. An erroneous report was made to the effect that the commissioners would demand a bonus from the operators, but it is officially stated that no such decision has been reached. As a matter of fact, the decision of the local commission must be sent to Washington and be approved by Indian Commissioner Burke and issued by him before it will become official. It is expected a report will be made within the next fortnight.

The New York mine, in the Picher camp, is just being opened up by Jefferson City, Mo., capitalists who also own the Cortez and King Brand mines in this field, and is proving a promising property. Operations are being carried on at a depth of 235 ft. and ore giving a 25 per cent recovery (locally speaking) is being taken out. There is little lead.

The United Zinc Corporation, the Charles M. Schwab interest in this field, is preparing to reopen its Royal mine, in the Picher camp. The Manhattan mine, which is another of this company's properties, is in operation and giving a good account of itself.

Although few mine sales are being reported, there is more activity in the Tri-State section than for many months. More than 100 mines are in operation, and there is a considerable shortage of shovelers at the mines.

ALABAMA

Conditions in the Birmingham District Improving Steadily

By George Huntington Clark

Birmingham—Optimistic predictions as to iron and steel production in Alabama for May have been more than realized. Steel production is steadily increasing, the Gulf States Steel Co. now having three of its six open-hearth furnaces going, and the finishing mills in part on double time. The Tennessee Coal, Iron & R.R. Co. is closely approximating normal steel output, if that figure has not been already reached.

The determining index of Southern merchant iron production, is the output of the Sloss Sheffield Steel & Iron Co., the largest producers of this class of iron in the South, now operating five of its six stacks, which is above normal.

There are now twenty or twenty-one furnaces active in Alabama, as compared with six on Jan. 1, and five on July 1, 1921. The increase, during 1922 has been steady during each succeeding month.

It is now estimated that the production for June should approximate, if not exceed, maximum production realized during any one month for the last eighteen months.

Iron mining in Alabama as usual is largely confined to the operations of the iron-making corporations, there being few, if any, independent mines putting out any class of iron ore for open market sale.

Reserve ore stocks have been drawn upon rather heavily so far during the year, and the scale of mining must soon increase, running approximately to an output of about 325,000 tons per month, or approximately 72 per cent of normal.

The opinion of the Tennessee Coal, Iron & R.R. Co. as to the stability of the iron and steel trade seems indicated by wage increases of 15 per cent to ore, and approximately 10 per cent to coal miners, effective on May 15.

The present percentage of unemployment in the district, in so far as iron and steel making is concerned, seems negligible and is steadily decreasing.

The Present Situation at the Mines

Few Copper Companies Remain Shut Down—Freight Rate Cut Expected to Stimulate Production—Coal Stocks Ample—Further Improvement in Lake Superior Iron Country—Lead-Zinc Activities Increasing

By A. H. Hubbell
News Editor, *Engineering and Mining Journal-Press*

ANNOUNCEMENT of the reduction in freight rates has caused little or no visible change as yet in operations in the metal-mining districts of the country. Undoubtedly it will stimulate production. It does not apply, however, to iron ore moving from the Northern ranges to the Lake Superior docks, this commodity being subject to a separate ruling not yet handed down, as a result of which iron-ore prices have not been quoted so far for 1922.

Coal stocks appear to be ample for the present, and no inconvenience is reported resulting from the strike. Skilled labor is becoming scarce in many districts, and in the Joplin zinc-lead district a shortage of shovelers has suddenly developed. Wages are at the low point, the general situation hardly permitting further cuts. In some districts they have already made some advance, particularly in the iron country and in the Birmingham district of Alabama. The average cost of supplies is rising slowly, Dun's index for June 1 being $169.977 compared with $164.444 on Jan. 1 and $159.833 on July 1 last.

In less than six months the copper-mining industry has passed from a position of widespread stagnation to one where almost all of the important operators of the country are producing. This transition, which began with Anaconda's resumption on a limited scale last January, was completed recently when North Butte and Davis Daly, in Montana, and the United Verde, in Arizona, started work. The Phelps Dodge branches at Tyrone, N. M., and at Clifton-Morenci remain shut down; likewise some of the smaller properties in northern Michigan. Stagnancy still prevails in the Shasta copper belt in California. Elsewhere in the United States important plants are running.

At Butte, about 10,500 men are employed. Anaconda is working thirteen mines and has both smelters at half capacity and its zinc plant at full capacity. East Butte has increased its force to handle Davis-Daly ore. At East Helena, the A. S. & R. Co. has several hundred men engaged.

Of the porphyries, Utah and Nevada Consolidated have reached their temporary objective of half capacity, with Ray and Chino lagging. In Arizona, the Copper Queen has increased its output from 6,250,000 to 7,500,000 lb. per month and is taking concentrates from its new Moctezuma mill at Nacozari. Old Dominion continues its monthly rate of 2,000,000 lb. Calumet & Arizona and New Cornelia are running at 60 and 40 per cent capacity, Miami is operating at 80 (as last year), and Inspiration is producing at a rate of not less than 5,500,000 lb. per month.

Elsewhere in the West, Engels, in California, is producing over 1,100,000 lb. per month, and Granby at 75 per cent capacity.

Copper production in northern Michigan is slowly increasing, May's output of refined metal being estimated at 11,550,000 lb. against 9,785,000 in April, or 52 and 44 per cent, respectively, of the district's pre-war normal of 22,000,000 lb. a month. Calumet & Hecla's production is 55 per cent of normal, that of Copper Range 97, Quincy 76, Ahmeek 93, and Isle Royale 45. Mohawk and Wolverine are producing at capacity.

In the Ducktown district of Tennessee both the two producers are running, Tennessee Copper at 70 per cent of capacity and the Ducktown S. C. & I. Co. at capacity.

Though conditions are still unsettled in the Lake Superior iron country, improvement is marked. Iron-ore production in May, though far below normal, was the largest since the 1921 season closed. Delay in quoting iron-ore prices is naturally keeping production down. On the Mesabi and Vermilion ranges it is reported that though active properties are operating on a 65 per cent basis their shipments are but 40 per cent of normal for this time of the year. About 9,000 men are working, compared with 16,000 normally, and on the Cuyuna 900, against 1,600 normally. On the Michigan ranges, about three-quarters of the men usually employed are at work, and production is on a similar basis.

In the Birmingham district in Alabama reserve iron ore stocks have been drawn upon rather heavily and an increase in output to about 70 per cent of normal is considered imminent. About twenty furnaces are in blast, compared with six on Jan. 1. Production of iron and steel is continuing its steady increase, as it has from the first of the year.

Better prices for lead and zinc, together with the forthcoming reduction in freight rates, have greatly improved the outlook for producers of these metals. The production of zinc ores by Butte & Superior and Anaconda continues large. In the Cœur d'Alenes, in northern Idaho, the Hecla Mining Co. is producing at the increased rate of 4,000 tons per month, against 3,500 a month ago, and the Federal and Bunker Hill companies without change at 5,000 and 6,000 tons, respectively, giving a total for the district of 15,000 tons per month. Bunker Hill's smelter is running two furnaces, handling 500 tons per day. Elsewhere in the Pacific Northwest smaller operators are more active. Trail is handling a normal tonnage. The Northport smelter is shut down. Tacoma is running at reduced capacity.

The number of mines in operation in the Joplin-Miami zinc-lead district has now passed the hundred mark, and others, particularly in the Picher section, are preparing to resume, this compared with seventy-five in operation on Jan. 1. Production is about 10,000 tons a week.

In the Wisconsin zinc-lead district, the production of zinc concentrates has recently increased and stocks on hand decreased. At the present rate, production is about 35 per cent of normal. Labor is plentiful.

Zinc operations in the Mascot district of Tennessee are somewhat less than half of normal.

Activity is slowly increasing in the southeast Missouri lead belt, and present plants are running at capacity. Construction of the 1,000-ton mill of the Annapolis Lead Co. is progressing. St. Joseph Lead has raised wages 10 per cent.

In California, there is considerable activity on the Mother Lode and among the smaller gold-mining operators in the north. The North Star and the Empire Mines, at Grass Valley, are running at capacity. The Randsburg silver camp remains in the limelight. Dredging companies are busy.

Nevada conditions are normal. Tonopah, the principal camp, is producing steadily, and on the whole there is considerable activity in the state.

In Utah, Park City, Bingham and the Tintic district continue busy, operations at Bingham progressing on an increasing scale. The Garfield smelter is handling Utah Copper's concentrates and the other Valley smelters are treating their customary tonnages. The Tooele plant has resumed.

Mining in Colorado at present displays no marked activity, save in a few localities, and these scattered. Strong efforts are being made to improve the situation. Conditions at Cripple Creek are unpromising.

In the Black Hills of South Dakota, the Homestake and Trojan companies are the only gold producers, their output totaling about $750,000 per month.

In Ontario, the gold producers at Porcupine and Kirkland Lake are striving for new records. Production from Cobalt continues normal, with the McKinley Darragh and the Dominion Reduction reopening their properties. International Nickel has reopened its refinery, evidencing better conditions in the industry. Activity in the Sudbury district is confined to the Mond company's limited operation.

THE MARKET REPORT

Daily Prices of Metals

June	Copper, N. Y., net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
1	13.625	30.75	31.875	5.65@5.75	5.50@5.55	5.275
2	13.625@13.75	31.25	32.00	5.65@5.75	5.50@5.60	5.275@5.30
3	13.625@13.75	31.25	32.00	5.65@5.75	5.50@5.60	5.30
5	13.625@13.75	31.50	32.25	5.65@5.80	5.50@5.60	5.30@5.35
6	13.625@13.75	31.625	32.625	5.65@5.80	5.50@5.60	5.35
7	13.625@13.75	31.375	32.375	5.75@5.80	5.50@5.60	5.35@5.375

*These prices correspond to the following quotations for copper delivered: June 1, 13.875c.; June 2 to 7 inc., 13.875@14c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

June	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
1	63⅛	63½	69½	153¼	154½	25	23⅝	28⅛	27⅞
2	63⅜	63¾	69½	154	155¼	24⅞	23¾	28⅛	27⅞
3	...			....	....	...	...	...	...
5				....	....	...	...	...	...
6	63⅛	63½	69½	154¾	155⅞	24⅞	23¾	28⅛	27⅞
7	62⅞	63¼	69½	154⅞	155½	25	23⅞	28	27¾

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

June	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	June	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
1	444⅝	99⅝	71¾	36¼	5	448½	99⅝	71⅜	...
2	446	99⅝	71¼	36⅛	6	450½	99⅝	70⅞	35¼
3	447⅜	99⅝	71¼	35⅞	7	450	99⅝	71⅜	35⅜

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, June 7, 1922

Metal prices have continued to advance during the last week, though the market has not been a particularly active one. The gradual improvement is a reflection of better general business conditions, which have caused surplus metal stocks to be slowly absorbed, and which are likely to continue. Monday was a holiday in Europe, so that foreign business on that day was at a standstill.

Copper

Sales have been in moderate volume during the week, with three or four orders approaching a thousand tons each. Demand has for the most part been for July-August delivery, though September copper has also been sold. Practically all consumers seem to be well supplied for the current month, but, on the other hand, most of the producers have no more near-by metal available. Those that have are anxious sellers and would be willing to shade prices slightly under the quotations made for later deliveries. During the entire week, copper was obtainable for 13⅞c., especially by those consumers situated near New York and willing to take June or July deliveries. However, some of the producers who raised their price to 14c. have been able to book orders of fair proportions at that level. It is significant that although business has not been so active as it was some weeks ago, there seems no tendency so far for the price to recede; it has merely not advanced quite so rapidly.

The foreign orders were held up somewhat by the holiday, but export demand for the week was of fair proportions nevertheless. The prices realized were about one-quarter of a cent above those for domestic deliveries. Most of the metal was booked for June and July delivery.

Lead

The official contract price of the American Smelting & Refining Co. was advanced today from 5.65c. to 5.75c., New York.

Demand for lead at the advancing prices keeps up wonderfully well. Supplies have been carefully sold, and it has been difficult to obtain lead for speculative holding either by dealers or consumers. For this reason, any prolonged lull in demand is unlikely, for lead continues to go rapidly into consumption, and demand from every lead-consuming trade is excellent, or excellent compared with last year. Even chemical sheet lead sales have been more satisfactory recently. Corroders continue to run to the capacity of their plants.

In the New York district, reputable consumers were fairly generously supplied at 5.65c., at least until Monday. In the last day or two orders assumed such large proportions that the market was pretty well cleaned up of all metal held at less than 5.75c. Spot lead commanded even higher prices. In the St. Louis district, lead is still obtainable at 5.50c., a pronounced effort being made by one producer to hold the market at that level for a time rather than to let prices advance so rapidly that an undesirable reaction will follow. Dealers are, however, having difficulty in obtaining lead for less than 5.60 to 5.65c.

Desilverized lead is commanding a premium of about 10 points in the Middle West, where supplies of chemical lead are still abundant. In the vicinity of the Eastern seaboard, however, chemical lead is selling at the freight differential over St. Louis prices, which brings the delivered price somewhat above that for which the desilverized article can be obtained.

Zinc

Demand has improved somewhat from galvanizers, and with consumption continuing considerably above production, prices have advanced further. There is so far little disposition for custom smelters to increase production, owing to the fact that ore prices have advanced so fast that smelting continues to be virtually a profitless operation. High-grade zinc continues to be in excellent demand at the same price as quoted last week—6½c. with a 30-point freight allowance. The New York market continues at the customary advance of 35 points over St. Louis quotations, this representing the freight.

Tin

Tin has advanced slightly in London, but the higher prices here are caused chiefly by the advance in sterling exchange. Demand has been good, and practically all of the spot metal available has now been taken up. Reports from Pittsburgh indicate that the tinplate mills are working practically at full capacity. American electrolytic tin is in good demand from tinfoil makers and others at the same prices quoted for Straits. Tin of 99 per cent grade is rather scarce for some of the better grades. However, Chinese No. 1 tin, which is a good 99 per cent grade, is now available again with the higher prices, several houses with Chinese connections making offerings.

Tin for September delivery sold at ¼c. to ⅜c. discount from the quotations for spot.

Arrivals of tin, in long tons: Total for May, Atlantic ports, 4,600; Pacific ports, 140. June 1st, Straits, 925; Liverpool, 50; Australia, 15; 5th, London, 25; China, 5.

Gold

Gold in London: June 1st, 93s. 1d.; 2d, 92s. 11d.; 6th, 92s. 1d.; 7th, 91s. 6d.

Foreign Exchange

Sterling exchange reached new high levels during the last week, the highest since it was released from control following the World War. The strength in sterling also affected other foreign exchanges favorably. On Tuesday, June 6, francs were 9.135c.; lire, 5.215c.; marks, 0.3425c.; and Canadian dollars, 99.16c., the highest point yet reached.

Silver

The first week of June showed a continued fall in silver prices, owing to lack of support from China and India, although the advance in sterling rates helped to steady the market in New York. On the 6th silver in San Francisco and New York was on about the same level, showing the weakness of China exchanges. The market closes quiet, without pronounced tendency, and the future depends upon China.

Mexican Dollars—June 1st, 54⅞; 2d, 54⅞; 3d, 54½; 5th, 54⅝; 6th, 54¼; 7th, 54½.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17.25@18.25c. for 98@99 per cent virgin grades.

Antimony —- Chinese and Japanese brands, 5.25@5.30c. W.C.C., 6@6½c. Cookson's "C" grade, spot, 8.75c. Chinese needle antimony, lump, nominal, 3.50@4c. per lb. Standard powdered needle antimony (200 mesh) nominal at 5½c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 6.75@7c.

Bismuth—$2@$2.10 per lb.

Cadmium—$1.15@$1.20 per lb.

Iridium—Nominal, $150@$170 per oz.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Outside market quiet at 29@32c. per lb.

Palladium—$55 per oz.

Platinum—$85@$87.50 per oz.

Quicksilver—$55 per 75-lb. flask. San Francisco wires $54.

The prices of **Cobalt, Magnesium, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium** and **Tungsten** are unchanged from the prices in the issue of June 3.

Metallic Ores

Chrome, Iron, Magnetite, Manganese, Molybdenum, Tantalum, Titanium, Tungsten, Uranium, Vanadium, and Zircon ores are unchanged from the quotations published June 3.

Zinc and Lead Ore Markets

Joplin, Mo., June 3—Zinc blende, per ton, high, $33.05; basis 60 per cent zinc, premium, $32; Prime Western, $32@$31; fines and slimes, $29@$28; average settling price, all blende, $29.64. Calamine, basis 40 per cent zinc, $15.

Lead, high, $73.60; basis 80 per cent lead, $70@$75; average settling price, all lead ore, $71.30 per ton.

Shipments for the week: Blende, 11,861; calamine, 69; lead, 1,585 tons. Value, all ores the week, $465,690.

Sellers held firm and secured advances in all grades of blende. Premium grades and some ore high in iron sold on $32 basis. The demand continues strong, the purchase exceeding the production. Careful survey of the situation points to only one week's supply of purchasable ore ahead of the production. At present 106 mills are in operation and the output is around 10,500 to 11,000 tons per week.

Lead was in stronger demand this week, with some ore selling on $75 basis. The production is less than the demand, which creates sharp competition among buyers.

Platteville, Wis., June 3—Blende, basis 60 per cent zinc, $32 per ton. Lead ore, basis 80 per cent lead, $75 per ton. Shipments for the week: Blende, 297 tons; lead, 40 tons. Shipments for the year: Blende, 6,704 tons; lead ore, 977 tons. Shipped during the week to separating plants, 713 tons blende.

Non-Metallic Minerals

Talc—High-grade foundry talc, $20 per ton, or $18 in carload lots, f. o. b. Virginia mills. Demand better.

Asbestos, Barytes, Bauxite, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, and **Talc** are unchanged from the prices published in the June 3 issue.

Mineral Products

Arsenious Oxide—7@7½c. per lb.

Copper Sulphate—6.15@6.25c. for large crystals. Prompt shipment scarce.

Potassium Sulphate, Sodium Nitrate, and **Sodium Sulphate** are unchanged from quotations of June 3.

Ferro-Alloys

Ferrocerium, Ferrochrome, Ferromanganese, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium, and **Ferrovanadium** are unchanged from the prices published June 3.

Metal Products

Copper Sheets—New York base, 20.50c. per lb.; wire, 15.75c.

Nickel Silver—26.75c. per lb, for 18 per cent nickel Grade "A" sheets.

Yellow Metal—Dimension sheets, 17.75c.; rods, 14.75c. per lb.

Lead Sheets and **Zinc Sheets** are unchanged from the quotations published in the June 3 issue.

Refractories

Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick, and **Zirkite** are unchanged from the prices appearing in the issue of June 3.

The Iron Trade

Pittsburgh, June 6, 1922

Production of steel ingots continues at a rate of about 38,000,000 tons a year. It is commonly believed that a considerable part of the steel demand in the past few months has been due to buyers fearing that the coal strike would interfere with deliveries. While up to date steel production has been at an increased rate, the coal strike does not appear to be any nearer settlement than when it started. The steel mills, on an average, are fully sold up for about two months at their present production rate.

Last Friday the American Sheet & Tin Plate Co. opened its order books for new periods at former prices, $4.75 for tin plate, 2.40c. for blue annealed sheets, 3.15c. for black sheets, 4.15c. for galvanized sheets, and 4.50c. for automobile sheets, but in sheets orders for July only are taken. Some independents are now selling for later deliveries at slight advances. Bars, shapes and plates are 1.60c. minimum, with early deliveries commanding premiums.

Pig Iron—The market continues absolutely stagnant, appraised values being $25, Valley, for bessemer and basic and $24 for foundry. Lake Superior iron ore prices for the 1922 season have not yet been developed.

Coke

Connellsville Coke—Offerings and demand are both light, prices being about $7 for furnace and $7.50 for foundry coke.

COMPANY REPORTS

Anaconda Copper Mining Co.

The Anaconda ceased production of copper about April 1, 1921, owing to the industrial depression, and remained closed down for the remainder of the year, operations being resumed Jan. 16, 1922. The complete financial report for the Anaconda and subsidiary companies follows:

CONSOLIDATED BALANCE SHEET, DEC. 31, 1921

ASSETS		
Fixed:		
Mines and mining claims, rights and lands	$119,438,110.62	
Buildings and machinery	76,285,549.17	
Investments in sundry companies	16,496,444.04	
		$212,220,103.83
Current:		
Supplies on hand, advances on ores and expenses prepaid	$21,989,306.50	
Metals and manufactured products in process and on hand at the lower of cost or market	17,817,363.59	
Accounts receivable and cash assets	21,235,831.13	61,042,501.22
		273,262,605.05
LIABILITIES		
[illegible] 2,331,250—$50 shares		$116,562,500.00
Minority stockholders' interest in [illegible] companies		2,486,295.12
[illegible] Jan. 1, 1925		49,201,700.00
[illegible]		24,182,834.37
[illegible]		13,075,368.31
Surplus:		
Surplus Dec. 31, 1920	$84,753,462.44	
Net loss for the year ending Dec. 31, 1921	16,999,555.19	
		67,753,907.25
		$273,262,605.05

CONSOLIDATED INCOME ACCOUNT

EXPENSE		
[illegible] products on hand [illegible] year		$36,516,880.05
Mining, including development		3,786,076.51
[illegible]		3,957,200.16
[illegible]		5,119,253.62
[illegible] transportation [illegible]		1,250,676.43
Miscellaneous expense including selling		5,337,188.60
State, county and Federal taxes		1,220,361.50
		$57,187,636.87
Balance brought down		6,257,042.38
Amount charged off this year for depreciation [illegible]		2,135,401.31
Interest on [illegible] bonds		3,108,267.89
Expenditure during suspension of operations		5,680,503.39
		$17,181,214.97
INCOME		
Sales of metals and manufactured products		$31,097,213.90
Royalties [illegible] rentals		2,016,017.00
Metals and manufactured products in process and on hand at end of year		17,817,363.59
Balance carried down		6,257,042.38
		$57,187,636.87
Income from investments in sundry companies		$120,025.78
Balance, net loss:		
Apportioned to minority interests	$61,634.00	
Carried to foregoing balance sheet	16,999,555.19	
		17,061,189.19
		$17,181,214.97

Purchase of the American Brass Co. was consummated Feb. 10, 1922, when more than 99 per cent of the Brass shares were acquired. An outstanding feature of the year was the development of the Anaconda metal shingle, to be made of copper or zinc. This was perfected in October, an operating plant and selling organization afterward developed, and the product is now being marketed.

In the copper department, 353,055 wet tons of ore were produced at the company's mines at Butte, Mont., and 373,410 tons were treated at the Anaconda concentrator.

The operations of the company include copper mines at Butte, a concentrator and smelter at Anaconda; refineries at Great Falls, Mont., and Raritan, N. J.; and a rod and wire mill at Great Falls. There are zinc mines at Butte, and reduction works at Anaconda and Great Falls. Miscellaneous products include lumber from sawmills at Bonner and Hope; coal from Diamondville, Wyo., Washoe, Mont., and Sand Coulee, Mont.; arsenious oxide; sulphuric acid from Anaconda; and fertilizer, the phosphate rock coming from mines at Conda, Idaho. Subsidiary companies include the Butte, Anaconda & Pacific Ry. Co.; the International Smelting Co. at International, Utah, and Miami, Ariz.; the International Lead Refining Co. at East Chicago, Ind.; the Anaconda Lead Products Co.; the Walker Mining Co.; the Arizona Oil Co.; and in South America, the Andes Copper Mining Co.; the Potrerillos Ry., and the Santiago Mining Co.

As is customary, the report fails to reveal to stockholders any technical details or costs of the company's operations.

Bunker Hill & Sullivan

The profit-and-loss analysis of the Bunker Hill & Sullivan Mining & Concentrating Co., operating at Kellogg, Idaho, for the year ending Dec. 31, 1921, is as follows:

DEBIT		Per Ton Concentrates Produced	
Production costs (89,923 tons mill product)			
Mining, 426,530 tons mined		$15.18	$1,364,669
Milling, West Mill, 438,526 tons mine ore	$348,214		
Sweeney Mill, 153,820 tons tailings	70,844	4.66	419,059
Shipping expense, 89,746 tons concentrates shipped		.26	22,960
Smelting costs:			
Freight and treatment, and lead and silver discounts (on ore shipped)		21.32	1,916,850
South Mill expense		.04	4,079
North Mill experimental		.30	27,003
Mine examinations		1.77	159,443
Interest paid on bank loans		.14	12,339
Worthless accounts and notes charged off		.07	5,958
Stores inventory adjustment		.03	3,200
		$43.77	$3,935,565

CREDIT		Per Ton Concentrates Produced	
Bullion			
Gross lead and silver value of product shipped	$4,602,349		
Less concentrates inventory adjustment at cost	4,371		
		51.13	$4,597,978
Royalties on lessees' ore		.27	24,214
Net profit of light and water dept		.01	529
Net profits on house rentals		.02	1,490
West Mill rentals		.12	10,291
Tramway rentals		.01	813
Dividends			
Caledonia Mining Co.	$13,081		
Sierra Nevada Consolidated Mining Co	240,918		
		2.82	253,999
Interest			
On loans and accounts	$34,873		
On bonds and other reserve securities	99,315	1.49	134,188
Sale of securities, net profit		.28	25,199
		$56.15	$5,049,335
Add: Bunker Hill smelter, net profit after depreciation		3.63	326,787
		$59.78	$5,376,122

The balance for the year carried to Surplus was $804,305.

The report gives complete cost data. The mining cost was $3.17, some of the principal items being: timber and lagging, 45c.; shovelers, 39c.; timbermen and carpenters, 26c.; miners, 22c.; compressed air, 16c.; machinemen, 13c.; and powder, 10c. Exploration cost $16.81 per foot; stoping, $2.02 per ton; tramming, 8c. per ton; hoisting, 7c. per ton; and pumping, 8c. per ton.

Concentration cost 79c. per ton, including 8c. for crushing and conveying; 4c. for screening; 9c. for jigging; 7c. for tube-mill grinding; and 18c. for concentration, including 7c. flotation royalty.

Alaska Juneau Gold Mining Co.

A report of the operations of the Alaska Juneau Gold Mining Co. for 1921 shows a loss of $168,731.84, according to the following profit-and-loss analysis:

DEBITS

Mining		$322,298.62	
Milling		573,414.52	
Marketing concentrates and bullion		45,620.62	
General local expense and taxes		61,919.81	
Storm slide damage		14,876.21	
Stock transfer expense		3,310.60	
Bond issue expense		553.82	
Bond interest		126,424.62	
Interest on note and loan accounts		57,695.67	
			$1,206,114.44

CREDITS

Bullion production (from amalgamation)		$797,074.57	
Gold recovery	$789,467.26		
Silver recovery	7,607.31		
Concentrates production		238,176.08	
Gold recovery	$180,235.47		
Silver recovery	32,764.08		
Lead recovery	25,176.53		
Liability		1,917.95	
Assumed on pay rolls	$12,321.03		
Less cost of accident settlements	10,403.08		
Revenue from rents		214.00	
			1,037,382.60
Net loss for year—to surplus account			$168,731.84

SURPLUS

Dec. 31, 1920, balance per account, deficit	563,624.69
Dec. 31, 1921, balance per account, deficit	732,356.53

Balance sheet as of Dec. 31, 1921, follows:

ASSETS

Property	$9,639,844.68
Mine development	1,965,322.33
Construction and equipment—main plant	3,333,592.68
Portable and underground equipment	49,208.14
Deferred charges to future operations	514,670.75
Supplies	325,114.73
Production in transit	130,027.86
Cash accounts	18,692.07
Sundry accounts receivable	2,650.93
Deficit in surplus account	732,356.53
	$16,711,480.70

LIABILITIES

Capital stock, authorized, 1,500,000 shares at $10.00		
Par value	$15,000,000	
Less unissued, 100,000 shares	1,000,000	
		$14,000,000.00
Notes payable—6 per cent guaranteed notes		460,000.00
Bond issue, 7 per cent 10 year gold bonds, authorized $3,500,000		1,836,000.00
Bond coupons not presented for payment		87,554.16
Loan accounts and advances against current production—interest bearing		205,991.83
Pay roll and accounts payable, and other liabilities		102,202.12
Depreciation reserve		19,732.59
		$16,711,480.70

Costs were $0.1997 for mining; $0.3554 for milling; $0.1910 for other costs; total, $0.7461 per ton trammed. Production was $0.6416 per ton.

Fairview Round Mountain Mines Co.

The annual report of the Fairview Round Mountain Mines Co., with properties at Round Mountain, Nye County, Nev., states that the leasing operations carried on in 1921 were highly successful and resulted in opening up more and richer ore than was expected.

The balance sheet is as follows, as of Dec. 31, 1921:

ASSETS

Mining properties	$989,075.97
Mining properties (discovery valuation)	303,171.90
Bonds and stocks	59,293.32
Mine and mill plants and equipment	20,272.25
Store supplies	1,421.28
Accounts receivable	39,077.80
Bills receivable	32,000.00
Cash on hand	2,929.96
	$1,447,242.48

LIABILITIES

Capital	$1,000,000.00
Profit and loss	41,632.75
Bills payable	7,500.00
Dividends uncalled for	4,951.73
Discovery valuation surplus	7,982.68
Ore depletion reserve	385,175.32
	$1,447,242.48

Movements of Ores and Metals for April

Imports and exports of the more important metals and ores during April, 1922, and April, 1921, as prepared by the U. S. Bureau of Foreign and Domestic Commerce, are as follows:

IMPORTS

In Pounds Unless Otherwise Stated

	April, 1921	April, 1922
Antimony ore, contents	29,400	
Antimony matte and regulus	2,710,581	986,465
Copper		
Ore, contents	[illegible]	7,764,694
Concentrates, contents	[illegible]	1,676,411
Matte and regulus, contents	[illegible]	1,375,591
Total	[illegible]	10,816,696
Imported from		
Spain	274,870	1,099,481
Canada	252,677	754,786
Mexico	2,636,950	870,035
Cuba	1,375,104	2,620,660
Chile	832,388	5,143,377
Peru	18,457	69,492
Other countries	1,148,559	258,865
Unrefined, black and blister	10,169,145	19,015,875
Refined, in ingots and bars	19,070,079	6,760,243
Old, for remanufacture	389,339	2,966,060
Composition metal, copper chief value		39,927
Lead		
Ore, contents	988,534	1,646,019
Bullion, contents	11,380,892	3,602,232
Imported from		
Canada	496,181	48,085
Mexico	11,562,680	3,837,468
Chile	234,627	736,689
Other countries	75,938	626,009
Pigs, bars and old	4,558,440	170
Manganese ore, long tons	47,260	25,559
Imported from		
Cuba		23
Brazil	31,350	13,700
British India	14,910	6,250
Other countries	1,000	5,586
Sulphur ore, as pyrites, long tons	24,059	30,480
Imported from		
Spain	21,609	30,480
Other countries	2,450	
Tin ore, long tons	607	1,359
Tin bars, blocks and pigs	2,483,655	10,526,046
Imported from		
United Kingdom	605,263	1,455,991
British Straits Settlements	1,814,441	8,564,510
Dutch East Indies		55,971
Hongkong	43,878	449,574
Other countries	20,173	
Tungsten ore, long tons	109	
Zinc		
Ore, contents	88,283	
Imported from:		
Mexico	88,283	
Blocks, or pigs and old	6,269,176	78

EXPORTS OF COPPER, LEAD AND ZINC

In Pounds

	April, 1921	April, 1922
Copper		
Ore, concentrates, contents	167,900	7,168
Unrefined, black and blister		112,030
Refined, in ingots and bars	40,256,030	62,196,959
Exported to (in part)		
Belgium	999,358	4,106,706
France	10,800,273	13,956,127
Germany	15,837,896	17,983,470
Italy	223,915	3,789,074
Netherlands	1,166,600	2,713,069
Spain		1,151,654
United Kingdom	7,976,634	3,914,443
Canada	1,541,715	265,219
Composition metal, copper chief value	68	9,803
Old and scrap	40	88,368
Pipes and tubes	184,046	196,084
Plates and sheets	342,813	590,378
Wire, except insulated	711,858	2,217,709
Lead		
Pigs, bars, etc.		
Produced from domestic ore	136,641	1,511,657
Produced from foreign ore	448,077	4,864,938
Exported to		
United Kingdom	..	2,634,283
Canada	18,983	119,980
Argentina	224,077	809,232
Brazil		430,188
Japan	224,000	112,000
Other countries	117,658	2,270,912
Zinc		
Dross		2,308,847
Spelter		
Produced from domestic ore	115,838	4,542,824
Produced from foreign ore		448,000
Exported to:		
France		2,167,732
Italy		112,045
United Kingdom		1,189,051
Canada		58,258
Mexico	2,618	143,119
Argentina	220	56,000
Japan	112,000	1,064,094
Other countries	1,000	200,525
In sheets and strips	388,412	582,531

MINING STOCKS

Week Ended June 3, 1922

Stock	Exch.	High	Low	Last	Last Div.	
COPPER						
Ahmeek	Boston	66	64	65	Sept '20, Q	$0.50
Alaska-Br. Col. new	N. Y. Curb	5¼	4¾	4¾		
Allouez	Boston	29	28	29	Mar '19	1.00
Anaconda	New York	57	56	56	Nov '20, Q	1.00
Arcadian Consol	Boston	4¼	4¼	4¼		
Ariz. Com'l	Boston	10¼	10	10	Oct '18, Q	0.50
Big Ledge	N. Y. Curb	*22	*20	*20		
Bingham Mines	Boston	15½	15½	15½	Sept '19, Q	0.25
Calumet & Arizona	Boston	66	65½	65½	Mar '22, Q	0.50
Calumet & Hecla	Boston	298	288	288	June '20, Q	5.00
Canada Copper	N. Y. Curb	*42	*38	*38		
Centennial	Boston	12	12	12	Dec '18, SA	1.00
Cerro de Pasco	New York	40¾	39½	39¾	Mar '21, Q	0.50
Chile Copper	New York	23¼	22½	22¾		
Chino	New York	33¾	31½	33¼	Sept '20, Q	0.37½
Columbus Rexall	Salt Lake	*29	*29	*29		
Con. Arizona	N. Y. Curb	*5	*5	*5	Dec '18, Q	0.05
Con. Copper Mines	N. Y. Curb	1¾	1¾	1⅞		
Copper Range	Boston	46¼	45½	45¾	Mar. '22, Q	1.00
Crystal Copper	Boston Curb	1¼	1	1 9/16		
Davis-Daly	Boston	8¾	8¾	8¾	Mar '20, Q	0.25
East Butte	Boston	12	11¾	11¾	Dec '19, A	0.50
First National	Boston Curb	*75	*70	*70	Feb '19, SA	0.15
Franklin	Boston	2¼	2¼	2¼	...	
Gadsden Copper	Boston Curb	1¼	1	1¼		
Granby Consol	New York	34¼	32½	32¾	May '19, Q	1.25
Greene-Cananea	New York	34¼	34	34¼	Nov '20, Q	0.50
Hancock	Boston	3	3	3		
Howe Sound	N. Y. Curb	3¾	[illegible]	[illegible]	Jan '21, Q	0.05
Inspiration Consol	New York	45	4[illegible]	4[illegible]	Oct '20, Q	1.00
Iron Cap	Boston Curb	8	7¾	8	Sept '20, K	0.25
Isle Royale	Boston	26	25	25¾	Sept '19, SA	0.50
Kennecott	New York	3[illegible]	38¼	38¾	Dec '20, Q	0.50
Keweenaw	Boston	3	1¾	2¾		
Lake Copper	Boston	5¼	4	5		
La Salle	Boston	2	1¾	1¾		
Magma Copper	N. Y. Curb	31½	31	31	Jan '19, Q	0.50
Majestic	Boston Curb	*16	*10	*10		
Mason Valley	Boston	2	2	2		
Mass Consolidated	Boston	3½	3	3½	Nov. '17, Q	1.00
Miami Copper	New York	31¼	30¾	31	May '22 Q	0.50
Michigan	Boston	3¾	3	[illegible]		
Mohawk	Boston	67½	66	67	Feb '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	10¾	[illegible]	[illegible]		
Nevada Consol	New York	1[illegible]	18	1[illegible]	Sept '20, Q	0.25
New Cornelia	Boston	20	19¾	20	May '22, K	0.25
North Butte	Boston	15	14¾	14¾	Oct '18, Q	0.25
North Lake	Boston					
Ohio Copper	N. Y. Curb	*16	*10	*10		
Old Dominion	Boston	27	2[illegible]	27	Dec '18, Q	1.00
Osceola	Boston	3[illegible]	36	36	June '20, Q	0.50
Phelps Dodge	Open Mar.	†185	†175		Apr. '22, Q	1.00
Quincy	Boston	[illegible]	48	48	Mar '20, Q	1.00
Ray Consolidated	New York	19	18	18¾	Dec '20, Q	0.25
Ray Hercules	N. Y. Curb	2	1¾	1¾		
St. Mary's Min. Ld.	Boston	48	47	47¾	Apr '22, K	2.00
Seneca Copper	Boston	14	14	14		
Shannon	Boston	1⅛	*95	*95	Nov '17, Q	0.25
Shattuck Arizona	New York	12	1[illegible]	1[illegible]	Jan '20, Q	0.25
South Lake	Boston	1¼	1¼	1¼		
Superior & Boston	Boston	1	1	1		
Tenn. C. & C.	New York	12¾	12	12¾	May '18, I	1.00
Tuolumne	Boston	*85	*80	*81	May '13,	0.10
United Verde Ex.	Boston Curb	31	29	[illegible]	Mar. '22, Q	0.25
Utah Consol.	Boston	3¼	2	[illegible]	Sept. '18,	0.25
Utah Copper	New York	69¾	67	6[illegible]	Mar. '22, Q	0.50
Utah Metal & T.	Boston	1	1	1	Dec '17,	0.30
Victoria	Boston	2	2	2	....	..
Winona	Boston	2	1¾	1 13/16	....	...
Wolverine	Boston	16	15	15	....	....
NICKEL-COPPER						
International Nickel	New York	18¼	17¾	18	Mar. '19,	0.50
International Nickel, pfd	New York	84	79	80	May. '22, Q	1.50
LEAD						
National Lead	New York	96¾	94½	95	Mar '22, Q	1.50
National Lead, pfd	New York	110	109¾	110	Mar. '22, Q	1.75
St. Joseph Lead	New York	15¼	15	15¼	Mar '22, Q	0.25
QUICKSILVER						
New Idria	Boston	1¼	1	1⅛	....	....
ZINC						
Am. Z. L. & S.	New York	2[illegible]	19½	19½	May '20,	1.00
Am. Z. L. & S. pfd	New York	48	47	48	Nov '20, Q	1.50
Butte C. & Z.	New York	8	7¾	7¾	June '18,	0.50
Butte & Superior	New York	33¾	32	32¾	Sept. '20,	1.25
Callahan Z. L.	New York	11¼	10¾	10¾	Dec '20, Q	0.50
New Jersey Zn.	N. Y. Curb	144½	143½	144	May '22, Q	2.00
Yellow Pine	Los Angeles	*53	*53	*54	Sept '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs; The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.	
GOLD						
Alaska Gold	New York	⅜	½	½	....	..
Alaska Juneau	New York	1¾	1¼	1½	....	..
Carson Hill	New York	†15	†12	15		
Cresson Consol. G.	N. Y. Curb	2 9/16	2½	2 9/16	Apr. '22, Q, X	$0.10
Dome Extension	Toronto			1		
Dome Mines	New York	29½	28⅞	29½	Apr. '22, Q	1.00
Florence Goldfield	N. Y. Curb	*20	*18	*18		
Golden Cycle	Colo. Springs	*79	*76½	*76½	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*8	*7	*8	Dec. '19,	0.05
Hollinger Consol	Toronto	9 70	9 65	9.70	May '22,	0.05
Homestake Mining	New York	70	70	70	May '22, M	0.25
Kirkland Lake	Toronto	*40	*39	*40		
Lake Shore	Toronto	2 33	2 25	2 30	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	18 25	19 75	18 00	May '22, K	0.05
Porcupine Crown	Toronto	*26½	*26	*26½	July '17,	0.03
Porcupine V. N. T.	Toronto	*27½	*23½	*24¼		
Portland	Colo. Springs	*27	*25	*25	Oct. '20, Q	0.01
Schumacher	Toronto	*65½	*63	*64	....	....
Silver Pick	N. Y. Curb			*9	....	....
Teck Hughes	Toronto	*54	*51	*52	....	....
Tom Reed	Los Angeles	*65	*60	*65	Dec. '19,	0.02
United Eastern	N. Y. Curb	1 11/16	1⅝	1 11/16	Apr. '22, Q	0.15
Vindicator Consol.	Colo. Springs	*8	*7	*7	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*9	*8	*9		
Wright-Hargreaves	Toronto	3.75	2 60	3.75	Apr. '22,	0.02½
Yukon Gold	N. Y. Curb	1	*90	*90	June '18,	0.02½
SILVER						
Batopilas Mining	New York	1⅛	1	1⅛	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*34	*30	*33	May '20, K	0.03
Coniagas	Toronto	1 25	1.20	1.25	May '21, Q	0.12½
Crown Reserve	Toronto	*17½	*15½	*17½	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3½	3⅜	3⅜	Apr. '22, Q	0 12½
La Rose	Toronto	*33	*30	*31	Apr. '22,	0 10
McKinley-Dar.-Sav.	Toronto	*28½	*27	*28	Oct '20, Q	0 03
Mining Corp. Can.	Toronto	1.05	1.00	1.05	Sept '20, Q	0 12½
Nipissing	N. Y. Curb	6½	6¼	6⅜	Apr. '22, Q, X	0 30
Ontario Silver	New York	8½	7½	8½	Jan '19, Q	0.50
Ophir Silver	N. Y. Curb	.	.	*12	Jan. '12,	0 10
Temiskaming	Toronto	*35	*29	*30	Jan. '20, K	0 04
Trethewey	Toronto	*4	*3½	*3¼	Jan. '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*21	*19	*20	....	...
Cash Boy	N. Y. Curb	*7	*5	*7	....	.
Dolores Esperanza	N. Y. Curb	2⅜	2¼	2¼	....	
El Salvador	N. Y. Curb	*6	*5	*5		
Jim Butler	N. Y. Curb			*7	Aug. '18, SA	0 07
Jumbo Extension	N. Y. Curb	*6	*5	*5	June '16,	0 05
MacNamara M. & M.	N. Y. Curb	*8	*6	*8	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1 11/16	1⅝	1 13/16	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*82	*77	*79		
Tonopah Extension	N. Y. Curb	1⅞	1⅝	1 13/16	Apr. '22, Q	0 05
Tonopah Mining	N. Y. Curb	1⅞	1⅝	1⅞	Apr. '22, SA, X	0 07½
West End Consol.	N. Y. Curb	1 3/16	1 1/16	1⅛	June '22, SA	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*10	*10	*10	Jan. '21, M	0 01
Cardiff M. & M.	Salt Lake	†96	†*93	*94	Dec '20,	0 15
Chief Consol	Boston Curb	4 15/16	4¾	4 15/16	May '22, Q	0 05
Consol. M. & S.	Montreal	24	24	24	Oct '20, Q	0 62½
Daly Mining	Salt Lake	†2 30	†1 45		July '20, Q	0 10
Daly-West	Boston	2⅛	2⅛	2⅛	Dec. '20, Q	0 25
Eagle & Blue Bell	Boston Curb	3	3	3	Apr. '21, K	0 05
Electric Point	Spokane	8¼	*7	*7¼	May '20, SA	0 03
Federal M. & S.	New York	14½	14½	14½	Jan '09,	1 50
Federal M. & S. pfd.	New York	52½	50¾	50¾	Mar. '22, Q	1 00
Florence Silver	Spokane	*23	*23	*23	Apr. '19,	0 01½
Grand Central	Salt Lake	*60	*60	*60	Jan '21, K	0 01
Hecla Mining	N. Y. Curb	6½	6⅜	6½	Mar. '22, Q	0 15
Iron Blossom Con.	N. Y. Curb	*23	*22	*22	Apr '22, Q	0 02½
Judge M. & S.	Salt Lake	†2 50	†2 20	2 60	Sept. '20, Q	0 12½
Marsh Mines	N. Y. Curb	*32	*24	*28	June '21, I	0.02
Prince Consol	Salt Lake	*5½	*5½	*5½	Nov. '17,	0 02½
Rambler-Cariboo	Spokane	*7	*6	*6½	Feb '19,	0.01
Rex Consol	N. Y. Curb	*11	*10	*11		
South Hecla	Salt Lake	†*60	†*35		Sept. '19, K	0 15
Standard Silver-Ld.	N. Y. Curb	*21	*20	*20	Oct. '17,	0 05
Stewart Mines	N. Y. Curb	*10	*7	*9	Dec '15,	0 05
Tamarack-Custer	Spokane	2 74	2 45	2 47	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2 12½	2.07½	2 10	Dec '21, Q	0 05
Utah Apex	Boston	3¼	3	3⅛	Nov. '20, K	0.25
Wilbert Mining	N. Y. Curb		....	*2	Nov. '17,	0.01
VANADIUM						
Vanadium Corp.	New York	51⅞	49	50	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp	Montreal	56	56	56	Apr. '22, Q	1.50
Asbestos Corp. pfd.	Montreal			75½	Apr. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	26⅞	21⅛	26⅞	Nov. '19, Q	1.00
Texas Gulf	New York	51½	46½	50¾	Mar. '22, QX	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	66½	65¼	65½	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	98¼	98	98¼	June '22 Q	1 75
Am. Sm. Sec. pf. A.	New York	†94	†93	93	Apr. '22, Q	1.50
U. S. Sm. R. & M.	New York	45¼	44⅛	44⅛	Jan. '21, Q	0 50
U.S. Sm. R. & M. pf.	New York	46⅞	45⅞	4 ⅞	Apr. '22, Q	1.75

Current Prices of Mine Materials and Supplies

RISE AND FALL OF THE MARKET

Advances—Track bolts and spikes up 10c. per 100 lb. at Birmingham. Cast-iron pipe advanced $2 per ton in New York and throughout West. Lumber advancing $1 @ $5 per M. ft. over country. Red and white lead, dry and in oil, up 25c. per 100 lb. Manila rope higher in South.

Declines.—Substantial reductions in bolts and nuts. Linseed oil market headed downward; decline of 3c. in New York and 5c. per gal. in Chicago. Dynamite cheaper in Southern and Southwestern states.

SHEETS—Quotations are per 100 lb. in various cities from warehouse; also the base quotations from mill:

	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
Blue Annealed					
No. 10	$2 40	$3.62½	$3 38	$4 15	$3 48
Black					
No. 28	3 15	4 30	4 30	5.65	4 35
Galvanized					
No. 28	4 15	5 30	5 30	6 50	5 35

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots:

	Pittsburgh Current	Pittsburgh One Year Ago	Birmingham	Chicago
Standard bessemer rails	$40 00	$45 00		$40 00
Standard openhearth rails	40 00	47 00	$40 00	40 00

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh Current	Pittsburgh One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⁹⁄₁₆-in. and larger	$2 25	$3 30	$2 55	$3 00	$4 10	$3 23
Track bolts	3 00@3 50	4 35	3.65	4 25	5 10	4 15
Standard section angle bars	2 40	2 50	2 40	3 00	4.00	3 25

STRUCTURAL MATERIAL—Following are base prices f.o.b. mill, Pittsburgh and Birmingham together with quotations per 100 lb. from warehouses at places named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	1 60	$1.85	$2 58	$4 00	$2 57½	$2 48	$3 10
Channel, 3 to 15 in.	1 60	1 85	2 58	4 00	2 57½	2 48	3 10
Angles, 3 to 6 in., ¼ in. thick	1 60	1 85	2 58	4 00	2.57½	2 48	3 10
Tees, 3 in. and larger	1 60	1 85	2 58	4 00	2 57½	2 48	3 10
Plates	1 60	1 85	2 58	4 00	2 57½	2 48	3 10

WIRE ROPE—Discounts from list price, f.o.b. New York and east of Missouri River, on regular grades of bright and galvanized are as follows:

Hercules red strand, all constructions	30%
Cast steel round strand rope	32½%
Galvanized steel rigging and guy rope	17½%
Round strand iron and iron tiller	15%
Plow steel round strand rope	45%
Special steel round strand rope	40%

	New York	Cleveland	Chicago
Drill Rod (from list)	55@60%	55%	50%

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

	Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
BUTT WELD—	1 to 3	71	58½	¾ to 1½	44½	29½
LAP WELD—	2½ to 6	68	55½	2½ to 6	42½	29½

STEEL PIPE—From warehouses at the places named the following discounts for hold steel pipe:

	Black New York	Black Chicago	Black St. Louis
2½ to 6 in. lap welded	61%	59½%	56

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	New York Current	New York One Year Ago	Birmingham	Chicago	St. Louis	San Francisco
6 in. and over*	$48 80@49 80	$58 30	$34 50	$44 10	$39 70	$51 00

	New York	Cleveland	Chicago
Nuts, hot pressed, sq., per 100 lb. Off list	$3.25	$3 50	$4 00
Nuts, cold punched, sq., per 100 lb. Off list	3 25	3 50	4.00

MACHINE BOLTS	New York	Cleveland	Chicago
1⅜ and 1¼x3 in. up to 12 in.	60%	60-10-10	60-10%
Button head bolts, with hex. nuts	30%	$3 90 net	

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York Current on Trucks	New York One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory
4x12x12	$0.11120	$0.1196	$0 0707	$0 095	$0 0635	$0 108	
6x12x12	.16670	.1345	0973		08	156	
8x12x12	20840	.1794	.1326	175	12	244	$0 17890

LUMBER—Prices of rough Douglas Fir No. 1 common, in carload lots to dealers, in yards at San Francisco. To contractors, $2 per M. ft. additional.

	6-8 and 12 Ft.	10-16-18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$24.00	$24.00	$25.00	$30.00
3x6 and 8	25 00	25 00	26 00	31 00
4x4-6 and 8	25 00	26 00	27 00	32 00

LUMBER (continued)

[illegible] City, delivered from lighters or cars to job, $[illegible]

	New York 20 Ft. and Under	New York 22-24 Ft.	Chicago 20 Ft. and Under	Chicago 22-24 Ft.
3x4 to 8x8	$[illegible] 00	$[illegible] 00	$[illegible]	$41 00
3x10 to 10x10	41 00	42 00	4[illegible]	44 00
3x12 to 12x12	43 00	45 00	4[illegible]	47 00

Other Cities

	8x8 In. x 20 Ft. and Under Pine	Fir	Hemlock	Spruce	12x12 In. 20 Ft. and Under Pine	Fir
Boston	$50 00	$52 00	$55 00	$45 00	$54 00	$52 00
Cincinnati	39 00	50 00			45 00	64 00
Montreal	78 00	45 00	55 00	55 00	78 00	47 00
Denver	.....	35 75	35 75	35 75		36 75
Minneapolis	43 00	40 00	39 00		47 00	40 00
Kansas City	33 00	34 00			36 00	35 00
Birmingham	21.00	......	......	......	26.00	

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2 40@2 50	$3 15	$3 90	$5 00	$3 25	$4 95
Cut	2 25	5 80	5 90	7 75		5 00

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots *without bags*. Cash discount not deducted.

	Current	One Month Ago	One Year Ago
New York, del. by truck	$2.40@$2.50	$2 40	$2 80
Chicago, f.o.b.	1.97	1 97	2 17
Cleveland, f.o.b.	2.26	2.26	2.43

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel 180 lb. net Finishing	Lump, per Barrel 180 lb. net Common
New York	$15 80@$16 80	$12 50	$3.68	$2 75@$3 18
San Francisco	22.00	18.00	.....	1 75

LINSEED OIL—These prices are per gallon:

	New York Current	New York One Year Ago	Chicago Current	Chicago One Year Ago
Raw in barrel (5 bbl. lots)	$0 88	$0 80	$0 98	$0 75

WHITE AND RED LEAD—Base price in cents per pound:

	Red Current Dry	Red Current In Oil	Red 1 Year Ago Dry	Red 1 Year Ago In Oil	White Current Dry or In Oil	White Yr. Ago Dry or In Oil
100-lb. keg	12 50	14 00	13 00	14.50	12 50	13.00
25 and 50-lb. kegs	12.75	14 25	13 25	14.75	12 75	13 25

HOSE—

Fire	50-Ft. Lengths
Underwriters' 2½-in.	49½c per ft.

Air	First Grade	Second Grade
¾-in. per ft.	$0.24	$0 19½

Steam—Discounts from List

First grade......40-10% Second grade.....50-5% **Third grade**.....5-10-5%

RUBBER BELTING—The following discounts from list apply to transmission rubber and duck belting:

Competition 60-10-5% Best grade 60-5%

LEATHER BELTING—Present discounts from list in fair quantities:

Light Grade	Medium Grade	Heavy Grade
50%	40-5%	35

RAWHIDE LACING—

For cut, best grade, 50-10%, 2nd grade, 60%.
For laces in sides, best, 41c. per sq.ft.; 2nd, 39c.
Semi-tanned: cut, 50%; sides, 43c. per sq.ft.

PACKING—Prices per pound:

Rubber and duck for low-pressure steam, ½ in.	$0 90
Rubber sheet	.45
Rubber sheet: wire insertion	.70

MANILA ROPE—Per lb., ¾-in. and larger, 1,200-ft. coils.

Boston	$0 20	New Orleans	$0 17½
New York	17	Los Angeles	16½
Chicago	19	Seattle	18

COTTON WASTE—The following prices are in cents per pound:

	New York	Cleveland	Chicago
White	7 50@10 00	12 00	12 00
Mixed	5 50@9 00	9 00	9 00

EXPLOSIVES—Prices per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0 2950	$0 3250
Kansas City	24	2750
Denver	2250	.2550
Baltimore	.2550	.27
Cincinnati	.2350	.255
New Orleans	.2725	.3075
San Francisco	195	.23

FLOTATION OILS—All prices are f.o.b. New York unless otherwise stated, and are based on carload lots. The oils in 50-gal. bbls., gross weight 500 lb.

Pine oil, steam dist., sp.gr., 0.930-0.940	gal	$1 10
Pine oil, pure, dest. dist.	gal	95
Pine tar oil, ref., sp. gr. 1.025-1.035	gal	46
Pine tar oil, crude, sp. gr. 1.025-1.035 tank cars f.o.b. Jacksonville, Fla.	gal	35

NEW MACHINERY AND INVENTIONS

The Parker Flotation Machine

Claims Made Include Small Repair Cost. and Minimum Operative Power and Attention

IN THE MILL of the Bunker Hill & Sullivan Mining & Concentrating Co. at Kellogg, Idaho, and also in the [illegible] mill, owned by the Bunker Hill & Sullivan, the Parker flotation machine is accomplishing remarkable results. The machine is the invention of J. B. Parker, flotation metallurgist for the Bunker Hill & Sullivan company. Mr. Parker also developed the successful flotation treatment for the complex ores of the Star mine, recently purchased by the Bunker Hill and Hecla companies. Prior to his present connection, Mr. Parker was with the Callahan Zinc-Lead Co., where he solved the problem of recovery of both zinc and lead by selective flotation.

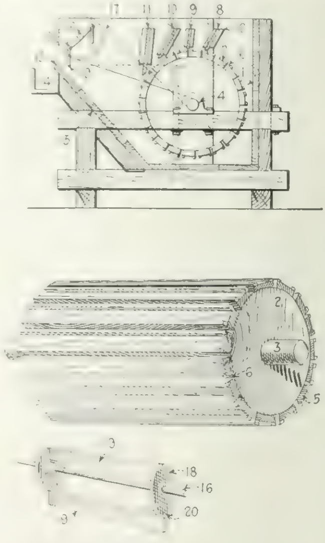
The Parker machine, for which patent is pending, is constructed of wood, driven by belt at a speed of 78 r.p.m., and requires 5 hp. for the standard 8-ft. machine, with pulp 35 per cent solids. The machine is especially adapted to selective flotation, and its low power consumption per ton, easy assemblage, and long wearing qualities make it a desirable unit for the small mill, and as it runs with the minimum attention (the only attention required is to oil once a shift), it should also be equally desirable for the large plant. The efficiency of the machine is amply shown in the following test, the results of which appear in the accompanying table. This test was run in the Bunker Hill & Sullivan concentrator. The feed was the combined classifier overflow and vanner tailing. The oil used was a mixture of 80 per cent Barrett No. 4 and 20 per cent steam-distilled pine. The only change made during the test was the per cent of solids in the feed. Samples were taken at regular intervals for eight hours.

RESULTS OF TEST OF PARKER FLOTATION MACHINE

[illegible]	Per Cent Solids	Recovery	Per Cent Lead in Concentrate	Per Cent Lead in Tailing
[illegible] 24	36.0	82.6	57.9	1.38
25	31.0	83.0	66.7	1.54
26	31.0	83.1	64.5	1.50
27	31.0	87.5	64.1	1.10
28	33.0	88.5	58.7	1.00
[illegible]	35.0	89.0	58.0	1.00
[illegible]	38.5	81.9	55.6	1.60
[illegible]	31.0	89.0	65.3	1.00
[illegible]	37.5	84.2	65.7	1.30
[illegible]	37.0	81.4	66.0	1.80
[illegible]	37.0	83.5	67.5	1.60
[illegible]	41.0	88.5	68.1	1.00
[illegible]	31.0	85.5	61.0	1.30
[illegible]	32.0	89.0	58.0	1.00
[illegible]	32.0	91.0	63.9	0.80
[illegible]	32.0	87.1	62.1	1.00
11	32.0	91.1	61.0	0.80

The work of the regular mill operations checks close with the results shown.

The body (1) is a rectangular-shaped box divided by an imaginary line into agitation and settling compartments. The rotor (2) revolves anti-clockwise at such speed that the greatest amount of pulp will cling to it. The pulp passes baffle boards (8 and 9) and will draw to itself an excess amount of air. The air not required for flotation is then expelled by baffles (10 and 11). After passing baffle 11, the pulp comes to rest in the settling compartment or spitzkasten, where flotation takes place. The froth in its travel from baffle (11) to lip (15) has opportunity to drop or release the entrained material which is to be rejected, and this material, after reaching the discharge end, is finally released by a weir, thus maintaining a constant pulp level in the machine. If conditions require froth to be removed mechanically, a scraper or froth remover (18) has been provided.



The Parker flotation machine

The froth remover consists of a shaft (16) to which an arm (20) is keyed, and from this arm scrapers (19) are suspended. The froth remover travels clockwise and the edges of the scrapers remove a definite amount of froth each time. The speed is so regulated that the froth will have time to replace material removed before another cut is made. Launder (14) conveys froth to another machine or bin. The rotor (2) is constructed by keying to the shaft or tube (3) four spiders. Riffles (5) are bolted to the spiders, and consist of strips 2 x 4 in. x 8 ft., on the edge of which are tacked strips ½ x 1 in. x 8 ft. These strips can be easily replaced if necessary.

The installation in the Bunker Hill mill consists of eight machines in two banks of four each, operated in series. The feed is split, half going to each bank. The first three machines make a finished concentrate. The fourth concentrate is in a closed circuit with a Dorr thickener, and returns as feed, and the fourth machine makes a finished tailing to waste. The machines are so placed that the tailing of the first travels by gravity as feed for the second, and so on.

Material to be floated is deposited with the required air on the surface of the pulp, thereby necessitating less oil to float a given amount of sulphides. This fact is important in selective flotation, and especially so where the separation depends upon the amount of oil used. Good aëration, with a close regulation of the same, is obtained. The repair expense is small, due, first, to the slow speed and small exposure to wear, and, second, to the fact that all repairs can be made without removing the rotor. Operation of the machine requires the minimum amount of horsepower per ton of solids, and, because of simplicity, it demands the minimum attention per ton of solids.

INDUSTRIAL NOTES

The Bucyrus Co., of South Milwaukee, Wis., has extensive enlargements to its plants at both South Milwaukee, Wis., and Evansville, Ind., under way.

The American Smelting & Refining Co. has purchased a 7-ft. diameter x 36-in. cylinder Hardinge conical ball mill for regrinding in El Paso unit. The same company, through its New York office, has purchased another 7-ft. diameter x 36-in. cylinder Hardinge conical ball mill for one of its plants in South America.

C. A. Coffin has retired as chairman of the General Electric Co., and is succeeded by Owen D. Young, long associated with the company as vice-president. Gerard Swope, president of the International General Electric Co., succeeds E. W. Rice, Jr., as president of the company. The latter will now devote his entire energies to the further upbuilding of the scientific, engineering, and technical phases of the company's work in the broadest sense, and will be honorary chairman of the board of directors. Anson W. Burchard, for many years vice-president, with particular reference to public utilities and foreign investment, was elected vice-chairman of the board. J. R. Lovejoy, vice-president in charge of sales, was elected a director, as was also G. F. Morrison, vice-president.

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Special Consulting Editors

Volume 113 New York, June 17, 1922 *Number* 24

A Silver Export Association

WHAT WILL HAPPEN to the price which will be paid American producers of silver after the expiration of the effectiveness of the Pittman Act (which will occur in two years or less) is a problem which is naturally engaging the attention of American miners. Since the principal market for the world's silver lies in Asia—in China and India chiefly—it is suggested by H. N. Lawrie, managing director of the American Gold and Silver Institute, that a Silver Export Association be formed, under the provisions of the Webb Act, to market silver in foreign countries. It would seem as if this suggestion were worthy of serious consideration by our silver producers.

At present the central silver market of the world is in London, although the United States and Mexico together produce 70 per cent of the world's silver. But, due to England's suzerainty of India, and her dominating trade position in China, it follows naturally that commercial, financial, and fiscal transactions center in London; hence, as has often been pointed out, the difficulty or inadvisability of transferring the silver open market from London to New York. But the idea of a Silver Export Association works well with existing conditions; and should prove of substantial benefit in securing higher prices for silver in the world market, and in avoiding the great depression and inflations of the silver quotations—smoothing out, in respect to silver, those high and low points of prosperity which constitute the "business cycle," whose extremes could well be minimized for general prosperity, as Mr. Hoover has recently pointed out.

Specific Gravity Sampling

THE SUBJECT OF SAMPLING and estimating ore in a mine is an important one, to which many contributions have been made, and which continues to be a perennial topic for discussion. The mechanical methods of cutting, grinding, and quartering, and thus obtaining a fair average sample, are well understood, though usually not practiced with sufficient care. Before this in importance, however, comes the knowledge of how to place the cuts—how long and in what direction and how far spaced. Great accuracy of observation, a true perception of the form and probable extent of the orebody, is a prime requisite to an accurate sampler. Thus, sampling lies essentially in the province of the expert and experienced mine geologist, of the type which has been developed in recent years, who combines with the knowledge of his special field familiarity with careful engineering methods.

Of first importance, then, is the placing and length of cuts; and an intelligent perception of what each cut means. This will not only enable accurate sampling, but will save waste. A great deal of country rock is uselessly sampled by unintelligent routine methods; or, frequently, cuts are made partly in ore and partly in country rock and so are of no value and even vitiate the results.

Next comes the accuracy of the sampling and the quartering—a mechanical requirement, most often observed.

Third comes the assaying, usually not sufficiently checked up. Samples are bound to be occasionally uneven; assayers are bound to be occasionally careless. The only safe system, where an important enterprise hinges on the result, is a triplicate of each sample, part to be assayed by a different assayer, under a system of secret numbering which will avoid comparison among the assayers. In the not uncommon case of a wide divergence, the agreement of two will commonly point out the third, who has made an error; and in nine cases out of ten a reassay will check this conclusion.

Finally comes the estimation of tonnage. Tonnage resolves itself into two factors—cubic contents and specific gravity. In the estimation of the former an accurate and shrewd geological knowledge is absolutely indispensable, since in all cases, practically, invisible ore must be estimated, even in the "ore in sight"; and when it comes to less fully developed ore, the best possible comprehension of its probable attitude and extent is everything.

As to the other factor—specific gravity—it is astonishing that it is so easily determined, so generally guessed at. Quartz measures thirteen cubic feet to the ton; and engineers are prone to assume that as a base. But as quartz becomes mixed with carbonates, fluorite, barite, or sulphides, or other ore-minerals, or as it decreases or almost disappears, it is evident that this is no more accurate a base than would be the volume of galena to the ton; that is to say, that it is totally unsuitable. Numerous specific-gravity measurements of large blocks of ore, systematically conducted, just as in chemical sampling, are essential to any ore-estimation that is to be dignified by the name of engineering. Weighing these blocks, first in air, and then in water, makes possible swift and accurate specific-gravity determinations, which are to be averaged algebraically (that is, by the weighted method), in proportion to the volume represented by each.

It is quite certain that if sampling were more scientifically conducted, we should have fewer discordances between engineers' estimates and the results of mining; and we would have a less glaring lack of unanimity between the results of the examination of the same mine, by different engineers, than at present.

The Wonderful Pauling Process

DURING THE DOG DAYS of last summer we received a bulletin from the U. S. Department of Commerce describing a recent invention of a German chemist, Harry Pauling, for the extracting of metals from ores, which seemed so preposterous in its claims that, on the basis of the published information, [illegible] the whole idea. Our opinion was given in a previous editorial published in the *Engineering and Mining Journal* of July 16, 1921. We find, however, that the claims of Herr Pauling really attracted considerable attention in this country; so much so that many samples of ore were forwarded to the German headquarters, and one company actually went so far as to send four representatives to Germany to investigate the process and to secure an American license for its use if it lived up to its promises. Now these investigators have returned with the sad story, and the metallurgical equipment of a well-known Nevada mining company will not be scrapped after all.

As is usual in developments of this kind, the original prospectus was strong on claims, but the wonderful secrets were not to be divulged until some future time when business relations had been completed. More weight than usual was given to the inventor's statements, because he was a chemist of some note, and his work was attested to by Professor Rheichenstein, also a scientist of reputation.

The sample of concentrate which the investigators carried with them contained about 30 per cent of iron, 32 per cent of sulphur, 3 per cent of copper, 22 per cent of "insoluble," 4 oz. of gold, and 3 oz. of silver. According to the prospectus, every metal present could be easily and simply recovered by solution methods, in an absolutely pure form.

When it came time for a show-down, a small quantity of the concentrate was treated with concentrated nitric acid until the sulphides were completely oxidized and the concentrate was disintegrated. Each metal was then precipitated by well-known methods of qualitative analysis. The investigators inquired what the relation was between this procedure and the Pauling process, and were somewhat amazed when told that that *was* the Pauling process. The nitric acid used is partly recovered. Considerable stress is also placed on the reaction of ferric nitrate and copper sulphide, the copper being recovered as a nitrate, the iron precipitated as a hydrate, and the sulphur as pure sulphur.

In short, the process embraced no reactions which are not thoroughly understood by every able metallurgical chemist. To decompose and neutralize the gangue in most ores would require enormous consumption of nitric acid; the handling of the acid itself would be a big problem; the market for the byproducts would be narrow or non-existent in most instances; and grinding and concentration would not be eliminated, nor would the final melting down of the bullion. It is probable that not one ore on this continent could be more economically treated by this process than by some other.

The best that can be said for the promoters of this fiasco is that they were thought to be honest, and that had they been men of more metallurgical experience they would probably not have put forth the claims that they did.

Also, the process would have more prospects of success in Germany than elsewhere, owing to the labor and nitric acid being cheap and metals being scarce. Furthermore, the process has given some prospect of commercial success in a small plant at Velten for producing copper sulphate from brass scrap, under German conditions of supply and demand.

It is greatly to the credit of E. A. Richter, of Berlin and New York, who was an intermediary between the German promoters and certain mining interests in this country, that the facts about the economic application of this process are now made public. We believe that Mr. Richter followed his honest convictions and that the process was really thought, by himself and other responsible people, to be worthy of investigation. It would be to the public interest if all investigations which turn out negatively could receive equal publicity.

So now we can go back to our knitting, casting our eyes up occasionally to more or less important rumors from Denver and points West.

Boosting Brass and Copper

THE ADVERTISING CAMPAIGN of the Copper & Brass Research Association will serve a useful educative purpose. The arguments given and illustrated appeal strongly to those who are interested in building operations and who consider the permanence of such work. There is no doubt that this is an important field for expansion, but we would suggest that efforts should be made to absorb some of the spending money of the average citizen. The public should be made to see that copper is a metal of great utility and low cost, suitable for many articles beside shingles and guttering. If the campaign for the popularization of the red metal is to go "over the top," it should be recognized that the average citizen's interest must be stimulated.

Some months ago we were told, particularly those of us in Western states, to "buy something made of copper"; but the advice was impracticable. No more beautiful metal is known. Either the raw metal or the alloy, brass, is suitable for the manufacture of a thousand and one articles of ornament and utility that are in continuous demand, the extensive sale of which would absorb much copper. This, however, would be of insignificant import to the copper industry compared with the educative results that would follow a nation-wide familiarization with the metal. However, as before mentioned, the average citizen is helpless. There is little or no demand for articles made of copper and brass, because of the absurd prices asked by the retailer—prices that are maintained because there is no demand. Thus it is that a closed circuit of inactivity is being maintained caused by the apathy of the producers and the gullibility of the producers and buyers.

A recent experience may be cited: The largest store in one of the principal cities of the United States was combed for a plain desk set with all-metal accessories for home use. The prices were ludicrous. The climax was reached when $4.50 was asked for a small brass postage-stamp box, weighing a few ounces. It was suggested to the salesman that the article in question be put away in a safe, whereupon he attempted to justify the price by remarking that it was pure brass! After an experience or two such as this the citizen of average means is disgusted with the buy-something-made-of-copper campaign and disheartened at the results of his efforts to do his share to relieve a stagnant market.

Retailers are educating the public to believe that copper and brass should be classed among the precious metals. It is time to combat this stupid policy with a vigorous corrective. The Copper & Brass Research Association might well issue to the public a plain statement as to the present market prices of the base metals in which they are interested. An advertisement to the following effect would do much to stimulate buying and discontinue profiteering: "Copper is selling for about 14c. per pound; zinc, about 6c. per pound. Brass is an alloy of the two. Cost of articles made of either should include only a reasonable charge for fabrication and marketing." A knowledge of the facts on the part of the buying public would make the retailers and those behind them "sit up and take notice." The ultimate result would be beneficial to the mining industry, to the public, and to the retailer, for a market would be fostered for the goods and a steady demand would result.

Preparing Ore for Cyanide Treatment

THE NEED for the destruction of cyanicides as a preliminary to the chemical treatment of a gold or silver ore has been disregarded in many up-to-date plants. Too much attention has been paid to the ease with which the precious metals may be dissolved in the milling circuit, and too little to the cost of the operation and the difficulty of ultimate recovery. The instability of the solvent is such that it would appear obvious that every precaution should be taken to see that chemical conditions are as nearly ideal as possible, for generally they are easily controllable. A recognition of the beneficial effects of a preliminary treatment with alkali has recently made possible the extension of cyaniding operations on the Comstock, with satisfactory metallurgic and economic results.

An interesting sidelight on such preliminary treatment is seen in the change of practice at what is known as the high-grade mill of the Nipissing company. The mixture of concentrate, custom ore, and byproducts, averaging about 100 oz. silver per ton, was formerly ground in a tube mill with water and bleaching powder, as a preliminary to cyanide treatment. This procedure is now replaced by one in which the material is first ground and then agitated in a 3 per cent solution of sulphuric acid. The bulk of the liquor containing the removed cyanicides is then displaced by water, the acid left after this treatment being neutralized with lime. The saving in cyanide amounts to about 25 lb. per ton of material treated.

Scope for so radical a reduction in the consumption of solvent exists in few if any other plants in which cyanidation is being practiced; but it has been proved in many instances in which ordinary practice is being followed that the efficient preliminary wet treatment of a gold or silver ore is usually an important factor in reducing the subsequent cost of chemico-metallurgical operations. It also facilitates the recovery of a maximum amount of gold and silver.

Industrial Fatigue

INDUSTRIAL FATIGUE, according to the popular idea, may be defined as the enervation that results from repetitive manual labor. Like many other catch phrases of recent birth, it is difficult to analyze, for there is no reason why such enervation might not spring from mental as well as from physical effort. However, despite the difficulty of analyzing or limiting the application of the term, it is evident that fatigue must be considered as an important factor in industrial life; the subject is one that merits discussion.

Present-day activity is on an intensive scale, for we aim at a high standard of excellence and efficiency. Anything that stands in the way of the attainment of an ideal should be subjected to criticism. Industrial fatigue, using the term in its broadest sense, is common; that much must be admitted. This is evidenced, first, by carelessness and accidents, and an excessive labor turnover afterward. The problem is not so insistent in connection with mining and metallurgy as it is in many other industries, for although much of the work done is of repetitive nature, there is usually a variety of interest involved that prevents boredom and obviates lassitude. However, the future must be considered as well as the present, and on looking forward one is bound to realize that successful co-operation may be the salvation of the mineral industries. Such co-operation is seen already in important consolidations between companies interested only in the mining and production of metals with those concerned with their fabrication. Co-operative effort such as this will involve an added responsibility in connection with an increase in repetitive labor, much of which, it may be anticipated with assurance, will be performed by machine. Some, however, must involve personal attention; hence the need for consideration of the subject.

The division of each twenty-four hours into three shifts of eight hours apiece was the first logical step toward the mitigation of industrial fatigue. Soon after the war broke out in Europe the American embassy in London was besieged with applicants for advice and relief. The result was chaos—and industrial fatigue. It was Hoover who took the common-sense attitude; for he divided the working day into three shifts of eight hours each, and so the problem was solved without fuss. Many of the older members of the mining profession remember when the twelve-hour shift was customary.

Next to the establishment of a rational period for recreation and rest comes the necessity of seeing that the conditions of work are as varied as possible. This is practicable in most instances in which the eight-hour shift is in vogue. Statistics show that the work of men who "change and change about" is as efficient as that of those who work only on the day shift. A regular change in regard to the hours of work is a preventive of industrial fatigue; it permits time and opportunity for recreation and leisure and for indulgence in hobbies; and this draws attention to a question of national as well as of individual importance.

What does the average worker do with his spare time, whether he be laborer, artisan, or salaried official? It is a pity that so few employers take an interest in their men in this respect, for the choice of a hobby on the part of the worker is often indicative of character and efficiency and a desire to excell. Such a change of occupation may prevent the industrial fatigue that is aggravated by idleness and self-commiseration.

Few workers whose tasks occupy but eight hours per day should complain of industrial fatigue. The mechanization of labor is not altogether undesirable, for the monotony of motion involved is often unconscious; it is unlike the monotony of repetitive mental reasoning, which is far more tiring.

Modern industrial conditions are favorable to the worker. His attitude depends almost entirely on what he does in his spare time. So long as libraries are empty of readers, so long as ideas and impressions remain unrecorded and unpublished, so long as gardens remain uncared for, few other than the overworked multibillionaire should complain of industrial fatigue.

A Shear-Zone and Sheer Nonsense

By T. A. Rickard

A FRIEND at Hyder, in Alaska, has sent me a page of the 'Sitka Sun' containing sundry geologic and economic definitions that ought to be interesting to those engaged in the gainful pursuit of mining. The Alaskan scribe spells it "sheer zone", and thinks apparently that it is a zone that is plumb or perpendicular, for that is the meaning of 'sheer' in such a context. The technical term with which he is struggling is 'shear-zone', a zone of rock that has been sheared or cut, and therefore crushed or brecciated. Such a portion of the earth's crust is supposed to be favorable to the presence of ore because the loose texture and fracturing of the rock offer facilities for the circulation of mineral solutions. The editor at Sitka says: "A sheer zone is a mineral deposit, contained in a slate or mineral belt". Thus it is said to be a mineral deposit in a mineral belt, which is confusing. On the other hand, slate is not the only rock capable of being sheared, for such a geologic structure is not limited to any kind of formation, although naturally it is more likely to be developed in a fissile rock than in one that is crystalline, such as granite. "A mineral belt", says our authority in the North, "can be, as in the Sitka mining district, 20 miles in width and 150 miles in extent of slate and diorite". So, it appears, diorite also can be subject to the same structural change. Probably he is thinking that the fissile slate is particularly likely to be sheared near its contact with the diorite. That is correct; because the intrusion of an eruptive may produce a line of weakness along which movement is probable. Next we are told that "a sheer zone can appear every few feet and it is not necessary that every sheer zone should pay". Which being interpreted means that conditions favorable to the deposition of ore do not always connote the existence of ore, because other factors besides kindly structural relations are needed to produce an ore deposit, and of these the chief is the passage or circulation of solutions sufficiently rich to precipitate ore and the presence of a precipitant that will induce the localization of valuable mineral.

Let us proceed to the next statement: "There are several different kinds of sheer zones, one of which is termed a true sheer zone, that can be traced for long distances, sometimes 40 miles or a great deal less". To this we venture to add the remark that there are several kinds of nonsense, some of which are harmful. The use of "true" in this attempted definition is a survival from the days when "true" fissure-veins were supposed to be superior in richness to other lodes. It is true that a shear-zone is traceable for some distance, for one of its characteristics is continuity, which involves the idea of recognizable width and measurable length. 'Zone' comes from a Greek word meaning 'girdle'; likewise 'belt' means a cincture, something that goes around something, such as the encircling strip of leather worn round the waist. This zonal idea is not implicit in geology, for the 'zone' or 'belt' to which the miner refers in his description of ore deposits is a strip or definite width of rock of vertical extent marked by certain characteristics.

Obviously to say that a shear-zone can be "40 miles or a great deal less" means that it can be of almost any length; however, the idea of length and of narrowness in proportion to the length is implicit. A portion of rock one mile long by one mile wide would not be a zone; the width must be so much less than the length as to suggest the essential idea of a strip or comparatively narrow piece.

The writer says: "A false sheer zone has no extent, at times they run adjacent to a true sheer zone, starting at the true sheer zone, and running at an angle of 45 degrees with little or no extent. At times a false zone will run a mile". We suggest that, not being what it is supposed to be, it may run clear off the map. If "they run adjacent at an angle of 45°" and have "no extent", they must be phenomenal, which describes an appearance that one does not understand. They remind me of the proverb that asserts there may be such things as volant nonruminating artiodactyles but at the same time declares them to be very unlikely birds. "In some cases pay is found running very high in value, but as we mentioned, never to any extent". So he who runs may read; the pay and the zone both run, a mile or less—what does it matter? The pay does not run "to any extent". This is discouraging. Moreover, it is a libel on shear-zones, which have been known to constitute lodes of unusual extent, for instance, not far from Juneau—a mining centre with which the Sitka gentleman ought to be familiar, for it has superseded his own town as the capital of Alaska. Finally, we are informed that "a sheer zone is truly a filling in of a crevice in rock caused by the centrifugal motion of the earth and other causes". The comprehensiveness of the last phrase is worthy of the by-laws of a corporation; apparently it includes the explanation that is conspicuously absent in this pseudo-scientific rigmarole. The Alaskan writer, like his "false sheer zone", has "run a mile" from his facts, and now transforms a crushed area into a crevice that has been filled by a force of which he has no evidence save the prompting of his own lively imagination. Indeed, his geology reminds me of the Kingdom of Heaven, of which it is said that it came not by observation.

Shear-zones deserve considerate treatment, for they are among the most productive of lode-structures. Usually the movement that has made them is distributed over a multiplicity of small slips rather than any one easily distinguishable fault. A good type of such ore deposits is the multiple gold-quartz vein in the schist of Otago, in New Zealand; another is the sheeted phonolite of Cripple Creek, where rich lodes were formed by the precipitation of tellurides of the precious metals along systems of minute fractures in dikes that had undergone mechanical strain, and along their contact with the older rocks. Such zones of shearing are usually marked by mineralogical changes; for example, massive diabase will become hornblende-schist. Metamorphic minerals, such as garnet, are developed. In the diorite of the Treadwell lode, for instance, enrichment coincides with the replacement of the ferromagnesian silicates by gold-bearing pyrite, accompanied by albite and calcite. In short, a shear-zone, especially if associated with an intrusive igneous rock, is a likely place for ore.

DISCUSSION

The Problem of Depletion

Discussion Between Senators Underwood, Smoot and McCumber Shows Careful Distinction Between Cost and Value as Applied to Revenue Act of 1921

THE EDITOR:

Sir—In your issue of April 22 appeared a discussion of "The Problem of Depletion," by C. B. Holmes, in which an essential feature was the criticism of an allowance of depletion based on *value* of property on March 1, 1913 (in case of property acquired prior to that date) instead of adhering to a uniform basis of *cost*.

The communication voices an erroneous assumption that the use of the term "value" as of March 1, 1913, was a Congressional error in drafting the law, when what Congress really intended to say was not "value" but was "cost." The fact is that the use of the terms "cost" and "value" in the law is not due to any error or misconception of the terms, but represents a careful distinction, deliberately made. It is the same distinction which applies to the determination of gain or loss on all kinds of property. The basis of this distinction is clearly set forth in a discussion between Senators Underwood, Smoot, and McCumber, with reference to the proposed provisions of the Revenue Act of 1921, as reported on pages 6517 and 6518 of the *Congressional Record* for Sept. 28, 1921, in which the pertinent parts are as follows:

"Mr. Underwood. . . . When the original income tax law was passed, the question was raised as to where capital should stop and where accumulated dividends or profits should begin. In the original drafting of the first income tax after the passage of the constitutional amendment the original draft did not prescribe the time when accumulated capital should be fixed. It was an oversight, and when the matter was called to the attention of the Ways and Means Committee they went into further hearings and consideration of it and finally worked out this proposition, that the income-tax amendment to the Constitution became effective on the twenty-eighth day of February, 1913; that regardless of what academic views we may have entertained as to the right to levy an income tax before that time, the Supreme Court had declared an income-tax law unconstitutional, and therefore, no matter what our academic views might be, under the law for the Federal Government to levy taxes on incomes before that date was a violation of the Constitution and it could not be done.

"Therefore the committee which drafted the first bill adopted the first day of March, 1913, as the beginning of the time when incomes or profits could be treated as such for the purpose of taxation, holding that before that time the accumulated profits and dividends were treated as the body of the estate, as principal. I think that conclusion was correct. I think it was correct from a legal standpoint, because prior to that time you did not have a right to reach back and tax the income unless you divided it in proportion to population.

"Mr. Smoot. There is no change in that.

. . . .

"Mr. Underwood. . . . but if it is the intention of the committee, either as to accumulated dividends of corporations or as to the growth of the value of property, when it is distributed either through the means of the stockholder or the corporation itself, to reach back to levy a tax on accumulations which occurred before the first day of March, 1913, I think you are writing an unconstitutional bill.

. . . .

"Mr. McCumber. . . . The committee agree entirely with the Senator that all accumulations prior to March 1, 1913, become a part of the principal, a part of the invested capital, of the corporation, and there is no intention to take those profits which had accumulated at that time and bring them forward and levy a tax upon them as profits; but if the Senator had owned a piece of land which he had bought in 1910, and he sold it in 1920, while we do not tax him on the difference between the 1910 price and the 1920 price for which he sold the property, we do tax him on the profit, measuring the 1920 sale price with the March 1, 1913, value. That measures his profits.

"Mr. Underwood. If that is all the bill does, I have no complaint; but I am not sure that that is all it does.

"Mr. McCumber. Let me carry it further. If, instead of purchasing a tract of land, the Senator had purchased stock in a corporation in 1910, and there were accumulations up to March 1, 1913, then whatever the property was worth in 1913 became, as the Senator has suggested, his capital; it belonged to him. If he sold that property in 1920, or disposed of any part of it, he was therefore disposing of a part of his capital, because it was treated as capital, and if he made a profit over and above what that part of the capital was worth on March 1, 1913, when he sold it in 1920, we simply tax the profits of the sale; not levying a tax on profits, but a tax upon the sale of his capital, of the thing itself, not of the profits arising from the thing. That is what is intended. I do not know that I agree even with that as a good policy, but that is really the only point that is involved, I think, in the amendment.

"Mr. Underwood. Let me ask the Senator another question, because I want to understand this matter. From his statement I understand him to say that the bill as reported by the committee does not tax any of the accumulated profits which were embraced as capital before March 1, 1913, in any event. Is that true?

"Mr. McCumber. No; it taxes simply the profit on a man's holdings, and that which he had accumulated prior to 1913 is a part of his holdings, a part of his capital. It is worth so much. If he does not sell it, of course there is no profit, and it cannot be taxed; but if he sells it in 1920, the difference between the 1913 price and the 1920 price, if there is a profit, is made taxable, as it is a sale of the corpus itself.

"Mr. Underwood. . . . I do hope, however, that if the Senator's committee mean what he says they mean, and what their report says they mean, they will put a proviso in those paragraphs distinctly saying that these paragraphs shall not be construed to tax accumulations or profits accruing prior to the first of March, 1913. If he will say that, that will end it.

. . . .

"Mr. McCumber. There is no doubt it should be made clear, if it is not clear now.

. . . .

"Mr. Underwood. As a matter of fact, a number of years ago we agreed in conference on this proposition. I think it will prevent future lawsuits and future differences if the Finance Committee will propose a simple amendment, declaring that nothing in this act shall be construed as warranting a construction that the bill taxes accumulated profits or dividends accruing prior to the first day of March, 1913."

During all this discussion the only question raised was as to whether the wording of the law made entirely clear what all the Senators agreed was its intention.

All the above reproduced discussion relates to the general proposition of the basis to be used in determination of taxable gain in the case of property owned prior to March 1, 1913. Manifestly, there was no Congressional error involved in drafting the depletion section of the law, so that in the case of properties acquired prior to March 1, 1913, the value of the property at that date (rather than its cost) would be used.

Perhaps in some cases this does introduce a further complication, but my own experience is that it is far less difficult to determine the fair value of the property as of March 1, 1913, than it is to go back perhaps twenty to fifty years to determine what was the cost of the mining property at the date it was acquired. I believe the Revenue Department officials would agree that they had more difficulty in determining the cost of property to be used for purposes of invested capital than they had in determining the fair value of the property on March 1, 1913, to be used for depletion.

In a further communication, in your issue of May 27, regarding "Inconsistencies in Mine Depletion Acts," Mr. Holmes again assumes that Congress has not been successful in enacting into law what it intended should be the basis for depletion. A review of the depletion provisions as they appear in the revenue acts of 1916, of 1918, and of 1921 (as they were enacted; not as they are paraphrased by Mr. Holmes) will show that they are all intended to reflect the mature, deliberate conclusion of Congress, as set forth in the discussion quoted above; viz., that, in the case of property acquired prior to March, 1913, the *value* of the property at that date, rather than its *cost*, should be the basis for determination of taxable gain. H. B. FERNALD.

New York.

Using the Katathermometer in Mines*

In connection with the co-operative metal-mine dust and ventilation investigations of the U. S. Bureau of Mines and the U. S. Public Health Service, some underground data have been obtained with intent to ascertain the adaptability of the katathermometer for determining the comfort of working places in mines. This preliminary study indicates that the instrument will probably be useful for making routine determinations of comfort conditions in the mines of the country, and that it may also prove an important accessory for investigative work on problems in ventilation and kindred subjects, in both coal and metal mines, although the instrument should probably be altered somewhat for maximum utility under the varied conditions in the mines of the United States.

The katathermometer is an instrument contrived by Dr. Leonard Hill, an eminent English physiologist, and its various features have been fully described by him in his book entitled "The Science of Ventilation and Open Air Treatment." He made exhaustive experiments, and concluded that the rate of cooling of the human body was the controlling factor in determining comfort or discomfort, and then set out to make an instrument that would measure this rate of cooling. The resulting instrument, the katathermometer, measures its own rate of cooling when its temperature approximates that of the human body.

Metallurgical Progress on the Rand

The New State Areas Plant

The new plant of the New State Areas Co. on the Witwatersrand embodies ideas quite different from standard practice in that part of the world. It will crush ore without the employment of gravity stamps and without amalgamation. Construction began in January. From the *South African Mining and Engineering Journal* we gather the following details of operation:

The plant will have a capacity of 50,000 tons per month, and all sliming of the ore will be effected by means of a combination of crushers and tube mills. Gravity stamps and amalgamation plates will be entirely eliminated, and it is expected that there will be not only a large saving in capital expenditure, but that working costs will be substantially reduced and the value of the ultimate residues will be certainly no higher than is the value of residues that are produced in the older plants.

The ore from the feed bins will pass into a large receiving bin capable of holding 1,300 long tons. From there the ore will be transported and sorted on three sorting belts to the crushers. There will be three sets of crushers, of which two will be in operation and one will be in reserve. In the primary set, Hadfield's jaw crushers will reduce the ore to 2½-in. cubes. In the secondary set, there will be horizontal disk crushers, which will reduce the rock passing through it to a maximum size of 1 in.

The whole of the crusher plant of the New State Areas equipment is being supplied by Hadfield's, Ltd. From the secondary crushers a main conveyor will then take the rock to the tube-mill bins. There will be thirteen tube mills, each 6½ x 20 ft. The standard size of tube mills on the Rand is 5½ x 22 ft., so that the New State Areas mills will be substantially larger than others on the Reef. Each tube mill will have a Dorr classifier and each will be operated by a 250-hp. motor.

The pulp from the tube mills will be pumped by 8-in. main slime pumps to the slime collectors. Ore will enter the water circuit in the crushers, and as soon as the pulp reaches the tube mills it will come into the cyanide circuit and will be ground in a cyanide solution. The slime collectors will be of a new type. They will be square concrete tanks. Eight of these tanks are to be erected. The overflow from them will go to three tanks of the same type. The slimes will pass on to the Brown agitator tanks, which are specially constructed for the purpose.

Instead of the standard type of Brown tank, which is 15 x 45 ft., the agitator tanks at the New State Areas will be 22 x 45 ft., thus giving double capacity in one tank. The slime from the Brown tanks will next pass to a pulp storage tank and from there will gravitate to a Butters filter plant of 600 leaves. The solution from the Butters filter will pass through classifiers in the usual way to a de-aëration plant and from this to the Merrill zinc-dust precipitation presses, the solution thereafter being returned to a large capacity storage tank.

The plant will have an initial capacity of 600,000 tons per annum, but will be capable of considerable expansion and can be duplicated for a comparatively small outlay.

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*[illegible] from Serial 2355, U. S. Bureau of Mines Reports [illegible]

The Mayo District in Yukon Territory

Three Strong Companies Now Operating in New Silver-Lead Region—Development Confined to Keno Hill Area—Mineralization Found Over Sixty-Mile Stretch—Field Remote and Means of Communication Uncertain

By Charles Francis Williams

Photographs by courtesy of Keno Hill, Ltd.

RAPID IMPOVERISHMENT of known gold placer deposits in the Yukon River basin has spurred the "quartz" prospectors in the North to greater effort, and several notable discoveries have been made. The finding of veins containing argentiferous galena on Keno Hill, in the Mayo district, in 1919, is probably the most important discovery made in the territory in recent years, and extensive prospecting by organized companies and private claim owners has since uncovered shipping ore in quantity at widely scattered points in the district.

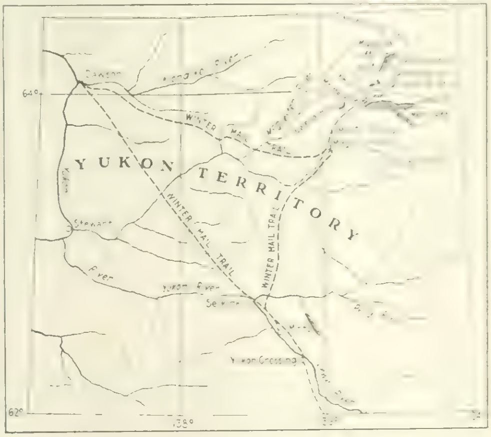
The Mayo district lies 125 miles due east of the town of Dawson between the headwaters of the McQuesten and Stewart rivers and 180 miles from the mouth of the latter. The Stewart River, together with the Yukon, forms the main artery of transportation during the summer months. Winter mail trails are maintained by the Canadian government. These connect the camp with Dawson and with the Overland trail at Minto, on the Yukon.

Mining Done in Winter, Prospecting and Development in Summer

Underground development and surface prospecting has, in the past, been carried on during the short summer season. The greater part of the ore is mined during the winter, from Nov. 1 to April 15, when the forty-two miles of road from the mines to Mayo Landing on the Stewart River are in condition for heavy sled traffic. The sacked ore is skidded down to Keno City at the foot of the hill in rawhides, and transferred to heavy sleds of ten tons' capacity for transportation to Mayo Landing, where the ore is stacked on the river bank. When the ice goes out, late in May, 500-ton barges carry the ore down to the Yukon, where it is reloaded on barges of 5,000 tons' capacity for St. Michael, at the mouth. Here it is transshipped in ocean bottoms destined for smelters on the west coast, a total distance of about 5,000 miles, at a cost of about $25 a ton for water transportation.

Freight on beach at Mayo Landing, brought on first boat from Dawson, May 30, 1921. Front Street in background

Ore and supplies are hauled over the road from the river to the mines at a contract price of about $30 a ton during the winter. The total cost of mining, transportation, and smelting is said to be under $100 a ton. One company is figuring on tractor haulage for next year, and railway transportation is under consideration. It is not improbable that a narrow-gage road will be built connecting the camp with the White Pass and Yukon Route at White Horse, or with a point on the Stewart River near Mayo Landing.



Map of Mayo district, Yukon Territory

Silver Discovered Over Sixty-Mile Stretch

The Mayo district lies fifty miles south of the height of land in the Yukon plateau area which has an average inter-stream elevation of about 5,500 ft. The plateau is composed largely of Pre-Cambrian schists and quartzites, deeply eroded by streams and rounded by glaciation.

Limited prospecting has uncovered silver ores on six isolated hills trending in a northeasterly direction from Mayo Landing—namely, Mount Haldane, Galena Hill, Keno Hill, Stand-To Mountain, Rambler Hill, and Mount Cameron—a distance of about sixty miles. This region is dissected by a number of lake-fed streams, but these are, with possibly one exception, unfavorable for hydro-electric power development.

Keno Hill, because of the extensive development and proved value of its ore deposits, will be described in greater detail, though further prospecting will probalso uncover important orebodies elsewhere in the district. This hill has an elevation of 6,346 ft. Its three-mile crest is broken by five peaks known as Keno, [illegible], Monument, Caribou, and Beauvette hills. The timber line conforms fairly close to the 5,000-ft. contour, and a considerable share of the properties undergoing extensive development lie above this line. Water is scarce on the summit during the summer, but may be hauled from springs just below the timber line. During the winter, snow water is used for domestic purposes. The northern face of the hill is precipitous, and has a stepped appearance, due to the outcropping of alternate hard and soft formations. Seven gulches drain the hill into tributaries of the Ladue and Stewart rivers. These gulches are, as a general rule, surficial expressions of fissures.

7,000 FT. OF SEDIMENTS EXPOSED ON KENO HILL

The country rock of the area is everywhere mantled by glacial drift, slide rock, and frost-shattered outcrops, held in place by ice and moss, and making it difficult to prospect. Fortunately, the galena and manganese float does not travel far, and often is found turned up by wagon wheels or under an uprooted tree stump. More than 7,000 stratigraphic feet of metamorphosed sediments are exposed on Keno Hill. The beds consist of banded blue and white gneissoid quartzites and schists. The schists are differentiated by predominance of mica, quartz, graphite, sericite, or hornblende. These beds strike in a general east and west direction and dip to the south at a decreasing angle of under 30 deg., but tilt abruptly near the crest forming the peaks. The basement is believed to be a granite batholith, from which dikes and sills and laccoliths of andesite, diorite, diabase and, occasionally, a felsitic rock grading from a rhyolite to a granite porphyry, have been intruded into the sediments. The diorite and diabase are largely altered to greenstone, which is intruded into the lower schist formations as sills and into the upper strata as laccoliths.

The basic intrusives are of different ages; both Pre-Cambrian and early Mesozoic eras are represented. These intrusives are believed to have a genetic relation to the different vein systems. The granitoid rocks are of small extent and cut across the structure in several places, indicating that they were the last intrusives in the area. There are three prominent horizons of quartzites. The upper bed and cap rock of the structure is over 2,000 ft. thick south of the hill; the lower bed is about 150 ft. thick, and the middle strata nearly 750 ft. The upper two are composed of alternating beds of schist and quartzite, and the lower one is frequently gneissoid.

KENO HILL FORMATIONS SHOW TWO VEIN SYSTEMS

Two distinct vein systems and several non-related veins have been found on Keno Hill. The oldest veins have an average strike of north 60 deg. east and dip 70 to 80 deg. to the southeast. They tend to parallel the strike of the formations and are fault fissures of large throw. The mineralization is arsenopyrite, siderite, limonite, manganese, pyrite, sphalerite, and some galena and tetrahedrite carrying the silver. The gangue is quartz. Gold assays are not uncommon.

The younger veins have a strike that varies from north 40 deg. east to north, and dip 60 to 75 deg. east. They intersect the older veins at an angle of about 70 deg., and are fault fissures of little throw, cutting across the strike of the formations. These veins occur in groups to the north and south of the peaks, and are contemporaneous with the greenstone intrusives which produced the folding resulting in these peaks. The mineralization is manganese, limonite, galena, sphalerite, stibnite, calcite, freiburgite, and quartz, in a siderite gangue, with altered quartzite and greenstone in the vein matter. (Calcite in the younger veins and arsenopyrite and pyrite in the older veins seem to be the differentiating mineral.) Another type of the east-west vein has been found on the north slope. It contains little or no galena, but carries freiburgite with manganese and a little chalcopyrite. These veins have given high silver assays and contain malachite and azurite near the surface. The mineralization follows the greenstone-schist contact as far as developed.

The older fractures appear to have undergone two distinct phases of mineralization. The later fractures caused movement and spreading in the older veins, and in the earlier sporadic mineralization, consisting largely of quartz, manganese and a little arsenopyrite, the quartz was replaced in some places by galena. When the older fissures are intersected by the younger veins, high-grade galena, freiburgite, and associated minerals of the younger veins were introduced. Except for these points, the older fissures have not been proved to contain shipping ore under existing conditions, but with reduced costs of mining and transportation they may develop into the big tonnage producers of the camp.

Some of the richest oreshoots have been found in the upper portions of the greenstone and quartzites where the north-south faults intersect the east-west faults beneath a schist capping.

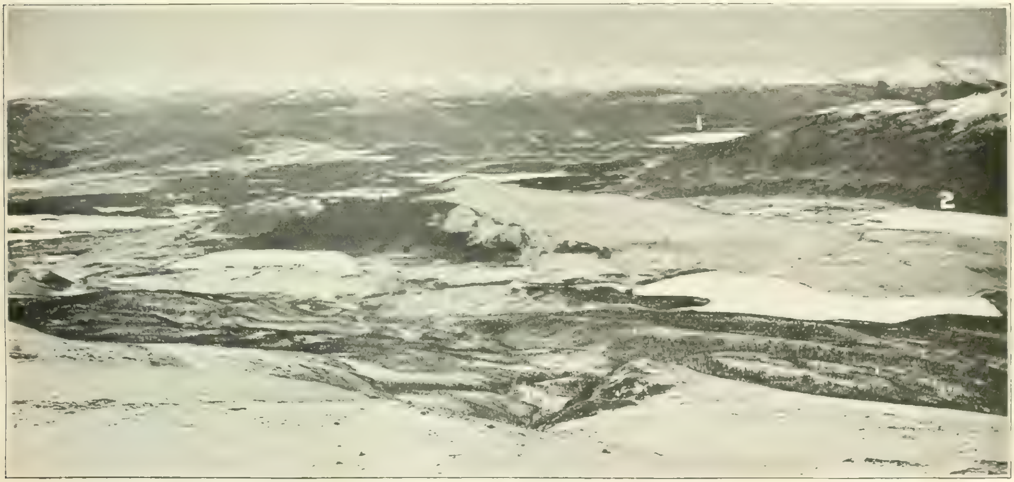
SILVER AS SULPHIDE AND IN TETRAHEDRITE

Silver occurs in all the galena in the form of an isomorphous sulphide and in tetrahedrite where the silver replaces the copper up to 30 per cent. Crystals of this freiburgite have also been observed in the galena. Considerable cerussite has been mined from the upper workings, but recent glaciation and rapid erosion, together with the absence of pyrite in quantity, mitigate against the possibility of extensive secondary enrichment, though a small amount of native and ruby silver was found at a depth of 200 ft. on a north-south vein. Recent prospecting of the east-west veins near the south base of the hill has uncovered a strong shoot of silver-galena assaying just under the present shipping grade. The vein lies between banded quartzite and schist walls with a siderite-manganese vein filling, and may indicate that the higher grade orebodies are associated only with the late north-south veins. The oreshoots developed in the short north-south veins near the summit, however, have not been proved to be persistent in depth, except in the vicinity of the intersection point with east-west veins, and little ore has been developed below the 200-ft. level.

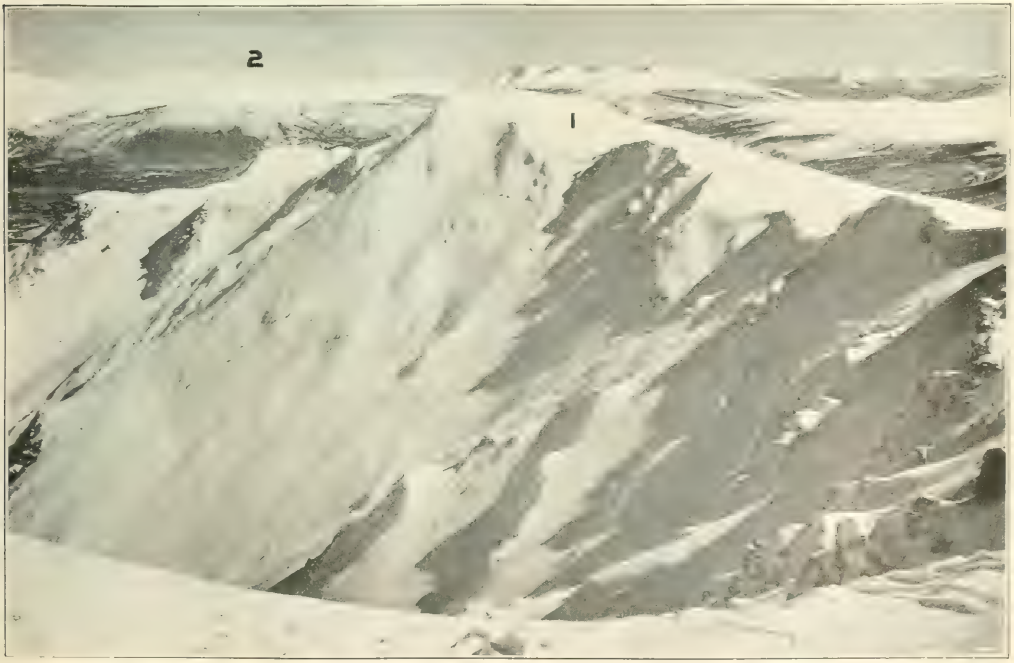
Extensive development work has been confined almost entirely to the Keno Hill area, where about 700 claims have been staked. The original stakers were placer miners with little knowledge of quartz prospecting, and they have, with few exceptions, been content to hold their ground by annual assessment work. This is unfortunate in that it has retarded the development of the district. The comprehensive exploration of the Keno Hill area is in the hands of three aggressive companies, which have optioned or purchased several groups of promising claims.

The Yukon Gold Co. was the first organization in

Views of the Keno Hill Region, Yukon Territory

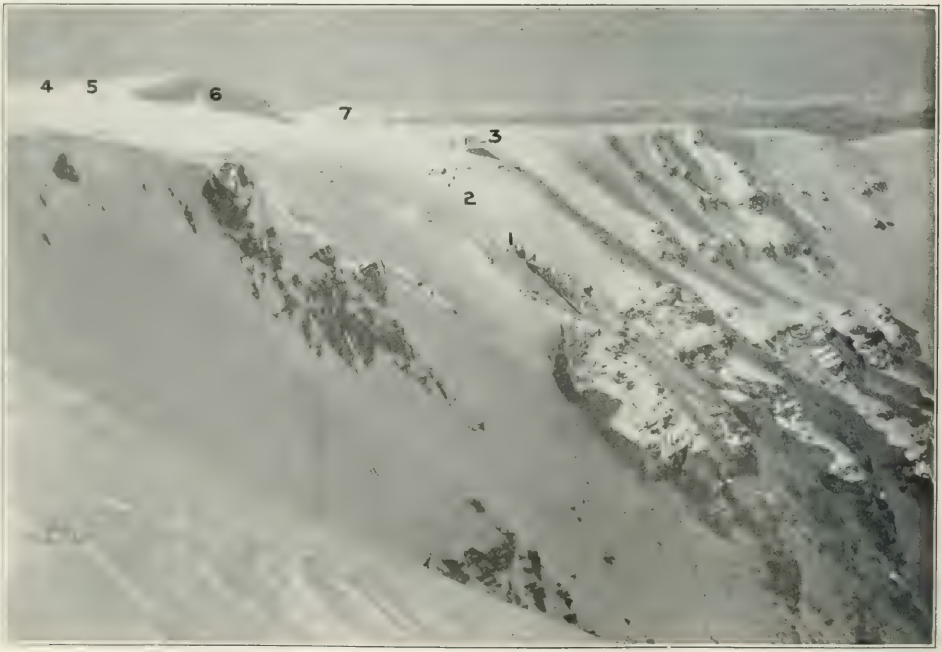


McQuesten Valley and Ogilvie Range seen from Keno Hill. 1—McQuesten Lake. 2—Ladue Lake



Looking east across head of Silver Basin, Keno Hill. 1—Caribou Workings. 2—Mount Patterson

Bluff 700 ft. high on Keno Hill, where several workings of Keno Hill, Ltd., are located. Cross indicates discovery point

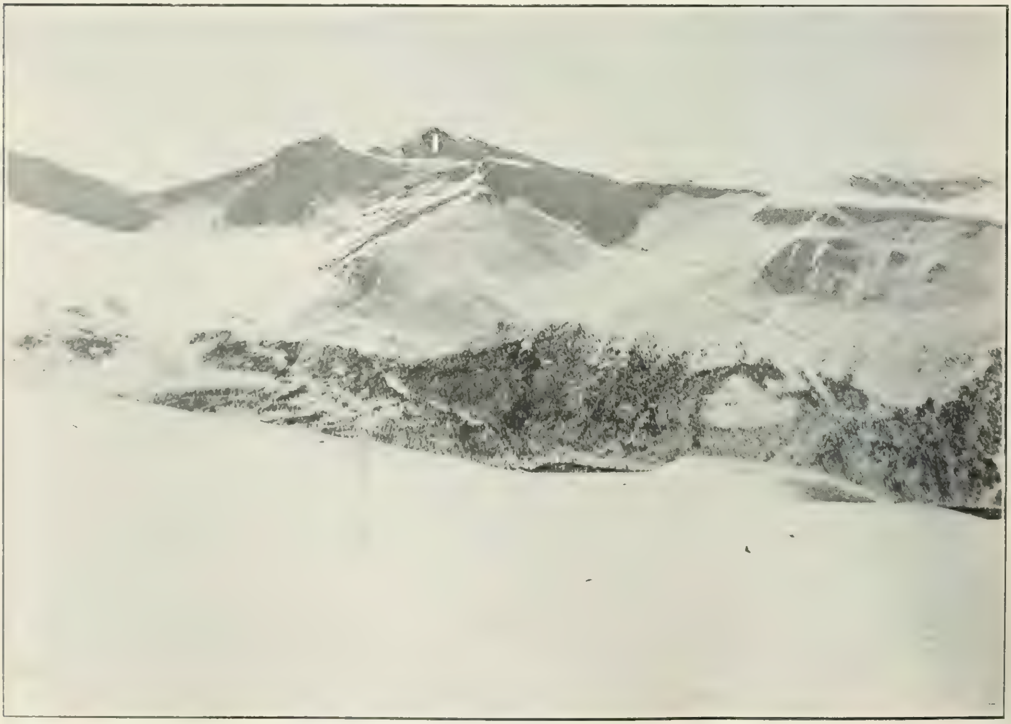


Same bluff as shown above. 1, 2, 3, 4, 5—Workings of Keno Hill, Ltd. 6—Keno Hill proper. 7—Lookout Mountain. Level stretch at top of bluff is Keno Plain

Looking east from point on Keno vein

Part of Mount Cameron (1) and Mount Patterson (2). Seen from bluff at Keno Hill

1—Silver King Mine, visible from the northwest end of Keno Hill. 2—Lookout Mountain, eighteen miles away. 3—Crystal Creek



Looking southeast from Keno Hill. 1—Mount Hinton in background the field (September, 1919), and secured options on ten claims and several fractions known locally as the "central group." These claims are now being developed by the Keno Hill, Ltd., the operating subsidiary. The main camp is situated just under the west summit at an elevation of 5,800 ft. above sea level overlooking the steep slope of Faro Gulch. The buildings are of frame construction, and include a bunk house, mess house, office and assay laboratory, hoist and compressor house, blacksmith and machine shop, warehouse, bins, and a sorting and sacking plant. Both gasoline and electric power are available. The bucket used for hoisting in the 235-ft. inclined shaft is carried in an overhead sling to the bins over the centrally placed sacking plant. The hoisting capacity is about forty tons per day. Power is transmitted to the mines from the company's 100-kw. steam power plant at Discovery, over a five-mile high-tension line. The company controls the water power rights at Frazer Falls, on the Stewart River.

The development work consists of nearly 3,000 ft. of shafts, tunnels, and open cuts on the twelve veins exposed on this group, eight of which have produced ore. These veins vary from 6 in. to 5 ft. in width. A second group of claims known as Friendship Camp, and lying just below the timber line on the west slope, has been the scene of active prospecting lately. The vein is remarkably persistent and well mineralized with galena. Water was struck in two of the shafts at an average depth of 50 ft., and operations will be held up pending the arrival of pumping equipment. This company has expended approximately half a million dollars to date and shipped 2,150 tons (net) of ore assaying 196.7 oz. of silver and 60 per cent lead. About twenty-five men are employed, and the 1922 shipment is expected to be about 3,000 tons having a slightly higher silver content than the first shipment. This tonnage will be mined almost entirely from the No. 9 vein. Warren McFarland is superintendent and Jack Stewart is mine foreman.

BRADLEY INTERESTS HAVE MODERN PLANT

The F. W. Bradley interests, represented by their Treadwell geologist, Livingston Wernecke, came in in July, 1921, and secured options on fifteen claims. An aggressive policy was initiated and a well-built and modernly equipped mine plant was put in operation within a few weeks on the claims adjoining the Friendship Camp on the north. The vein is believed to be a continuation of the Friendship Camp vein, and has been uncovered for several hundred feet. It is from 3 to 14 ft. wide at the outcrop.

The mineralization is galena and some freiburgite in quartz and siderite gangue. Two shafts are being sunk to a depth of 300 ft., and four connecting levels will be driven to determine the nature and size of the oreshoots. Steam hoisting and compressor equipment have been installed. About 250 tons of ore, which will be recovered from the development work, will be shipped this year. About twenty-five men are employed. W. B. Hargraves is superintendent and J. H. Jones and Dan McDonald are the foremen.

SLATE CREEK COMPANY ENTERED RECENTLY

The Slate Creek Mining Co. is another recent entry into the Keno Hill field. This company has taken options on nine claims, and will continue active prospecting all winter. A small lot of rich freiburgite ore said to assay over 1,000 oz. has been mined on the Lucky Queen group, at the head of Gambler Gulch. A 400-ft. shaft is being sunk on the Walsh group, just above the town of Keno City, and a 1,000-ft. haulage tunnel is being driven from the main camp on Lighting Creek to connect with this shaft. The company has bonded several promising claims on the north slope between Faro and Gambler gulches at an elevation of about 4,700 ft., and has a crew engaged in opening up this section, the scene of several rich strikes. J. Moore Elmer is manager and E. E. Bussey is in charge of the company's operations.

SILVER KING ONLY EXAMPLE OF SECONDARY ENRICHMENT

The oldest producer in the district is the Silver King mine, on Galena Hill. This mine was owned and operated by Tom Aitkin in 1914-15, and is reported to have produced ore valued at $400,000 from two oreshoots near the surface. The largest was 8 ft. wide and 150 ft. long. The vein dips 70 deg. to the west and has a quartz foot wall and a schist hanging wall. It is the only example of secondary enrichment of economic importance so far uncovered in the district. A shaft was sunk to a depth of 250 ft., but little development work has been done on the vein. The ore was galena, argentite, and pyrargyrite in a barite gangue. The first shipment, of sixty tons, assayed 452 oz. of silver and 46 per cent lead. The second shipment, of 1,180 tons, assayed $3 gold, 270 oz. silver, and 31 per cent lead. At the time this property was operating it was believed to be an isolated occurrence of silver ore.

LOOKOUT AND SHAMROCK ONLY OTHER SHIPPERS

The Lookout mine, on Mount Haldane, was operated by a local company known as the Lookout Silver Lead Mining Co., Ltd. A strong irregular vein in quartzite was opened up at an elevation of 3,500 ft. and prospected by 1,000 ft. of shafts and tunnels. The pumping equipment failed to handle the water, and the mine was closed down after shipping twenty-seven tons of hand-sorted silver-lead carbonate ore to the Trail smelter two years ago. The vein filling is quartz, manganite, pyrolusite, limonite, cerussite, and galena.

The ore is of a disseminated character and will require milling before shipment. The smelter returns on the shipment were as follows: 0.01 oz. gold; 95.60 oz. silver; 0.40 per cent moisture; 59.40 per cent lead; 0.70 per cent zinc; 4.70 per cent sulphur; 12 per cent silica; 4 per cent iron; 1.10 per cent cobalt oxide; and 1.20 per cent magnesium oxide.

The Shamrock group, at the head of Ericksen Gulch, on Keno Hill, has shipped three tons, said to have averaged 200 oz. per ton. No other shipments are known. A number of outlying properties have good showings in the surface trenches and shallow shafts. The Silver Basin group, on the north side of Keno Hill, is particularly promising, and will probably be prospected extensively this year.

The more distant properties on Rambler Hill, where workings at an elevation of 4,500 ft. have uncovered a wide vein of oxidized ore said to assay 50 to 135 oz. of silver and 65 per cent lead. At Stand-To Mountain and Mount Cameron, where sheeted zones about 50 ft. wide carrying galena have been found near the timber line, the surface has hardly been scratched. Galena float brought in assayed about 100 oz. silver.

The high coast range makes the climate pleasant [illegible] of the year. The summers are dry and warm and the winters are cold and have a comparatively light fall of snow. The thermometer seldom registers below 30 deg. in the lowland areas of the district and remains at this point only for short periods, and on the upper reaches of Keno Hill the temperature is well above zero when it has fallen to 60 deg. below in Dawson.

A sawmill is in operation at Mayo Landing having a capacity of 20,000 ft. of lumber a day. Another mill is being built at the mouth of Duncan Creek, eleven miles south of Keno City. Lumber costs about $160 a thousand delivered at the foot of the hill.

Silver King Mine, looking toward McQuesten Lake

The lower slopes of Keno Hill are well forested. The timber is spruce and is suitable for cabin logs and mine timbers. Fire wood is plentiful at $10 a cord. The nearest operating coal mine is at Tantalus Butte, on the Yukon River, 150 miles above Dawson and 250 miles from Mayo Landing by water. This mine produces about 2,000 tons a season for local consumption. The analysis of this coal is 51.84 per cent fixed carbon; 41.84 per cent volatile matter; and 2.69 per cent ash.

MEANS OF COMMUNICATION UNCERTAIN

Communication with the outside world is slow and uncertain. Letters addressed to the United States require three to four months for answer in the winter and at least two months in summer. Telephone service has been established between the mines and Mayo Landing, but the Government line on the Yukon connecting White Horse with Dawson has not been tapped.

The freight rate from Vancouver to Mayo Landing is $83 a ton during the summer. From this point 10c. a lb. is charged to Keno City at the foot of the hill and an additional 5c. to the summit via the wagon road.

LONG LIFE OF CAMP NOT YET IN EVIDENCE

Sufficient development work has been done to guarantee the continued production of high-grade ore for some time. Nothing has yet been uncovered, however, to assure sustained production for a long period of years.

The prevailing wage in the district is $5 for an eight-hour day, with board and lodging. There are about 600 people in the district, but there is a shortage of hard-rock miners at all times, and men are exceedingly scarce during the summer, when the hydraulic operations around Dawson and the prospecting fever take their quotas from the mines.

Dr. W. E. Cockfield, of the Canadian Geological Survey, has spent the last three summers in the district, in preparation of a monograph on the silver-lead deposits. With his assistants he has played an important part in the development of the camp; ready at all times to give sapient instruction and advice to prospectors or to survey roads through the subarctic forests when no territorial funds were available, thus exemplifying the true scientific spirit in the best interests of the Survey.

Miami Copper's Costs per Ton Decline

A lucid and valuable report of operations of the Miami Copper Co. for 1921 states that an average of less than five mill sections was operated in that period. The results of these operations were as follows:

		Copper Content, Per Cent
Ore milled, tons	1,868,757	1.758
Concentrate produced, tons	73,123	38.372
Copper in concentrate, lb.		56,117,827
Copper per ton of ore, lb.		30.03
Mill extraction, per cent		85.37

The cost of milling ore to the point of concentrate on board cars is as follows:

Direct crushing expense	$0.35983
Direct concentrating expense	.19784
Tailing and concentrate handling	.06095
Water for concentrating	.05825
Miscellaneous expense	.02777
Total	$0.70464

The total milling cost dropped 12c. per ton as compared with the previous year, despite a higher power cost, the reduction being due principally to lower labor costs and a reduction in the amount of experimental work.

The metallurgical results in the mill were good, the copper extraction being 85.367 per cent and the sulphide copper in the mill general tailing being 0.132 per cent. These are the best yearly figures which have been obtained since the beginning of operations in 1911.

The filling of the canyon in front of the mill with tailing was completed in August, and furnishes a much-needed yard space to the extent of 3.52 acres.

During the last month of the year the new tailing elevating plant was completed and put in operation. This consists of a battery of six Wilfley sand pumps discharging through 1,260 ft. of 18-in. wood-stave pipe line against a total head of 37 ft.

The smelter returns of refined copper on the concentrate shipped amounted to 53,311,941 lb., and the cost of this copper in concentrate on board cars at Miami was as follows:

	Per Ton Ore	Per Lb. Copper
Mining	$1.14905	$0.04028
Milling	.70464	.02470
General	.38384	.01347
Total	$2.23753	$0.0745

The figures show a decrease in all departments as compared with the records for the previous year, the total reduction amounting to 28c. per ton. The reduction in the cost of copper, however, is less than ½c. per lb., due to the fact that the copper content per ton of ore is less than in the previous year, which is attributable, as previously explained, largely to interference with mining operations by the delay in the delivery of the hoisting equipment for No. 5 shaft.

The Geological Department of Phelps Dodge Corporation at Tyrone, N. M.

Organization of the Work—Methods of Obtaining and Recording Data—Assay Maps Are in Charge of the Geological Department

BY DJEVAD EYOUB

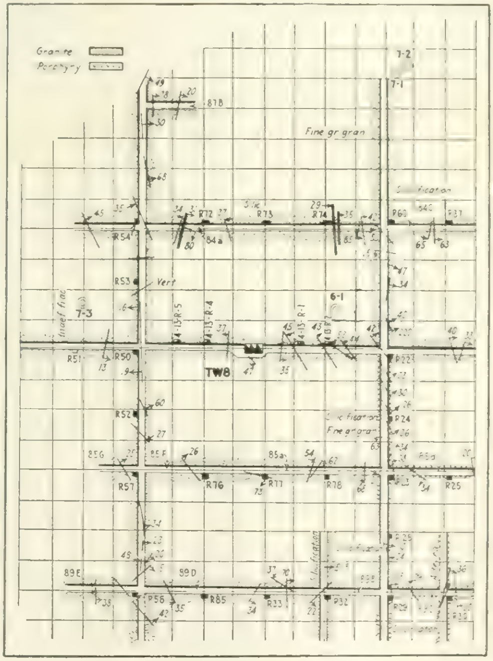
ONE of the interesting features of the operations of the Phelps Dodge Corporation at its Burro Mountain mines, at Tyrone, in New Mexico, is the work done by its geological department, consisting of a chief and three assistants. The chief geologist, besides being in direct charge of the department, supervises the work done in the chemical and sampling departments, though the former, from many standpoints, may be considered autonomous and solely responsible to the general manager.

The mines were divided into two main groups at the time the company took over the property from the original owners, and despite the large amount of development work subsequently done, these two divisions have been kept distinct. The mines in No. 1 division are reached by a tunnel; those in the other division, known as No. 3, are reached by various shafts. One assistant geologist is assigned to each division; he does the underground as well as the office work. This method of having the same man do all the work for a division, instead of having one man confine his work to the mines and another to the office, is believed to be more satisfactory than a distinct division of the respective activities. The remaining member of the department looks after the sampling and the log of the churn drills, and, whenever he has extra time at his disposal, as when the drills are idle, he helps the others, who are invariably unusually busy at the beginning of the month.

The division geologist ordinarily begins his rounds of the mine about the middle of the month. He goes to all the drifts, raises, and stopes where work is being done. Probably ore is being taken from a dozen or more stopes, but, except in rare instances, he goes only to square-set and slice stopes. His underground equipment includes a 100-ft. cloth tape, a leather-covered note-book, a 6-in. celluloid scale with centimeter divisions, which serves also as a protractor; various large-scale maps of the individual workings, and a large map covering the entire division.

On reaching the working place, the geologist identifies a survey station to which he ties his work. Beginning from the point where the geology has been noted last, the worker proceeds to note the character of the rock and the nature of the mineralization. Slips, whether important enough to be classed as vein or not, are noted by taking the distance on both sides of the drifts. Dip and strike are noted, and the size of the slip. In working the geology of a raise the distances are taken from the rail level, and preferably all four faces are projected on cards, 3 x 5 in., as indicated in the accompanying sketch. It is sufficient to visit a "raw" raise at the time of its completion. In softer ground where cribbing is required the geologist should keep the working constantly in mind and examine it after every other round if possible. Though development raises may be overlooked occasionally, the exploratory work should never be neglected.

On the raise cards the geologist notes the kind and character of the rock, the important minerals present, and the location of the more prominent slips. Not infrequently the geologist may experience difficulty in determining the nature of the rock. Whenever he is not sure he takes a specimen with him, so that he may study it in the office, where he has better facilities. After being in a mine several years the nature of the different rocks becomes so fixed in the worker's mind that at sight of a raw drift he is able to identify the rock from the way it has broken.

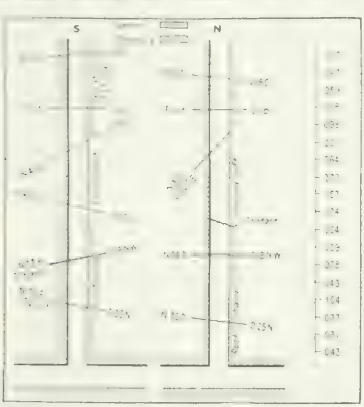


Portion of mine map on which geology is indicated

The last few days of the month are spent in a rapid survey of the workings, so as to make the report rendered at the beginning of the month complete. The engineering department prepares a list of workings, the sampling department adds the average assays for the advance made during the month, and the geological department records the kind of rock through which the advance has been made, including a notation as to whether the rock is mineralized or not. The latter fact is indicated, of course, by the assays, but the geologist's note is useful in serving as a rough check on the sampling.

At the office are three sets of maps, each traced from the original in the engineering department, the geologist bringing the three sets up to date. These consist of geological, "pick-assaying," and "channel-assaying" sheets. A scale of 1 in. to 50 ft. is used. The geologist records pyritic slips in red ink; mineralized slips, in green; "pug" slips, in blue; and the slips where marked oxidation is observed, in brown. Other information, such as the presence of certain minerals, is noted in black.

The next set to be brought up to date is the pick-assay sheets. The sampling department sends a statement covering the pick assays taken after each round from drift and raise. Whereas the drift assays are recorded on the standard sheets, the raise assays are kept in a loose-leaf book, where the channel as well as the pick assays are written side by side. The pages are numbered and entered in the index, so that by referring to the section of the mine where any raise is situated, and noting the number—they are given in consecutive order—the assays on any particular raise are easily determined at a future time.



Typical raise-sketch, showing the method of recording the geology

Channel assays came at a later date; but by the time the geological and pick-assay sheets are finished, they begin to arrive from the assay office. These are recorded in similar fashion, but are checked with the compiled list as sent from the sampling department.

When the three sets of maps are completed, the work on sections begins. Vertical sections of all stopes are made at intervals, the frequency of which varies. Some of the more important stopes have geological vertical sections as well as another set of assay sections made along the opposite co-ordinate. The sections are generally at 25- or 30-ft. intervals. The average of the assays for these distances is recorded on the section. It is good practice to color the part of a drift where the assays are above the standard adopted for a part of the mine. This affords a ready way for visualizing the degree of mineralization in any particular level.

After recording the geology, completing the two sets of assay sheets, and then transcribing the assays onto the sections, the work of "bringing up" the models begins. These are copies on rectangular celluloid sheets of the work already done on the standard geological sheets. The sheets can be superimposed, and the relationship of the levels noted. These models help greatly in giving a correct idea of the geology of the mine. Attention might be called to the fact that in transcribing the geological data onto the geological vertical sections, dip charts must be used; this makes a great difference, especially when the strike forms an acute angle with the direction of the co-ordinate on which the section is being made. The office work is usually completed about the middle of the month; the same cycle is then repeated.

Twice a year the geologist is particularly busy, making the semiannual ore-reserve estimates. The details of this work form a subject by itself, but it may be mentioned that the superintendent and the chief geologist, after long discussions, in which the foremen may be consulted, and, not infrequently, the judgment and the decision of the general manager are sought, mark certain limiting lines on the level and stope assay maps.

Each stope has its "oxide factor," based partly on what the stope in question has already shown in mill returns and partly on the opinion of the chief geologist and the superintendent. All the assays within this boundary are averaged, both on the pick map and the channel map. Sometimes the boundaries are drawn originally on the level sheets, and at other times on the sections, according to the procedure to which the particular orebody best lends itself. In either event the lines are transferred from level sheets to the sections, or vice versa. Thus, when a colossal amount of adding-machine work is done, there will be two pick and two channel averages for the same orebody. Channels are weighed against the pick assays and a final average is attained. By the use of a planimeter the areas are determined. From the gross tonnage thus obtained the total ore mined is subtracted, and the result is indicated as the ore reserve of that particular orebody. There are a number of orebodies where only churn-drill information is available. The estimates for these areas are made by the use of the pyramidal formula. Estimates thus made are entitled to high rating, though they are probably not as accurate as the estimates for the mine proper, where considerable work is done and more complete data regarding the nature of the deposit can naturally be obtained.

The member of the department who attends the churn drills spends a good part of the day at the scene of operations. These are often far apart, a fact which necessitates the use of a horse or an automobile in getting about. Samples are approximately $\frac{1}{64}$ of the total amount of sludge discharged from the hole. The drillers dry these samples on the fire, so that when the geologist arrives he has only to remove the dry samples from the pans and reduce them to a suitable size. The sample weighs 15 or 20 lb.; it is reduced to a size of about 2 lb. Another pan which has received the sludge from a total of probably 50 ft. is panned and the minerals present are noted. It is customary to take samples at 10-ft. intervals while the drill is passing through the oxidized zone and at 5 ft. after entering the sulphide zone. The geologist returns to the office at about 4 p.m., when he records in the log book the work done and the sample returns, along with the geological data obtained.

The geological department serves as the repository of the geologic and assay information; it is a source of constant and useful help to the superintendent and foremen. In a small mine such information may be kept in the manager's mind, but in bigger enterprises this is impossible, and the geological department, with its records and indexes, serves as an invaluable source of information for the officials.

Marketing of Soapstone*

Sold in Slabs and Blocks to a Limited Field of Manufacturers and Builders—Schuyler, Va., Is Chief Source of Supply—Deposit Must Be Large to Warrant Construction of Plant

By Raymond B. Ladoo
Mineral Technologist, U. S. Bureau of Mines

SOAPSTONE is sold chiefly in slab or massive form and in this discussion only slab or massive soapstone will be considered. Some soapstone is ground and sold for much the same purposes as low-grade, impure talc. The distinction between soapstone and talc should be noted. Talc is a definite mineral, whereas soapstone is a rock or an aggregate of minerals containing talc in greater or less quantity, together with chlorite, tremolite, pyroxene, quartz, calcite, dolomite, or other minerals. Its talc content is usually sufficiently high to give it a soapy "feel."

The domestic soapstone industry is peculiar in that there are only two or three producers, of which one is pre-eminent and accounts for nearly the total production. Moreover, the soapstone industry apparently has not been well developed in other countries, and little or no competition is experienced. The marketing of soapstone accordingly is not at present a complicated subject.

Soapstone is used primarily in the form of slabs, usually one to two inches thick, fabricated into laundry tubs, kitchen sinks, sinks, hoods, and table tops for laboratories; acid-resisting tanks, electrical switchboards, and for building material such as lavatory stalls, baseboards, shelving and stair treads. Its property of absorbing and retaining heat makes it of value for griddles, foot warmers and heating stones for fireless cookers. In the form of cores for electric heating elements in electric flatirons and similar appliances, the properties of electrical resistance and heat retention are utilized. In the form of brick, soapstone has been used to a limited extent as a refractory.

Most soapstone is cut and fabricated for the market by the producer at or near the quarry. Some soapstone is sold in the form of large rectangular blocks which may be sawn and fabricated nearer the centers of consumption, but most unfabricated material is marketed in large sawn slabs. These slabs are bought by companies that are making laundry tubs, sinks, and similar products, and occasionally by companies whose main business is the working of marble for structural purposes. "Raw material" marketing, however, is relatively infrequent and unimportant.

Soapstone products are sold all over the United States, and a small quantity is exported; but the consumption is largest east of the Mississippi, where the freight rate from the principal point of production in Virginia is not unduly high.

VIRGINIA PRINCIPAL SOURCE OF SOAPSTONE

The chief marketing point is Schuyler, in Virginia, but small quantities have been shipped from Chester, Vermont; Arrington, in Virginia; Marriotsville, in Maryland, and from a few other localities. The Chester stone was fabricated largely at Boston; the Arrington stone locally, and the Marriotsville stone at Stamford, Conn.

The annual consumption of soapstone for the last ten years has varied from 12,330 short tons, valued at $501,059, in 1918, to 26,562 tons, valued at $628,077, in 1913. The average has been about 20,000 tons per year. There are no seasonal fluctuations in demand except in so far as building operations in the North and West are influenced by weather conditions.

No well-defined and generally accepted standards and specifications for soapstone have been evolved. Individual consumers have their own requirements—for example, dielectric strength tests for electrical switchboards—but there seem to be no definite standards. The principal requirement for slab soapstone is that it shall be sound and free from cracks, seams, and "shakes." Pyrite and magnetite are generally objectionable impurities, particularly when the stone is to be used for electric purposes, but for some uses they are not so regarded. For acid-proof tanks, the presence of calcite and dolomite is objectionable. Color ordinarily has no influence on price, except that for structural purposes iron oxide stains are undesirable. For refractories, fireless-cooker stones, griddles, and similar utensils, where the soapstone is subjected to heat, a stone high in talc and one which will not split and spall under heat is necessary. This last requirement is not always well met by some soapstone now marketed. It must be remembered, however, that deposits of soapstone of commercial size and of ideal character may not be available.

SHIPMENTS ARE USUALLY BY CARLOAD LOTS

Usually, the quantity of unfabricated soapstone handled in a single lot depends upon the capacity of a freight car, for carload shipments prevail. Small shapes and some fabricated soapstone articles are sometimes sold and shipped in small quantities.

No system of premiums and penalties prevails in the soapstone industry, and sampling by consumers is not practiced. As soapstone is not sold on the basis of analysis or physical tests, the consumer merely makes a visual examination, noting the quality, and the workmanship if it be fabricated.

The only requirements for transportation are that strong, well-designed crates be used, to protect the stone and prevent breakage in transit. Slab soapstone is always shipped on edge, as the liability of breakage is less than when placed flat on the bottom of the car. The only limit to the size of package is the size of the freight car. The minimum carload is usually 24,000 lb.; the maximum, the capacity of the car. No insurance is considered necessary.

The value of soapstone is variously computed by the square foot, cubic foot, ton, pound, or piece of finished product, depending upon the nature, shape, and size of the articles shipped. Thus, laundry tubes may be sold by the individual unit, block soapstone by the cubic foot or by the ton, and slab soapstone of a definite thickness by the square foot. The terms of payment vary, but follow those in common use in other indus-upon terms, cash in thirty, sixty, or ninety days or deferred, secured payments.

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There seem to be no special marketing problems which producers should know. However, possible new producers should consider the relatively small consumption, the efficiency with which soapstone is now being produced, the amount of capital required to equip an efficient plant, the freight rates to important markets, and the price at which competitive materials, for example slate, are sold in those markets. There are no trade groups or middlemen or combinations of producers which exercise any control over the market or marketing conditions or price.

The prices of soapstone products vary greatly, depending upon the amount of labor involved in manufacture. Thus, crude block soapstone brings the lowest price and fabricated articles or intricate shapes bring the highest prices. The present prices (April, 1922) vary from about $10 to $100 per ton. As the average soapstone runs from 11.2 to 11.5 cu.ft. per ton, the cubic-foot price varies from about $0.87 to $8.92 per cubic foot. These prices may be easily converted to prices per square foot for slab soapstone of varying thicknesses.

The marketing unit, as noted before, may be the square foot, cubic foot, pound, ton, or piece. In 1915 the U. S. Geological Survey reported that, when the average price for the year for all soapstone sold was $25.45, the value of crude, block soapstone was $2 or less per ton; when sawed into slabs the value was increased to more than $15 per ton; and when made into laundry tubs its average value reached approximately $30 per ton.

The average prices of all sawed and manufactured soapstone for recent years are shown in the following statistics from the U. S. Geological Survey:

AVERAGE PRICES OF SOAPSTONE
Per Short Ton

Year..	1912	1913	1914	1915	1916	1917	1918	1919	1920
Price..	$23.06	25.04	25.93	26.45	25.50	20.24	40.64	32.12	36.00

Imports have no influence on the domestic market, for soapstone in appreciable quantities has never been imported. Great Britain and some of the Scandinavian countries have produced a small quantity of soapstone, but it has never competed in our markets. This is probably due to the fact that the price compared to the weight is low, and transportation charges would be unduly high. It is reported that a large deposit of soapstone of excellent grade has recently been discovered in eastern Canada. The commercial exploitation of this deposit might have some effect on the domestic markets.

Telephone Takes Tenth of Country's Lead

The importance of lead in the maintenance of the telephone systems of the country is borne out by statistics just prepared by the Western Electric Co. At the company's plant near Chicago, which manufactures a good part of the communicating apparatus used throughout the country, there is consumed each year approximately one-tenth of the total amount of lead produced annually in the United States. In 1921, the factory purchased 53,111,000 lb. of the metal, which was used as a covering for 35,360,000 ft. of telephone cable—enough lead to fill 664 railroad cars of 80,000 lb. capacity each, and enough cable to reach from San Francisco to New York, with a piece left over long enough to reach from New York to London.

Texan Potash Interests Seek Relief from Foreign Monopoly

A group of ranch owners, business men, and oil companies in the potash region of Texas have petitioned Congress for legislation that will give the Texan potash industry relief from a foreign monopoly that they say threatens to prevent the development of the natural resources of Texas, which, when developed may furnish as abundant a supply of high-grade potash as the German and Alsatian mines and at a lower price to American consumers. Unless there is remedial action, the petition asserts, the United States will be left at the mercy of European operators so far as its potash supply is concerned, instead of being put in an independent position by developing its own supply of a mineral essential to crop raising, as well as in the manufacture of munitions.

The petition alleges that the German-French group has by co-ordination created "what in effect is a monopoly of the world's potash supply, based upon the limitation of natural resources and 'tying' contracts which evade the laws of the United States," and that "this monopoly, apparently manipulated by a German industrial group, has put out of operation American potash plants representing an investment of about $30,000,000, widely distributed throughout the United States."

"A new international problem faces Congress," say the petitioners. "Hitherto the national Government has not found it necessary to take action aimed at the regulation of international combinations in restraint of trade. Post-war conditions, however, are responsible for the organization of an international monopoly which Congress must cope with to protect the interests of the American people. Congress will have to face similar international combinations. We respectfully suggest that it might be well to develop a policy for dealing with them in a case in which the issues are so clearly drawn. The French government after the Armistice acquired the mines, and recently has been developing a plan for their control. What pressure the German interests brought to bear upon the French operators of the mines is apparent from subsequent developments by which American competition has been almost eliminated and the price of potash has been raised."

The petition then gives reasons for the belief in the probability of extensive development of the Texas potash fields. It calls attention to encouraging reports from the U. S. Geological Survey, although it indicates that the certainty of commercial deposits will not be revealed until more drillings have been made. These, it says, are now being put down.

Bain Analyzes Proposed Mine Law Revision

Complying with a request made by the Committee on Mines and Mining of the House of Representatives, H. Foster Bain, director of the U. S. Bureau of Mines, has analyzed the more important changes proposed in the revision of the mining laws prescribed in the bill now before the committee. The full text of Mr. Bain's statement, submitted to the committee since his departure for Alaska, may be obtained on application to the Bureau of Mines.

Ajo Enterprise of the New Cornelia Copper Co.—III

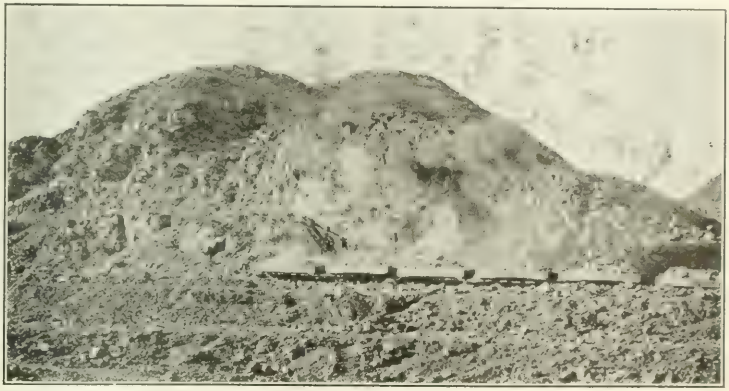
Electrolytic Precipitation Improved by Development of a Process for the Reduction of Ferric Sulphate by Sulphur Dioxide in Towers — Whole Leaching Plant Built With Exceptional Care—Operation Has Justified Innovations

By A. W. Allen
Assistant Editor *Engineering and Mining Journal-Press*

THE SPECIAL FEATURES of the process adopted for the treatment of the oxidized ores at Ajo are summarized in U. S. Patent No. 1,224,458, which was issued to John C. Greenway and Harry W. Morse on May 1, 1917. The specifications discuss as a preliminary the difficulty experienced in the hydrometallurgy of copper ores containing iron, on account of the formation of ferric sulphate. This, as is well known, tends to dissolve the copper on the cathodes and to raise the potential difference necessary for electrolysis, thus causing a loss of electric energy. Iron in the ferrous form, however, is harmless; consequently, the general practice is to withdraw a certain proportion of the solution coming from the electrolytic plant and to subject it to reduction, then returning it to the main circuit. The electrolytic solution being acid, the efficiency of reduction is low; it amounts usually to about 20 per cent. The important feature of the Ajo process is that this proportion may be raised to about 80 per cent by using neutral instead of acid solution. Thus, it is possible to maintain a low content of ferric iron in the liquor going to the electrolytic cells. The application of the process is as follows, assuming the operation of the plant for a time sufficient to insure regular procedure: The solution is circulated through the ore, a proportion going forward and finally percolating through a fresh charge. Then, being almost neutral in reaction, it is passed through towers containing sulphur dioxide, by which nearly all the ferric iron is reduced to the ferrous state. One result of this reaction is the production of sulphuric acid, according to the following equation:

$$Fe_2(SO_4)_3 + SO_2 + 2H_2O = 2FeSO_4 + 2H_2SO_4$$

The amount produced, however, is generally insufficient for economical operation, so acid is usually added as required. To remove iron and base-metal compounds that accumulate, and to prevent fouling, a portion of the circulating solution is withdrawn and treated with metallic iron, the cement copper formed being afterward dissolved in a solution coming from the electrolytic cells, so that any resultant ferric sulphate is reduced to the ferrous state. The solution then goes to the electrolytic department, where copper is precipitated.



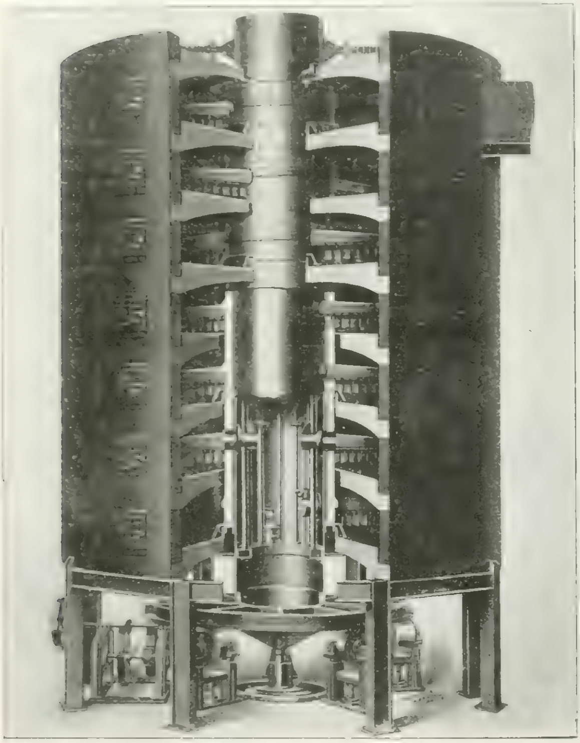
Mining the third and last hill, December, 1921

A part of the acid solution from the cells goes to the leaching vats. The object of the procedure adopted is not to remove all the ferric iron from the solution at any stage of operations, but to reduce the amount previous to passage through the electrolytic cells. The presence of a certain amount of ferric iron in the solution is beneficial, for it acts as a solvent of the copper in the ore. The claims sustained show that the patent covers the use of a solution of sulphuric acid to extract the copper, such solution being maintained in contact until almost neutral; a part of the effluent is then subjected to reduction in towers through which sulphur dioxide is passed, after which the copper is recovered by electrolytic precipitation, with or without previous acidification of the solution with sulphuric acid; or a part of the recent leach solution is treated with metallic iron, another part by sulphur dioxide, the metallic copper produced during the former reaction reducing a further amount of the ferric iron in the solution, the liquor being subjected ultimately to electrolytic precipitation of a proportion of the contained copper.

Mention has been made in previous articles of the weight of expert opinion and experience that supported the metallurgic decisions made in reference to the proposed treatment of Ajo ores. In the mining department, also, no experiments were made in the selection of the men to take charge of the work. Michael Curley was appointed general superintendent, and Frederic Ekman, mine superintendent, both of whom were thoroughly conversant with a system of mining that has since proved capable of successful adaptation at Ajo, for both had learned what there was to know on the subject in the iron mines of the Lake Superior region.

Co-operation between the mining and metallurgical departments showed that the ore should be delivered at a point where sufficient fall by gravity would be available for primary as well as for secondary crushing in gyratory breakers. A cut was made through a hill overlooking the town site and close to the present coarse-crushing plant. A standard-gage single track was laid from there to the mine—a distance of about 4,000 ft. A trestle approach to the coarse-crushing plant was designed in accordance with the weight and type of locomotive and cars chosen as most suitable. There is a difference in elevation, between the approach to the pit and the trestle, of 14 ft.; this gives a maximum adverse grade, when hauling ore, of about 1.8 per cent.

A certain proportion of the oxidized ore available was contained in three hills, two of which have already been mined and milled. The third is now as shown in the halftone. The sides of the hills were steep. Mining by means of intermediate benches was considered impracticable. It was decided to break the ore in such a way that the removal of all of it would be possible from the base, where the railroad track would be laid. Steam shovels with dippers of 4-cu.yd. capacity were chosen as being adequate in size to take the rock without excessive expense for reduction of large pieces by block-holing. The Osgood company's machines were favored, a choice that has not been regretted. Air-dump cars holding about forty tons were considered preferable, the Kilbourne-Jacobs type being adopted. The scheme of mining involved combination blasting by means of explosives placed in drill holes and also in adits and crosscuts, the latter procedure being used in high banks.



Wedge furnace used at Ajo

Design of the Treatment Plant

A milling capacity of 5,000 tons per day having been decided upon, the design of the plant, under the supervision of Mr. Greenway and Dr. Ricketts, was placed in the hands of A. G. McGregor. David Cole was also consulted, and, later, designed an experimental flotation plant. It was realized that first cost and future operating cost should be the main considerations in the selection of equipment, and Mr. McGregor considered that there was less chance for a serious mistake in selection than there was in the grouping and the arranging of the various units. It is important in such work that the characteristics of the equipment adopted be understood fully; also, that it be installed so that conditions of operation will be as nearly ideal as possible. A number of feasible plans are usually given consideration before final decision is made; any one of these can be adopted with assurance of ultimate success, provided the work is carried out with proper skill and attention to detail.

The plant at Ajo gives the impression of unusual permanence. This is partly owing to neatness of design and to the use of concrete and iron throughout. The approximate weight of steel used in the principal structures, supplied by the Kansas City Structural Steel Co., is of interest, for in the aggregate it amounted to no less than 2,500 tons. The power-plant building required 500 tons; the electrolytic-cell house, 400 tons; the storage bins and the sulphur dioxide buildings, about 200 tons apiece; the trestle approach, 215 tons; the central structure between the leaching vats, 160 tons; the coarse-crushing plant building, 280 tons; and the fine-crushing plant building, 115 tons. Gyratory breakers were chosen for primary and secondary crushing. Belt conveyors were selected throughout for the conveyance and elevation of the crushed ore, except in the fine-crushing department, where belt-and-bucket elevators raise the discharge from the penultimate crushers into the chutes leading into the final crushers. A 10,000-ton steel bin provides storage for the ore after it has been crushed in the gyratories and is then in a condition to be handled by belt conveyors and feeders. This permits elasticity of operation and control in the coarse-crushing plant.

So far no method has been devised which will prevent delay due to lack of storage facilities in the coarse-crushing section. It would be uneconomical to adopt a primary crusher of such a size or to duplicate the unit so that the rock could be reduced as fast as it could be delivered by a train of ore cars. At Ajo the cars are dumped one at a time into the hopper of the large gyratory crusher, the locomotive remaining attached meanwhile; but it is obvious that the locomotive and attendants are delayed for considerable periods, waiting for the hopper to empty. This appears to be one of the disadvantages of air-dump cars, which require connection to auxiliary apparatus in the locomotive so that they can be tipped. Alternative practice is indicated by the method adopted elsewhere—at Chuquicamata and at the Arthur mill of the Utah Copper Co., for instance—where no gravity fall into the primary crushers is available, where there is no approach trestle of appreciable height, and where, in consequence, large ore cars can be used. At Chuquicamata the train of cars is left on the track leading to the unloader, the brake on one car at a time being released so that it can run by gravity into the receiver of a Wellman-Seaver-Morgan electric hoist-unloader, by which it is lifted and dumped onto the grizzly that leads to the primary crushers. At the Arthur mine in Utah[1] the same type of hoist-unloader is in use, but each car is pushed up an 11 per cent incline for a short distance into the dumping cradle of the unloader by a diminutive locomotive "mule," which is controlled by the operator in charge of the car-dumping mechanism. In both plants the cars serve as efficient storage bins for the unbroken rock, permitting an even delivery of material into the crusher without involving waste of time, labor, or power.

DEVELOPMENT OF THE DISK CRUSHER

Although various and sundry types of crushers have been used to prepare ore for leaching treatment, it is obvious that, where no classification and separate treatment of slime is feasible, the product must contain a minimum of exceedingly fine sand and slime. In copper ores this is largely because of the coarse character of the charge; increased crushing, to within certain limits, would permit the inclusion of a greater amount of fine material, because less movement of slime would result.

In the earlier work at Douglas some negative results were obtained because of the character of the mass leached, not because of the nominal size to which it had been crushed. Horizontal as well as vertical disk crushers were used in the experimental plant at Ajo. A 48-in. horizontal type of machine reduced the ore from 4 to 1½ in. It was then passed to a vertical disk crusher, or fine reduction machine of the same size as the other but in which the disks were horizontal.

No screening was practiced. Sundry minor structural weaknesses were noticed in the apparatus, which at the time had just passed the experimental stage; the principle of operation, however, was so attractive that further improvement in design was thought to be justified.

Early in January, 1915, David Cole, who was consulted concerning the fine-crushing plant at Ajo, felt that the good work done in the experimental plant could be duplicated on a large scale, and that the disk crusher could be modified in design so that a satisfactory leaching product could be obtained at a reasonable cost and without the necessity for the excessive "repairs" that had been found necessary in plants using the Symons machine. Chalmers & Williams, the manufacturers of the new crusher, were willing; and Mr. Cole was given authority to re-design the apparatus. Details of the development of the machine now in use, as well as of later models, will be described by Mr. Cole in a separate article.

Lead was chosen as the most suitable material for the piping to convey acid solution, for the lining of the leaching vats, and for the construction of anodes. The small amount of trouble experienced from corrosion since the plant has been in operation is evidence of the care taken in preliminary investigation in this direction, although the results are contrary to much experience elsewhere. The only minor alteration made was to protect with wood the lead that was exposed, on the sides of the leaching vats, to the abrasive action of the sand in the solution that short-circuited in consequence of the high rate of percolation. A bottom support of perforated wood was adopted. Two types of acid-pump were chosen, because no one factory could deliver all the equipment required in the limited time available. These were supplied by the Worthington Pump & Machinery Co. and by the Chemical Valve & Pump Co., of New Jersey.

Sulphur was used in the experimental test to produce the sulphur dioxide needed for the reduction of ferrous iron, but much trouble was experienced. The process involved the use of a comparatively rich sulphur-dioxide gas. The problem was to determine the cheapest method of production. The matter was finally submitted to the Wedge Mechanical Furnace Co., the idea being to use sulphide ores from Bisbee. A. G. McGregor and H. A. Tobelmann, as representatives of the New Cornelia company, visited various plants in the Eastern states where Wedge furnaces were in operation and producing a gas used in sulphite-pulp digesters. In that industry it is desirable to secure as rich a gas as possible, containing a negligible quantity of sulphur trioxide or free oxygen. The furnace in use in the sulphite-pulp mills, roasting a pyrite with a sulphur content of about 42 per cent, can produce a gas that averages 13.8 per cent of sulphur dioxide. After this investigation and after a consideration of comparative costs, it was decided to use Wedge furnaces of the sulphite-pulp type at Ajo.

The objection to the use of pyrite as a source of sulphur in the sulphite-pulp industry arose because uncalcined particles of ore were carried by the gas into the pulp. It was planned at Ajo that the gas from the roasters would pass through a short balloon flue to a Cottrell electrical precipitator, for the removal of the dust. This apparatus was found unnecessary and was later discarded. Disadvantages in connection with the use of pyrite as a source of sulphur dioxide were more than counterbalanced at Ajo by the fact that the parent company, the Calumet & Arizona, controlled large deposits of sulphide ore at Bisbee, which must be roasted before treatment in the smelter at Douglas. It was therefore planned to send sufficient of the ore from Bisbee to Douglas via Ajo, where it would be deprived of its sulphur. This is a striking example of the benefits of co-operation in industry, by which two processes that individually might be considered as prohibitively costly can be operated on a co-operative basis at reasonable expense.

To be concluded

Tests of Mine-Locomotive Storage Batteries

The Bureau of Mines has undertaken to establish a list of permissible storage-battery locomotives for use in gaseous mines, and has issued Schedule 15, "Procedure for Establishing a List of Permissible Storage-Battery Locomotives for Use in Gaseous Mines." Up to the present time, two approvals have been issued under this schedule and considerable testing work has been done on four other applications which have been made for approval.

Prior to the publication of Schedule 15, the Bureau conducted field and laboratory investigations to determine the hazard from batteries used in mine locomotives. These investigations indicated that the safety of the locomotive would depend largely on proper care of the battery; also on the use of a battery as mechanically rugged as possible. For this reason the Bureau staff considered it advisable to subject the batteries to a jarring or bumping test to prove their adequacy as regards mechanical endurance and ruggedness. These tests on the batteries of the locomotives are described in Serial No. 2,358, *Reports of Investigations*.

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[1] *Min. & Sci. Press*, April 5, 1919.

Geological Experts—What the Judge Thinks

By Doska W. E. Monical

IN MINING LITIGATION, do two sets of witnesses, [illegible] on opposing sides, bring about the desired results? Is the present legal procedure efficient? Some writers assert that because the testimony of one witness so often counterbalances that of another, the whole system, like competition in armaments, is futile. Is this true, or is the net result of the opposing arguments the shaking down of the geologic facts?

One indication of the effectiveness of expert testimony is the reaction of the presiding judge toward it. To get a concrete measure in this direction, I have reviewed the decisions in all the important *reported* mining cases of the last forty years, with some attention to those of preceding years. Following is a detailed list of the cases, with excerpts from the judge's opinion wherever he has made any laudatory or disparaging remarks regarding expert witnesses. Where no excerpt is made, the judge has delivered no opinion relative to the testimony. These excerpts are proffered for their intrinsic interest and without comment.

In 1880, in the case of Overman Silver Mining Co. v. Philip Corcoran *et al*, Judge Hawley, delivering the opinion, said:

"Every lawyer at all familiar with the trial of mining cases where the question of existence, or non-existence, of a lode or vein is raised, understands the difficulty that is often, we might say always, encountered in the attempt to ascertain the facts. Practical miners, experts, and men of science are often examined as witnesses, and they frequently differ as much in their statement of facts as in their conclusions of judgment."

In 1882, in the case of James Harrington *et al* v. Robert C. Chambers *et al*, the judge made no remarks regarding expert testimony.

In 1886, in the case of Hyman v. Wheeler and others, Judge Hallett, charging the jury, said:

"The number of witnesses called by the parties was governed by rule of court, so that one could have no advantage over the other in that respect; and the witnesses are arrayed in point of numbers on party lines, half on one side and half on the other, so as to produce an embarrassing conflict of testimony. Such conflict is not an unusual feature of testimony in a mining suit. It has become so common and general that many thoughtful men entertain doubts as to the value and efficiency of trial by jury in such cases. If a given number of witnesses of fair character and intelligence can be produced at the will of the parties for or against any proposition that may arise in a mining controversy, without reference to the truth of the matter, of course the result of such an investigation cannot be very satisfactory."

In 1890, in the case of Cheesman *et al* v. Hart *et al*, Judge Philips, delivering opinion of the court, said:

"My observation at this trial satisfies me that an important mining litigation is a model training school for expert testimony; and if there ever is a case where the judge himself, like the witnesses in this case, should have the largest latitude of taking part in the discussion, it should be accorded in such cases, at least so far as it 'is profitable for doctrine, for reproof, for correction.'"

In 1893, in the case of Doe v. Waterloo Mining Co., the judge made no remarks regarding expert testimony.

In 1889, in the case of Cheesman *et al* v. Shreeve *et al*, Judge Philips, charging the jury, said:

"Some of the witnesses, unquestionably, have not told the truth; and it is for you to conclude who they are, and whom you will believe. Judging from this trial, there must be something in the altitude of that mountain, or the depths of its mines, wonderfully prolific of falsifiers and orators. From the men of science, versed in geology, mineralogy, and mining engineering, to the most unlettered miner who dwells in the bowels of the mountain, many of them seem to be orators; and, immediately after taking the witness stand, they would be found on the platform, on the same plane as the judge, making a speech to the jury, with all the warmth, energy, and zeal of hired advocates. Some of them were simply partisans, and seemed to have forgotten the office which the law and the obligation of their oath imposed upon them, to speak to the truth of their knowledge, and to tell nothing but the truth. Such exhibitions are to be deplored. They tend to break down the popular respect for the solemnity, dignity, and justice of judicial trials; and, where they obtain, trials are likely to become a mockery, and justice a failure. It will be found, however, gentlemen, in this case, as in the vast majority of trials, that the prominent, controlling facts in the great mass of testimony lie within a small compass."

In 1889, in the case of Butte & Boston Mining Co. v. Société Anonyme des Mines de Lexington, Judge Hunt said:

"The evidence was conflicting, many experts for plaintiff claiming that the apex of the vein from which the ores were extracted was in plaintiff's ground, and that it was wholly disconnected with any vein in defendant's ground, while an equal number of expert witnesses called by the defendant testified that, in their opinion, the apex of the vein was in the defendant's ground."

In 1899, in the case of Golden Reward Mining Co. v. Buxton Mining Co., Judge Thayer, delivering opinion of the court, said:

"The witness from whom this evidence was elicited was certainly competent, by reason of his training and experience, to form an opinion on the subject to which the inquiries were addressed which would be more reliable than an opinion formed by a person who lacked in special knowledge, training, and experience."

In 1900, in the case of Argonaut Mining Co. v. Kennedy Mining & Milling Co., the judge made no remarks regarding expert testimony.

In 1905, in the case of Wall *et al* v. United States Mining Co., District Judge Marshall said:

"I am aware that some experts color their opinions to suit their interests, too readily assuming that they are justified in advancing specious arguments to support their employer's side of the case; but it has not been my experience that they deliberately misstate facts, as distinguished from opinions, with greater frequency than other witnesses."

In 1912, in the case of Collins v. Barley *et al*, Judge Tully Scott, delivering opinion of the court, said:

"We can find no case wherein such a wild guess has been accepted as proof. In fact, the most that can be said in favor of such a conclusion is that it is the opinion of an engineer. But in view of the many worked and ore-bearing veins in the same locality, on the same mountain, with similar dip and strike, this opinion can be regarded as but little, if anything, beyond a guess, and mining engineers cannot be said to be infallible as guessers."

In 1915, in the case of Stewart Mining Co. v. Ontario Mining Co., Judge McKenna said:

"The court observed that the decisive assignment of error was lodged against the finding that the vein had not its apex in the Senator Stewart Fraction claim, and, after referring to the testimony of witnesses as to the inclination and apparent strike of the vein at certain points, said: 'But, taken as a whole, the evidence supports the findings, and the controversy arising on this appeal becomes a question as to the correct interpretation and application of the rule of law that should apply to the facts of the case.'"

In 1916, in the case of Jim Butler, Tonopah Mining Co. v. West End Consolidated Mining Co., Judge Averill made no remarks regarding expert testimony.

In 1916, in the case of Butte & Superior v. Clark-Montana Realty Co., Judge Bourquin said:

> "The testimony is of five experts for each party, all men of eminence in geology, or mining engineering, or both. For plaintiffs are Greene of Butte, Irving of Yale, Mead of New York, Searls of Nevada, and Winchell of Minneapolis. For defendant are Finch of Denver, Emmons of Minnesota, Salisbury of Chicago, and Burch and Urley of California. There is some conflict of facts and more of argument, opinions, and conclusions. Most of it can be imputed to the complex geological and other problems, conditions underground, difficulties of observation, and honest differences of interpretation by reasonable and learned men. But in instances partisanship apparently impaired judgment. As a whole, however, the testimony inspires confidence and deserves careful consideration. . . .
>
> "The court finds that the northerly wall of the Rainbow apex crosses the common side line 190 ft. from the southwest corner of the Blackrock, and that the southerly wall so crosses 301 ft. from said corner. For plaintiff the testimony is that the latter crossing is 'about' 308—rather the extreme and indefinite limit of the mineralization which accompanies the vein—to 314 ft.; for defendant, 'about' 300 to 301 ft. All agree there is no defined wall—that it is indefinite and leaves much to judgment. Considering the evidence in light of inspection and that the burden of proof is upon plaintiff, it is believed that the concession of defendant is more nearly right and as favorable to plaintiff as the facts warrant. The exposure is in a surface trench, and it is difficult to distinguish vein matter in place from mere seepage effect in adjacent country, whether of vein solutions or surface waters, and perhaps mushrooming beyond the limits of the vein proper below. A shaft might have contributed to accuracy. Finch testified that within the limits of the 300 ft. he included 15 ft. to the extreme limit of rock alteration, with a few little seams in it 'to be consistent with the interpretation of a vein at other points.' This is admirable frankness, but imports that at vital points and to indefinite extent he characterized that as vein which in his judgment is not vein, to serve his client and avoid haphazard of comparison. The difficulty is that, when an expert shades his testimony upon the principle *do ut des*, partisanship is likely, if not certain, to favor his client, and the court cannot determine to what extent, inevitably detracting from the weight of his opinion."

In 1917, in the case of Geddes *et al* v. Anaconda Copper Mining Co., Judge Ross made no remarks regarding expert testimony.

In 1917, in the case of Bourne v. Federal Mining & Smelting Co., Judge Dietrich said:

> "Upon the whole, the relation of the witnesses to the parties was such that presumptively it may be said that the witnesses for the defendant were more interested in the result than those of the plaintiff; but in consideration of the nature of the issue and the absence of any evidence of a disposition on the part of the witnesess upon either side to be unfair, I am not inclined to attach great importance to this feature of the case. No question is made of the honesty or integrity or general character of any of the witnesses. They do not differ widely concerning the evidentiary facts, and it is not strange that they should take different views of the significance of these facts and the scientific conclusions to be drawn therefrom."

In 1918, in the case of Original Sixteen to One Mine, Inc., v. Twenty-one Mining Co., Judge Rudkin said:

> "The experts on each side consisted of geologists, mining engineers, and practical mining men. It is almost needless to say that the opinions of these experts were positive and unequivocal in favor of the party who called them, and little would be accomplished by adding one or more additional experts to the long list already on the record."

In 1920, in the case of Star Mining Co. v. Federal Mining & Smelting Co., Judge Ross said:

> "Sufficient reference has already been made to the inconsistent testimony and opinions of the distinguished geologists of the respective parties, the nature of which confirms us in the opinion that in the consideration and decision of such cases it is safer, and consequently more satisfactory, to rely upon the testimony of expert mining engineers who are familiar with the mineral formations and deposits of the particular district and upon the actual work and observations of experienced mining superintendents who have active charge of the work in such mines."

Healthful Mine Conditions Demand Intelligent Operation of Wet Drills*

Notwithstanding all the effort made to introduce wet drills to prevent dustiness of air of metal-mine working places, there has during the last few years arisen in Australia and South Africa an impression that wet drills, including the Leyner type, actually cause undue quantities of finely divided ore and rock to rise into the air, these fine particles being chiefly attached to particles of fog or spray escaping from holes using water drills. This is said to have created consternation in the ranks of the mine operators who have complied with drastic wet drilling regulations and purchased and operated various types of wet drills.

In view of this situation and the fact that wet stopers are being rapidly introduced with considerable success in many of the metal mines of the United States, D. Harrington, who has for the last five years been engaged largely in studying the dust problem in the metal mines of the West for the U. S. Bureau of Mines, has compiled the dust sampling of air of drilling places in 214 workings in thirteen mines at time of drilling, using various types of wet and dry drills with upper, inclined, horizontal, and some down holes. The result of these tabulations indicates that irrespective of the conditions in South Africa and Australia, the use of wet drills in the United States results in a decided decrease of dustiness of the surrounding air as compared with dry drilling, whether the holes are upper, or inclined, or horizontal, and practically irrespective of the types of drill used. Nevertheless, there are some dangers from dust in air surrounding wet drilling operations unless certain precautions are taken.

The dust studies to date in metal mines of the United States by the U. S. Bureau of Mines indicate definitely that wet drills as used in drilling of all classes of holes aid decidedly in reducing dustiness of air in drilling places. However, it has been found that wet drills, whether of the Leyner type or stopers, if not operating satisfactorily or if out of repair, may throw into the air of working places a mist or fog, laden with minute mineral particles, which when breathed has the same effect as dry dust and is fully as dangerous. In addition to danger when wet drills are not efficiently used, if water or compressed air and water forced through the drill is under excessive pressure, say over 100 lb. per square inch, there may be danger of escape of mist or fog laden with mineral particles; hence these pressures should be held below 100 lb. per square inch, which, in general, is the practice in the United States.

Wet drills must be kept in repair and must be operated with intelligence. As far as proved by the sampling of the Bureau of Mines, the wet drills, even when at their worst, still give conditions much more healthful than do dry drills.

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*Abstract of a paper, "Drilling and Dustiness of Metal-Mine Air," by D. Harrington, *Reports of Investigations*, U. S. Bureau of Mines. Serial No. 2339

USEFUL OPERATING IDEAS

Seneca's Novel Man Cage

Built on Ferris Wheel Principle for Use in Compound Shaft—Other Notes—Shaft Spillage Eliminated

By Henry M. Payne

THE Seneca shaft of the Seneca Copper Corporation, Calumet, Mich., has two compartments, with a ladderway in the center. The first 1,320 ft. is vertical. The shaft then passes through an arc of 610 ft. on a 600-ft. radius and into a slope at 32 deg. for 770 ft. further. The curved part is provided with twenty 4-ft. sheaves in each compartment.

In order to handle both ore and men in such a hoistway and keep the skips at all times vertical, a specially designed skip has been devised by W. J. Uren, superintendent at the Seneca. This skip, which dumps like a Kimberley, has proved markedly satisfactory and successful.

The man skip is not unlike a single cage of a Ferris wheel, suspended on trunnions between two vertical steel beams. The top is rounded to avoid hitting the roof, on the curved part of the shaft, and the entire cage is covered with heavy wire net. To reduce oscillation when in motion, and owing to change of direction, the pantograph side bars are attached to oil cylinders, which act in the same manner as shock absorbers on an automobile, and adjusted to any given load and speed. As a result, the cage passes through shaft, curve, and incline as steadily and as normally vertical as though continuously in a straight shaft.

Automatic gates are in operation at the ore chutes, so that instead of the estimated 8 per cent spillage usually occurring, there is none. It is Mr. Uren's theory that the discharge of the chute should be in exact conformity to the angle of the shaft above. The measuring box requires sizing of the rock, which at no time should exceed one-third of the internal diameter of the chute. Under these conditions a seven-ton skip is loaded without spillage in five seconds.

The drifts are 8 x 12 ft. in dimension, with a 24-in. gage track. Six-ton cars on two four-wheel trucks are used for tramming, the body being 16 ft. long and 4 ft. 4 in. wide, with drop doors. The axles of the trucks are 30 in. wide center to center.

The Gratiot shaft, which was recently taken over by the Seneca company, extends for thirteen levels at an angle of 34 deg. and will, when deepened, intersect the Seneca workings at a distance of 3,200 ft. The upper 100 ft. of the shaft is being lined with concrete, forming three compartments, the manway being fitted with a concrete stairway. The hoistways are being laid with 60-lb. rails bolted to 6 x 10-in. stringers laid in concrete sockets. The manway stairs are faced with creosoted planks, bolted down.

A new power house is being built at the Gratiot, on posts to facilitate construction. The building foundations, around the engines, will be laid during the summer.

Supplies Required in Mine Track Work

By George J. Young

In the construction of mine tracks considerable variation is encountered in the track gage, size of tie, spacing of ties, and in the weight of rails used. The minimum gage is 18 in., and for ordinary hand-tramming a 16-lb. rail is used. For light motors 25 to 30-lb. rails and for heavy motors 35 to 50-lb. rails are used. Ties in most cases are used transverse to the track length, but in a few instances two longitudinal stringers are used to support the tracks.

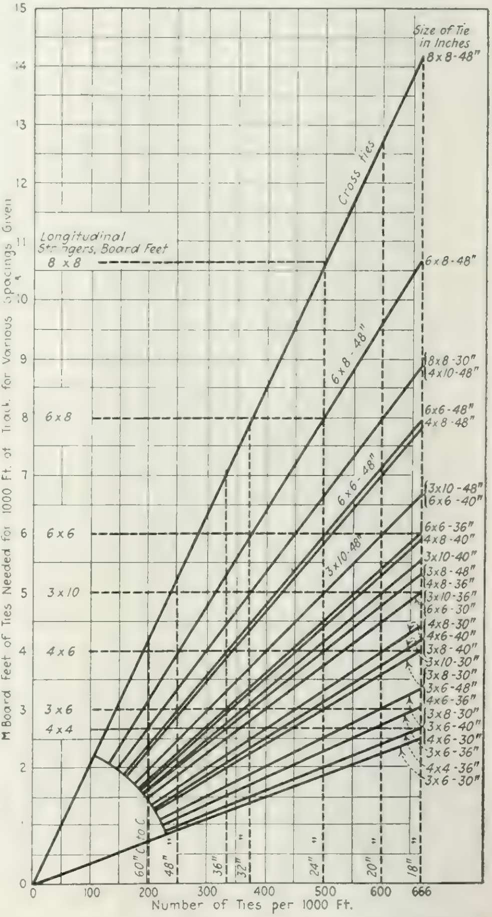


Chart showing board feet and number of ties needed in mine track work

Where a solid rock bottom free from ground movement characterizes the drift or adit, the longitudinal stringer support for the track is worth consideration. The smallest tie used is 3 x 6 x 30 in. in length. Smaller ties are used, but only for unusually light work.

Tie spacing ranges from 18 to 60 in., center to center. The accompanying diagram enables the total number of board feet required for 1,000 ft. of track for the sizes of ties specified to be readily determined. The diagonal lines give the board feet for cross ties, with various spacings, and the horizontal heavy lines the board feet required for two longitudinal stringers for the 1,000 ft. lengths of track. In addition, rail weights, track spike and bolt sizes are given.

TRACK SPIKES FOR 1,000 FT OF TRACK

	Inches Center to Center						
Spacing of ties ..	18	20	24	32	36	48	60
No of spikes	2,664	2,400	2,000	1,500	1,332	1,000	800

BOLTS FOR 1,000 FT OF TRACK

Two hundred and sixty-four bolts are needed per 1,000 ft. of track, using 30-ft. rail lengths, 66 joints. Double the number of bolts needed for 15-ft. rail lengths.

WEIGHT OF RAILS FOR 1,000 FT OF TRACK

Wt. of Rail Lb. per Yd	Wt., Lb.	Size Spike, In	No Per Lb.	Size Bolt, In	No Per Lb	Wt of Fish Plates Per Pr., Lb
12	8,000	3 x⅜	7	½x2	2.62	3.44
16	10,656	3 x⅜	7	½x2	2.62	4.36
25	16,650	3½x½	3.35	⅝x2¼	2.45	5.70
30	19,980	3½x½	3.35	⅝x2¼	2.45	10.45
35	23,310	5 x½	2.5	¾x3	1.33	12.10
40	26,640	5 x½	2.5	¾x3	1.33	16.10
45	29,970	5 x$\frac{9}{16}$	2	¾x3	1.33	18.75
50	33,300	5 x$\frac{9}{16}$	2	¾x3	1.33	25.05

Non-cupellation Method of Gold-Bullion Assay

By A. W. Allen

The customary procedure adopted in assaying bullion for gold has persisted for so long without appreciable modification that the question of an alternative method has been considered by few. This is due largely to the fact that current practice permits an estimation of both gold and silver in the bullion. Recently, however, Arthur Westwood aroused interest at a meeting of the Institute of Metals by describing the following novel procedure, which has given satisfactory results. In this the cupellation phase is omitted, and copper is used in place of silver as the inquarting element.

The amount of bullion taken for assay, according to the originator of the method, is five grains—a fact that draws attention to the system of weights and measures still in vogue in England, even in precision work such as assaying. To this is added copper in amount so that the total weight will be from two to two and one-fourth times the amount of gold present. A gas muffle-furnace is used, the muffle being replaced by five or six silica tubes, 1⅛ in. internal diameter and 3 ft. long; these project from the front of the furnace for half their lengths. The copper-bullion tests are melted, each in a clay cup of a shape to fit the tube, and each tube taking ten cups. The tubes are connected at the back of the furnace with a small boiler; the front ends of the tubes are open to the atmosphere. A steady flow of steam is maintained during the melting and cooling of the tests.

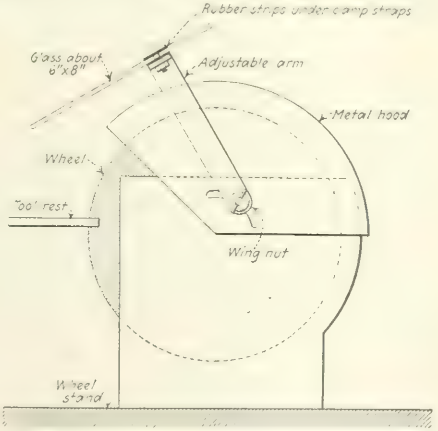
Melting, provided a temperature slightly above the melting point of copper is maintained, is done in five minutes. The tests are then withdrawn toward the open ends of the tubes to cool. On removal, the beads are hammered and rolled in the usual manner. Annealing is unnecessary. The fillets are then folded, and parted with acid.

The new method has the merit of extreme simplicity. Its adoption should result in an appreciable economy of time and labor in those operations where an estimate of silver content is not required. Mr. Westwood has published sundry data in support of its accuracy; but the scope and application of a non-cupellation method in general metallurgical work remains to be estimated. The fundamental idea is attractive and will doubtless appeal to many assayers.

Glass Shield for Emery Wheel

By W. J. Tait

The glass shield shown in the in the accompanying illustration has been found of considerable value in protecting operators of emery wheels. It obviates the use of goggles, with all their attendant troubles, such as broken parts, dirty lenses, and the general dislike manifested toward them.



Glass shield to protect operator of emery wheel

In addition, the operator cannot inhale the particles thrown up by the wheel. This is a greater menace than is ordinarily supposed, as large numbers of these particles are not visible but show their presence by pitting the shield.

The glass used is a piece of plate from a broken windshield, and all the material is usually available in the ordinary shop. By mounting the glass in a hinged holder, it can easily be pushed out of the way when desired.

Various adaptations can be made so that the shield will work without interfering with the usual operations in a shop.

Pouring Copper for Wire Bars

Side-dump ladles have been installed at the Quincy smelter, in northern Michigan. These pour tangentially, thus enabling continuous pouring for wire bar, it having been found that intermittent pouring causes a jolt in the unset metal at the moment of solidification, which affects the quality of fiber in the finished product.

THE PETROLEUM INDUSTRY

Naval Oil-Reserve Leases Explained By Secretary Fall

DECLARING that he was defending neither specific acts nor general policies regarding the leasing of Naval Oil Reserves, but that he was merely offering a frank and full explanation of the reasons and motives of himself and the Secretary of the Navy in the performance of such actions and the establishment of such policies, Secretary Fall of the Interior Department has made a long report to the President. It says in part:

"The naval petroleum reserves were created by order of the President, and out of the lands theretofore withdrawn as general petroleum withdrawals and are as follows:

"No. 1, Sept. 2, 1912, 38,969 acres, in Elk Hills, Cal.

"No. 2, Dec. 13, 1912, 29,341 acres, in Buena Vista Hills, Cal.

"No. 3, April 30, 1915, 9,481 acres, Teapot Dome, Salt Creek, Wyo.

"The geographical situation of Naval Reserves Nos. 1 and 2 has been hereinbefore casually referred to. With reference to the oil development, it may be stated that there exists competition in these fields between some of the large companies of the United States, among others the Standard Oil, the General Petroleum, the Associated Oil, the Pacific Oil, the Union Oil, the Pan American, and others. There are four pipe lines upon Naval Reserve No. 2, with one pipe line owned by the Standard Oil upon Naval Reserve No. 1, other pipe lines adjacent to such reserve, and still another large pipe line building into Naval Reserve No. 1, with the prospects of still a third line entering such reserve.

"These respective pipe lines lead to refineries upon the Pacific Coast and thus afford an opportunity for the Navy to dispose of its oil, at competitive bids, upon each of said reserves, to exchange crude oil at the well for fuel-oil certificates calling for delivery at the Western seaports; or, if it so desires, to have its oil conducted as it comes from the well through such pipe lines, directly to the coast, at such points as may be reached, particularly Los Angeles and San Francisco.

"With reference to petroleum reserve No. 3, in Wyoming, of course, it is well understood that the geographical situation is entirely different. In an air line from the Salt Creek field, in Wyoming, to Los Angeles it is approximately 1,000 miles. By air line from said Salt Creek field to Norfolk, Va., and points north it is approximately 1,700 miles. No pipe lines connecting this field with either coast have ever been constructed. The only pipe lines in the vicinity of naval petroleum reseve No. 3, or in the Salt Creek field, is the one pipe line of the Midwest Refining Co., with a total length of approximately fifty miles, extending through the field and to the refineries of the same company at the city of Casper. To transport the oils from the Salt Creek field, which is now producing, and from that portion of the same known as petroleum reserve No. 3, it would be necessary either to use tanks mounted upon vehicles, which, of course, would be nonsensical, or to extend the present Midwest line a short distance and use it for transporting oils to Casper, from which point, however, the crude oil, or any products thereof, would necessarily be transported then upon tank cars of the railroads touching that place. The facts, however, are that the present capacity of this pipe line is not sufficient to take the present production of the Salt Creek field.

"It is of peculiar interest to note that from the experience of others engaged in the production of oil, and through the research and experiments and experience of the Bureau of Mines experts through actual tests in the field and checking tests in the laboratory, it has been stated, and is generally conceded as an established fact, that through no present known process of pumping, or through the natural flow of an oil well can more than 20 per cent of the oil contents of an oil sand be extracted. These facts have been pointed out in Bulletin No. 148 of the Bureau of Mines, issued in 1917, which bulletin, unfortunately, has proven of interest only to experts and has not been read generally by those who assume to know something of the oil question. This bulletin was written by Mr. J. O. Lewis, then with the Bureau of Mines; later chief petroleum technologist; and now with Smith-Dunn, of Marietta, Ohio, who hold the patents to the so-called Smith-Dunn, or Marietta, process for forcing compressed air into the oil sand and drawing it out through adjacent wells. In this process the air takes the place of the gas, and has definitely established the fact that gas is the principal medium in bringing the oil to the well, and its production, depletion, or waste must be considered in arriving at the possible production and at least at the term of life of the flush production of oil wells.

"In considering the naval oil program—that is, the matter of the use of the naval royalty oils from the then production in reserves 1 and 2, and the use to be made thereof—the construction of storage therefore at strategic points and where the oil would not be wasted or lost but could be retained without fear of such loss above a fraction of 1 per cent for ten-year periods, it was mutually agreed between the Secretary of the Navy and the Secretary of the Interior that such program should be worked out first for such two reserves, and should not be extended to naval petroleum reserve No. 3, unless there was danger of loss to the Navy through drainage therefrom. The alarming conditions existing in the first two fields, as hereinbefore related, caused early attention, however, to be directed to the possibilities or probabilities of such drainage of the Teapot Dome, in naval reserve No. 3. . . .

"Mr. Heald [of the U. S. Geological Survey] states that—

"'If appreciable loss becomes imminent, due to intensive drilling near the line, fractions (within the naval reserve) should be leased in the order given' (by him). And he concludes with the advice that no further leasing should be done. I am glad to send this report up in full, as attached hereto, as I understand that some parties have claimed that they had information it was of a very reassuring character, and that because of the advice given, no lease of any area in the Teapot Dome should have been made.

"The official of the Bureau of Mines representing the United States Government in this district is Mr. F. P. Tough, chief oil and gas supervisor, who has official representatives checking oils, supervising drilling, making tests, collecting royalties, etc., all residing in Wyoming, and who every day during the year are actively in the field in the performance of their duties. To Mr. Tough instructions were given prior to September, 1921, and through him instructions given his subordinates, to make careful examination into the probable drainage of the Teapot Dome, or petroleum reserve No. 3.

"Mr. Tough is a graduate of Columbia University in mining engineering, with a course of geology, and for six years was resident geologist for the oil properties of the Southern Pacific interests in California. The conclusion of the oil experts of the Bureau of Mines, communicated both in verbal and written memoranda reports to the Secretary of the Interior, was that much more grave and serious danger of losses by drainage through outside drilling existed and exists than appeared to be understood by the Bureau or the Geological Survey. Their experience upon the ground was and is that where faults occur, as they do occur in the similar structure and in the identical sands supposed to underlie the Teapot Dome within the present producing area of the Salt Creek field, such faults have not interfered at all with drainage and they have not caused a sealing of one pool of oil from another or from encroaching waters. I herewith file, marked 'Exhibit I,' memorandum report made by Mr. Tough, which brings up to date information heretofore obtained from time to time during our investigation. Because of the actual facts stated as above experienced, particularly as to the wells drilled in the Salt Creek field and the water level in relation thereto, this report, even if it be considered as conflicting with the reports of geologists and others, would be almost conclusive.

"As has just been shown, the undeniable facts, in so far as human judgment can ascertain them from expert evidence and otherwise, are that at least a certain portion of the north part of the naval reserve No. 3—the Teapot Dome—is now, or will be, disastrously affected through drainage by the drilling upon the lands outside the reserve, which drilling is now being carried on from day to day. Such drilling upon such lands is in accordance with the terms of the law itself, and those conducting such operations are protected by the law. This being the case, it is necessary immediately, or it is practically admitted by everyone claiming to know anything of the conditions, that it will be necessary in a comparatively short period of time to protect such threatened area, and that the only feasible method of such protection is to cause drilling operations of offset wells and the consequent production of oil from the Teapot Dome.

"As shown herein, conditions are not similar in the Salt Creek field. It would become necessary either to add to the present overstocked oils by attempting to dispose of the oils so drawn from Teapot Dome in a market where competitive conditions do not exist, or to provide storage upon the ground for the same. Such storage would be a thousand miles from Los Angeles and 1,700 miles from Norfolk, with no method of transportation to either point, or any other seaport, except by transportation overland in tanks. In the next place, neither the Interior Department nor the Navy Department has any appropriations or funds which could be used or diverted for the construction of such storage. Therefore, the only possible method by which it could be handled would be to sell the oil for such price as it might bring. The only other alternative would be to allow the present owners or lessees of adjoining lands to drain this area and to use for their own purposes the oils obtained therefrom without compensation to the United States Government or to the Navy.

"Therefore, Mr. President, the Secretaries of the Navy and the Interior were, in attempting to formulate the proper administrative policy for the preservation of the interests of the Government in the oils of petroleum reserve No. 3, the Teapot Dome, at the beginning of the year confronted with these conditions, to wit: First, that by deferring productive drilling in naval reserves Nos. 1 and 2 in California great and irreparable losses had been incurred through the drainage of the governmental land by wells drilled upon privately owned or privately held lands; second, that serious, and as we believed immediate danger of material losses to the Government was impending through the drainage of an area approximately at least 2,000 acres out of naval petroleum reserve No. 3; third, that in the event of an attempt to protect by drilling offset wells in petroleum reserve No. 3 such production could not be effective because of the geographical and commercial conditions existing in the Salt Creek field, as hereinbefore set forth. We realized that conditions were entirely different, as I have explained, in the California and Wyoming fields. In the one, to reiterate, we had competitive bidding, competitive prices, competitive pipe lines, and water communication through such pipe lines. In the other, Wyoming, no competitive bidding, a geographical monopoly, no pipe line except to a railroad, and that of insufficient capacity to convey the then daily production by 50 per cent of the total being produced, no pipe lines from the railroad, no pipe lines to the water, and no possibility of the Navy using the oils except through the sale in such restricted and non competitive markets, with the proceeds to the miscellaneous fund, or some exchange to be worked out based upon the low price of the crude oils in the Salt Creek field and the acquisition of naval fuel oils when needed.

"The final conclusion of this matter, after almost continuous consultation between the Navy and the Interior Departments, was the formulation of a skeleton contract setting out the royalties which would be required, the exchange provisions and others, and containing practically the identical terms as finally embodied in the signed and executed contract now held by the Mammoth Oil Co. The details, however, were under consideration for many days, and consultation with other independent oil companies and their representatives were proceeding in the meantime. When attention was called to certain provisions with reference to pipe lines and connections, particularly frank statements were made by such representatives of well-known financial ability, that although they could finance the proposition without difficulty, they could not enter into exchange transportation agreements such as were finally demanded and to which Mr. Sinclair acceded. The royalties offered by Mr. Sinclair were more than those offered by either or any other party during these discussions."

Oil Production Decreases Except in California

The petroleum situation is discussed under date of June 1, by the Federal Reserve Board in its survey of business, as follows:

Production of crude petroleum during April decreased considerably for the country as a whole. This was especially noticeable in District No. 11 (Dallas, Tex.). In this district crude petroleum production, which reached a peak during March, declined sharply, and only 13,750,590 bbl. was produced, a decrease of 2,496,090 bbl. This large reduction was due partly to the unfavorable weather conditions and partly to the low production of new wells completed. Both the Louisiana and Texas fields shared in this reduction, the April daily average yield for all Texas fields being 349,713 bbl., against a daily average flow of 389,944 bbl. during March. District No. 12 (San Francisco) again reports increased production, and a decrease in consumption, resulting in the largest stored stocks of crude petroleum since April, 1917.

Average daily production in California during April was 341,077 bbl., compared with 333,737 bbl. in March and 338,981 bbl. in April, 1921. Forty producing wells were completed during the month. Stored stocks of gasoline held in California decreased 12,693,835 gal. during March and stood at 63,718,701 gal. on April 1, compared with 51,573,945 gal. on April 1, 1921.

An estimate of the crude oil production in Distict No. 10 (Kansas City) indicates a decrease when compared with March, but an increase when compared with April last year. In that district there was an increase in the number of wells completed, and the daily new production was 7,107 bbl. less than in March, but more than double the daily new production during the corresponding period a year ago.

No radical price changes have been noted in any of these districts for crude oil. Refiners report a general improvement in the situation, with the increasing demand for gasoline. As the season has advanced increases of from 2c. to 2½c. per gallon have been made.

MEN YOU SHOULD KNOW ABOUT

W. J. Loring has returned to San Francisco.

G. L. Sheldon, of Denver, Col., has gone to Fuerte, Sinaloa, Mexico.

Eugene B. Braden has returned from New York to San Francisco.

R. C. Moore is doing geological work on the Kaiparowits Plateau, in Utah.

Thomas H. Leggett has returned to New York from a journey to Nevada and Utah.

T. A. Rickard returned to San Francisco last week from a visit to Santa Rita, N. M., and Denver, Col.

A. I. D'Arcy, mine operator of Goldfield, Nev., has returned to Goldfield after an absence of two months.

L. F. S. Holland is examining mines in central Oregon. He expects to return to Hollywood, Cal., about the middle of June.

John V. W. Reynders, a director of the A. I. M. E., addressed the local section of the Institute in San Francisco on June 5.

W. W. Wishon has been appointed consulting engineer to the Katherine Big Four Mining Corporation, operating at Kingman, Ariz.

J. H. M. Shaw, director of the Exploration Company, sailed to London from New York on June 13, on his return from El Oro, Mexico.

Major J. M. Campbell, of Middlesboro, England, made a tour of inspection of the mines and open pits on the Mesabi iron range last week.

John A. Anderson has gone to Overland Canyon, Tooele County, Utah, to do prospecting work. He expects to remain there until September.

D. D. Muir, Jr., in charge of the Salt Lake City office of the U. S. Smelting, Refining & Mining Co., was in San Francisco early in June.

C. D. Avery, of the U. S. Geological Survey, has returned from a visit to the Moorcroft, Wakeham, Thornton, Osage, and Newcastle oil districts.

J. D. Northrop is in New Mexico making a special examination on the east side of the San Juan Basin in connection with coal leasing work.

Luther B. Eames, formerly with the Goldfield Consolidated and Hollinger companies, is now with the Stearns-Roger Manufacturing Co., of Denver.

A. H. Brooks, in charge of the Alaskan division of the U. S. Geological Survey, is en route to Alaska with the party of **C. H. Huston**, the Assistant Secretary of Commerce.

Stanly A. Easton, manager of Bunker Hill & Sullivan Mining & Concentrating Co., spent a few days at the home office of the company in San Francisco, early in June.

C. H. Abeling, mill superintendent for the Vipont Silver Mining Co., at Vipont, Utah, is making a visit to Boise, Idaho, Spokane, Wash., and the Cœur D'Alene mining district.

Prof. Frederick W. Sperr, with a party of forty-two students from the Michigan College of Mines, spent two weeks recently on the Gogebic Range studying mining methods and equipment.

F. A. Wildes, state superintendent of mines, recently visited the Mesabi iron range on one of his inspection trips. The trip included the operations and plant of the Mesabi Iron Co. at Babbitt, Minn.

H. I. Altshuler, formerly with the Cerro de Pasco Copper Corporation, at Cerro de Pasco, Peru, is now at Tayoltita, Distrito de San Dimas, Dgo., Mexico. Mr. Altshuler was recently in San Francisco.

Major Yuill, mining engineer, of London, England, has arrived in Canada and is on his way to Lake Chibougamou, Quebec, to examine the mineral deposits there in the interests of a group of British financiers.

Dr. Frank D. Adams, professor of geology and dean of the faculty of applied science at McGill University, Montreal, has been appointed chairman of the Canadian Advisory Council for Scientific and Industrial Research.

John G. Barry, consulting mining geologist, has recently completed some examinations in the Santa Eulalia camp, and has proceeded to the Santa Barbara and Parral districts of Chihuahua, Mexico, on additional work.

James F. Callbreath, Secretary of the American Mining Congress, arrived in Denver on June 12, and will remain to complete arrangements for the Western Mining Conference which will be held there June 20 and 21.

In recognition of his services in developing metal research in this country, **Dorsey A. Lyon**, chief metallurgist of the U. S. Bureau of Mines, has had conferred upon him the degree of Doctor of Science by the University of Utah.

Frank H. Blackwell, chief geologist and mining engineer of the McKinney Steel Co., and **Clarence D. Pitman**, mining engineer, have gone to the company's gold mine in Mexico. They will visit other southwestern properties, and Mr. Pitman will take up residence in El Paso.

H. L. F. Blake, mining engineer, of Ottawa, has gone on an exploring expedition to the Ungava district in Northern Quebec in charge of a party of British engineers, representing important English financial interests. The principal objective of the expedition is Lake Chibougamau, on the southern border of Ungava.

Sidney Paige, G. W. Stose and **Mrs. Knopf**, geologists in the services of the U. S. Geological Survey, left June 1 for a field conference in Pennsylvania to establish certain conclusions with regard to the Glenarm series. They were joined in the field by **Florence Bascom** and **Anna I. Jonas.** State Geologists **Ashley** and **Mathews** expected to participate in the review of the stratigraphy, with which both Pennsylvania and Maryland are concerned.

H. S. Mulliken, head of the new War Minerals Supply Division of the U. S. Bureau of Mines, Washington, D. C., is in New York on Wednesday and Thursday of each week, largely in connection with the co-operative Government work connected with the determination of prices obtained for major metals. He has offices in the Custom House in connection with the U. S. Bureau of Foreign and Domestic Commerce, Room 734, and may be addressed there.

F. G. Cottrell, formerly director of the U. S. Bureau of Mines, and until recently head of the Division of Chemistry and Chemical Technology of the National Research Council, has been selected for the directorship of the Fixed Nitrogen Research Laboratory, of the Department of Agriculture. He will succeed **Richard C. Tolman**, who has resigned to become professor of physical chemistry and mathematical physics at the California Institute of Technology at Pasadena. No decision has been made as to the exact date on which Dr. Tolman will turn over the work to Dr. Cottrell, but it probably will be late in the summer. Dr. Tolman's duties with the California Institute of Technology begin with the fall term.

Mining and metallurgical engineers visiting New York City last week included: **Charles F. Jackson**, of Cleveland, Ohio; **G. J. Kennedy**, of Easton, Pa.; **M. F. Sayre**, of Schenectady, N. Y.; **S. W. Harris**, of Silver City, N. M.; **S. A. Crandall**, of Kellogg, Idaho; **T. K. Muir**, of El Paso, Tex.; **W. M. Dake, Jr.**, of Denver, Col., and **A. J. Bartlett**, of Marytown, W. Va.

OBITUARY

H. W. Pridgeon, manager of the West Springs, Ltd., died April 19, at Johannesburg, South Africa. Mr. Pridgeon was for many years underground manager of the Brakpan Mines, and in 1916 was appointed manager of the Daggafontein gold mine. In 1919 he was transferred to West Springs.

James H. Pearce, aged seventy-four years, a leader in the development of the Minnesota iron ranges and one of the founders of the city of Chisholm, Minn., died at Minneapolis on June 3. Mr. Pearce came to the Minnesota iron ranges from Michigan thirty years ago as general manager of the Corrigan-McKinney interests. He was instrumental in opening up some of the first mines on the Mesabi range and was at one time associated in mining with **A. M. Chisholm** and **George H. Crosby**, of Duluth.

New Books

A Standard Work on Colloids Revised

Chemistry of Colloids. By W. W. Taylor. Longmans, Green & Co., New York. $3.50.

This is the second edition of an excellent treatise that appeared in 1915 and served to remind one that the development of colloid chemistry was not entirely due to German investigators. It has served as a concise textbook, and for reference by workers in other sciences who are interested in the subject. It treats primarily with the fundamental theories of colloidity, and it is interesting to note that the work done has been so thorough and so scientific that no radical changes of interpretation are noticeable in the new edition. The general arrangement has been maintained, the book being divided into four main divisions, dealing with the general properties of colloids, methods of preparation, surface phenomena and adsorption, and application of colloid chemistry.

Under osmotic pressure one notes reference to the work of Einstein, who maintains that osmotic work varies directly with the number of particles in unit volume. The subject of ultrafiltration is discussed at greater length, as is the action of electrolytes on emulsoids. Bachman's work on alcogels is quoted, and increased attention paid to the structure of gels, the author showing that there has been a return to the early theories of Frankenheim (1835) and Nägeli (1858). Little additional work has been done during late years on the preparation of colloids; the theories of adsorption are still unsatisfying and incomplete. The final chapters of the book deal lightly with the practical application of colloid chemistry, the author discussing dyeing, tanning, the soil, purification of sewage, and the application of colloid chemistry to biology.

The treatise is a scholarly attempt to discuss the fundamental principles underlying colloidal phenomena. It is creditably free from errors, technical and typographical, and will be recognized as one of the standard textbooks on the subject. A. W. A.

Two Commercial Directories

Industrial Directory and Shippers' Guide. Published by New York Central Lines, New York.

This book will be of interest to all who may have occasion to ship freight over any of the New York Central Ry. lines. It contains sketches of the industrial communities reached by the road, a directory of some 50,000 producers and manufacturers of almost every conceivable product, a large number of city and railroad maps, particulars of banks and trust companies and commercial organizations in the region covered, and much information of value to importers and exporters, all in a well bound book of about 1,000 pages. The volume will be sent free of charge to those to whom it will prove useful.

Hendricks' Commercial Register, 1922. S. E. Hendricks Co., 70 Fifth Ave., New York. $12.50.

This is an exceedingly valuable book for those who want to know "who sells what," and it is constantly used in this office for answering inquiries as to names of producers, manufacturers, and dealers in all parts of the country. The classifications are the same as formerly: alphabetically by commodities; by individuals or companies; and by trade names.

◆

Aluminum and Its Alloys. By C. Grard. Translated from the French by C. M. Philips and H. W. L. Phillips. D. Van Nostrand Co., New York. $5.

This book discusses the properties, thermal treatment, and industrial application of the metals mentioned in the title. Only six pages are devoted to winning the metal from its ores, so the book is chiefly of interest to present and prospective users of aluminum. The topics covered include physical, chemical, and mechanical properties; micrography, preservation, soldering, quenching, and casting. Much experimental work is illustrated by charts. The book is hardly large enough to be comprehensive, but contains much of value.

◆

The Engineering Index, 1921. Published by The American Society of Mechanical Engineers, New York City. $6.

When we have occasion to look up a reference to an article published in the technical press, we instinctively turn to this book or to the Industrial Arts Index published by the H. W. Wilson Co. The Engineering Index is not so complete, omitting to catalog many articles which would hardly interest mechanical engineers, but it gives a brief absract which is often valuable. Over 14,000 articles are listed, which appeared in about 600 engineering and allied technical publications. A new volume is published each year, and the books are valuable to those who have need to look up the published literature on any engineering subject.

◆

Coal Mining Costs. By A. T. Shurick. The McGraw-Hill Book Co., New York. $5.

Although metal miners are not usually particularly interested in coal mining, the two branches overlap at many points, and much data that apply to the one phase of mining activity are equally applicable to the other. The present book is the first to discuss coal-mining costs on a comprehensive scale. The various sections cover mining costs, shaft sinking, haulage costs, timbering costs, and miscellaneous inside costs, all the data applying to underground work. The metal miner will find much of interest.

Technical Papers

Uses of Copper and Zinc — The *Monthly Journal of the Utah Society of Engineeers* for February (Hugh C. Lewis, University Club, Salt Lake City, Utah; price, 25c.) contains an eleven-page article discussing briefly the principal ways in which copper and zinc are used and some of the specifications which the metals so used must meet. There is little that is new in the article, but it is a good compilation.

Thickness of Strata — Professional Paper 129-C issued by the U. S. Geological Survey, Washington, D. C., obtainable on request, describes the graphic and mechanical computation of thickness of strata and distance to a stratum. The paper gives a geometric solution, a trigonometric generalization, and simplified methods of computation.

Mining Accidents—Technical Paper 295, "Quarry Accidents in the United States During 1920," and Technical Paper 299, "Metal-Mine Accidents in the United States During 1920," are now available from the U. S. Bureau of Mines, Washington, D. C. The bulletins consist largely of tabulations, with accompanying explanations.

Magnesium — The *Electrician* for Jan. 27, 1922, has an article on the production of metallic magnesium, describing principally an electrolytic process to be used by the Magnesium Company in England. The article is reprinted in *Chemical and Metallurgical Engineering* for May 24, 1922. (New York, N. Y.; price, 25c.)

Anti-Corrosive Material for Tanks—Metallurgists who have acid solutions to handle are accustomed to having much trouble from deterioration of apparatus which comes in contact with the corrosive liquors. In the *Iron Trade Review* for April 6 is a six-page article "Why Pickling Tank Rods Corrode," which describes a series of experiments conducted on various acid-resisting materials used in tank construction and suggests means for minimizing acid attack. Monel metal seems to have much to commend it for such uses. Reprints of the article may be secured free of charge from the International Nickel Co., 67 Wall St., New York City.

Hydraulic Calculator for the Solution of Water Problems in Canals, Flumes, Culverts, Pipe Lines, Etc. Devised and for sale by J. R. Jahn, Berkeley, Cal. Diagrams are accompanied by flexible transparent straight-edge and an eight-page pamphlet of directions.

A nomographic chart for the purposes stated above and for various other calculations incident to irrigation, water power, and water supply, including pumping plants, weirs and earthwork estimates. Values for n in open and closed conduits and for v in open canals are suggested.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

TESTIMONY by Horace V. Winchell on the proposed revision of the mining law was an interesting feature of the hearing before the Committee on Mines and Mining on June 8. It developed that Secretary Fall is opposed to any radical change.

International Nickel will resume work at its mine and smelter on Sept. 1, it has been definitely announced.

The Denison "Blue-Sky" bill will not be considered at this session, on account of the large amount of other legislation pending.

Increasing scarcity of skilled labor is reported from various mining districts.

Mining in the State of Washington is now about a third of normal, according to a review in this issue.

A consular report from Mexico states that money is scarce there and that some mining companies are having difficulties in securing needed funds.

Activity continues in the Porcupine district. Dome has taken an option on the Foley-O'Brien, and a rumor is in circulation concerning the sale of the Schumacher.

Iron Ore Freight Rates Ordered Reduced

Interstate Commerce Commission Rules for 10 Per Cent Cut from Northern Ranges to Lake Docks

A 10-per cent reduction in freight rates on iron ore from points in Minnesota, Wisconsin, and Michigan to upper Lake ports, effective July 1, 1922, has been ordered by the Interstate Commerce Commission. In announcing this reduction the commission says its recent order making general rate reductions did not apply to ore from these districts. In justification for the reduction the commission says that since August, 1920, none of the rates on iron ore to upper Lake ports have been reduced, while some have been increased. Under the new order the rates after July 1 will be 90 per cent of existing rates on iron ore from Minnesota, Wisconsin, and Michigan to upper Lake ports.

When the commission made its general rate advance in August, 1920, rates on iron ore north of the Lakes were not increased because they had previously been subject to a special increase by the director general of railroads of about 57 per cent.

The commission's order will not affect the U. S. Steel Corporation, it is said, which moves most of its ore from the ranges to the docks over its own rails. The company's railroad earnings will be cut, but so will its book costs of ore. Independents, however, taking ore from the ranges are benefited by the order at the expense of the railroads handling the ore.

The Duluth, Missabe & Northern and the Duluth & Iron Range roads had already announced a voluntary cut of 10c. to 90c. on ore from mine to docks, effective July 1.

Alexander's Estate Awarded Engineer Mine

The Engineer mine, at Atlin, B. C., belongs to the estate of Captain James Alexander, according to a ruling of the Appeal Court at Victoria on June 6. The property had been relocated in 1907 by Captain Alexander, wrongfully so, it was alleged, by the original locators. After the "Princess Sophia" sank, with Alexander on board, the property passed to Allan I. Smith, of Philadelphia, to whom Alexander had willed it. Smith has since died and the mine will thus go to his estate.

Large Radio Receiving Set for Mining Camp

One of the largest inland radio receiving sets in the country is being installed at the Standard Camp of the Standard Chemical Co. in Montrose County, Colorado. The receiving station will be able to pick up messages from any sending station in the United States. The Standard Chemical Co. is the largest producer of radium-bearing ores in the country, and the plant has been installed by the company for the benefit of its employees.

International Nickel to Resume

The International Nickel Co. will resume work on a small scale at its Creighton mine, in the Sudbury district, Ontario, on Sept. 1. Two blast furnaces at Copper Cliff will be blown in at the same time.

All of the bessemer matte produced will be shipped to the new Port Colborne refinery. The old refinery at Bayonne, N. J., is being dismantled. The new rolling mill at Huntington, W. Va., is expected to be ready for operation during the summer.

Shasta Zinc & Copper Co. to Start Smelting

The Shasta Zinc & Copper Co., of Winthrop, Cal., recently started to fire its large reverberatory. It was expected that it would take about a week to heat it, when smelting would begin. Zinc ore is being hauled from the Star mine. The refinery addition is almost completed. The company will manufacture zinc oxide.

Second Fire at Manhattan, Nev.

The mining town of Manhattan, Nev., which suffered a $75,000 fire on May 26, was again visited by fire on June 3. The loss is estimated at $30,000. The business district was practically wiped out as was a part of the residential section.

Callahan Zinc-Lead to Increase Capital Stock

The directors of the Callahan Zinc-Lead Co. voted June 5 to increase the capitalization from 500,000 to 1,000,000 shares. Stockholders are to be given the right to subscribe to part of the new issue in an amount and at a price to be announced after the increase has been authorized at a special stockholders' meeting to be held on July 24.

The proceeds of the new financing are to be used for the acquisition, development and equipment of new properties. It is understood that the stock will not be issued except as required for this purpose. The condition of the treasury is excellent, with sufficient cash on hand for more than three years' requirements on a basis of present maintenance operations. The company has no indebtedness aside from current accounts payable.

No decision has been made as to the date when operation will be resumed. The announced reduction in freight rates will greatly benefit Callahan, as its concentrates are subject to a long haul to points east of the Mississippi. This in conjunction with the improved market for lead and zinc is thought to make the outlook brighter.

The high-grade ore recently cut on the No. 6 tunnel level of the Galena Mining Co., of whose stock the Callahan company owns 62 per cent, still holds up in grade. The heading is now in about 95 ft.

Dome Takes Option on Foley-O'Brien

An option has been taken by Dome Mines, Ltd., of Porcupine, Ont., on the Foley-O'Brien property, which lies east of the Dome Extension. Considerable work was done on it some years ago, and low-grade ore was opened up, which is believed to be on the extension of the Dome ore zone. It is understood that the option extends over a period of several years, and that the purchase price is for exchange of Dome shares, although the terms have not been disclosed.

Schumacher Property at Porcupine Reported Sold

There are a good many rumors to the effect that the property of the Schumacher Gold Mines, Ltd., adjoining the Hollinger, at Porcupine, Ont., has been sold. The company has 1,850,000 shares outstanding, of which F. W. Schumacher controls 1,300,000, and it is understood that he is holding them for $1 per share. The property is equipped with a mill, which treated 112,000 tons of ore, giving a production of $561,885.

Iron Ore Exported to Germany

By Reuters Agency

Madrid, May 26.—According to news from Melilla, the Cia. Española de las Minas del Riff has exported to Germany since May 1 nearly 30,000 tons of iron ore and is to export a further quantity of 45,000 tons. All the ore is intended for Westphalian works.

Plan to Reorganize New Idria Quicksilver Mining Co.

Reorganization of the New Idria Quicksilver Mining Co. as the New Idria Quicksilver Mines, Inc., is planned. The former has been in the hands of a receiver for the last eighteen months. Under the plan the new company will issue $125,000 ten-year 7-per cent mortgage bonds, 30,000 shares of 8-per cent non-cumulative preferred stock, of $10 par value, and 35,000 shares of common stock of no par value. The bonds will be secured by the entire property of the company, together with its claim against the American & British Manufacturing Co. A verdict in this suit has already been received by the New Idria, but the case is still in the courts. Retirement of the bonds is to be provided for by a sinking fund, into which will be paid at least half of the annual net earnings.

Creditors of the New Idria company will receive $125,000 in bonds, 10,000 shares of common and the same amount of preferred stock. The company owes them about $225,000.

The present shareholders will be allowed to subscribe for 20,000 shares of the new company's preferred stock in proportion of one share of new preferred plus a bonus of one share of common for five shares of old plus $10 cash. Subscribers must make their first payment by July 1, 1922, to have any interest in the reorganized company. The remaining 5,000 shares are reserved for the use of the managers in meeting reorganization expenses, any balance to be held in the treasury.

Professional Engineer's Bill Amended

Ontario's Professional Engineer's bill, in a greatly emasculated form, has passed through the committee, and is ready for the Legislature. As the bill now stands all engineers have the right to organize into a "Professional Engineers' Association" and to protect the title "Professional Engineer," but they have no special rights in respect to work of an engineering character, which was the chief feature of the bill as originally drafted.

Gold Output Figures Reported

By Cable from Reuters to "Engineering and Mining Journal-Press"

London, June 12—The gold output in India during May totaled 32,527 oz.

The production of gold in West Australia in May amounted to 39,725 oz.

The output of gold in New South Wales during the first five months of 1922 totaled 13,379 oz.

Ewert May Ask Rehearing in Zinc Land Case

The U. S. Supreme Court has stayed its mandate in the recent decision nullifying the purchase of Indian zinc lands by Paul A. Ewert on the ground that as a Government officer he was ineligible to make the purchase. This action is to permit Ewert to file a petition for a rehearing of the case within sixty days.

News from Washington

By PAUL WOOTON
Special Correspondent

Winchell Testifies at Hearing on Mine Law Revision

Prospector's Day Almost Over, He Says —Fall Opposed to Radical Change in Present Statute

Much of the opposition to the proposed revision of the mining laws is coming from the prospector and his friends. This opinion was expressed to the Committee on Mines and Mining on June 8, by Horace V. Winchell, who, as a member of the Ingalls committee which drafted the bill now before the Committee on Mines and Mining, appeared in support of the measure. He pointed out with particular clearness that the day of the prospector is almost over. Little can be done to restore the prosperity he once enjoyed, owing to the fact that the mineral deposits which can be located from surface indications have been taken up. Mr. Winchell pointed out that this condition does not apply to Alaska, but most of the area in the mineralized sections of continental United States have been gone over so thoroughly as to limit greatly the opportunities of prospecting in the old-time way. Prospecting, he pointed out, is becoming more and more a matter of large expenditure and is based on geological and engineering data, rather than on surface outcrops.

Mr. Winchell made a painstaking explanation of the various features of the bill and explained the good which he believes would come to the mining industry were the laws revised. Despite his convincing arguments, however, it is apparent that the Committee on Mines and Mining is far from being enthusiastic about the bill. This also applies to Representative Rhodes, the chairman of the committee, on whose initiative the legislation, to a great extent, depends. The attitude of the chairman and of several members of the committee may be explained in part by the views entertained by the Secretary of the Interior.

It was revealed at the hearing that Secretary Fall is inclined to the opinion "that it would be inadvisable at this time to pass a law radically changing the general laws now in effect." Secretary Fall, who has been a prospector himself, and who has had extended mining experience in the United States, where the apex law has applied, and in Mexico where vertical side lines govern, believes that as the laws relating to the disposition of metalliferous minerals have been in effect for more than fifty years, during which time they have been interpreted by rulings of the courts and of Government departments, it would be unwise to create confusion in the vested rights represented by the thousands of mining claims which have been located under the existing laws. It is his opinion that minor modifica-

[illegible] [illegible] been suggested from time to time to cure existing defects, and it is his view that such a course would be much better than the one proposed that involves a general revision of the mining laws.

Secretary Fall does not want to be understood as being opposed to all revision. He admits that legislation dealing with metalliferous mining has been [illegible] and disconnected. He thinks, however, that these laws could be brought into more comprehensive form without changing the general processes under which the mining industry has been conducted and which have been construed so thoroughly by the courts. He also calls attention to the fact that, with the exception of the placer claims for non-metalliferous minerals, the law with reference to placer locations practically is superseded by the provisions of the general leasing law of 1920.

If the Committee on Mines and Mining will indicate its belief that the time has come to abolish the apex law and to revise other of the mining statutes, Secretary Fall states that he will be more than willing to give the entire matter personal consideration, and bring to the assistance of the committee the specialists on mining law serving with his department. He points out, however, that unless Congress is ready to adopt vertical side lines for mining claims, there would be no advantage in requiring locations in quadrangular form and making certain of the other amendments suggested in the bill now before the committee.

H. G. Moulton, of New York, explained that the form of the present bill could be changed so as to be less objectionable to the prospector. He urged the early revision of the mining code along the general lines of the present bill. He said it would be in the interest of the entire mining industry. In expressing these views, he stated that he fully understands the prospector's point of view, as his father was a prospector and that he himself had spent much time in the field searching for promising indications of mineralization.

No date was set for the next hearing of the series.

Further Action in Red River Placer Claims Case

Following its recent decision denying placer mining claims in Oklahoma in the Red River bed, the U. S. Supreme Court has issued a mandate denying the claims of all those who are asserting rights in the river bed based on placer mining locations.

To meet the Supreme Court's decision, Senator Nicholson, of Colorado, and Representative Newton, of Minnesota, have introduced bills to authorize the Interior Department to lease to persons and corporations land in Tillman and Cotton counties, Okla., belonging to the Government, which were prior to Feb. 25, 1920, claimed in good faith under the placer mining laws.

Advises Wildcatting for Potash in Texas

As a result of the establishment of the fact that potash is widely distributed in the red beds of the Southwest, the U. S. Geological Survey is trying to convince prospectors that wildcatting for potash should accompany wildcatting for oil in that region. The extra cost of drilling so as to recover cores is amply justified, it is contended. Some wells are now going down where the primary purpose is to prospect for potash. The Pennsylvania Oil Co., Lancaster, Pa., has contracted for the sinking of five wells in Ector and Crane counties of Texas. The contract provides for the cutting of cores. Another oil company has announced its intention of cutting cores in three counties.

Many War Minerals Claims Disallowed

Four Awards Made Subject to Secretary Fall's Approval

Subject to the approval of the Secretary of the Interior awards have been recommended by the War Minerals Relief Commissioner as follows: Shelby J. Gish, Big Timber, Mont., $5,436.25; Duckworth & Meadows, Sumpter, Ore., $1,074.09; G. A. St. Clair, Duluth, Minn., $7,724.05.

Disallowances and the commissioners' reasons therefor have been recommended as follows:

Salt Lake Tungstonia Mines Co., Preston, Idaho, stimulation not established; Harry W. Boynton, San Francisco, no request or demand; Thomas Bessler, Jr., Sumpter, Ore., stimulation not established; Altshuler & Berger, San Francisco, no additional award justified; The Matchless Tungsten Mining Co., Denver, not commercial; Rare Metals Production Co., Denver, no request or demand; Andrew Mandoli, Anaconda, Mont., not commercial; Rare Metals Ore Co., Denver, stimulation not established; Butte Central Mining & Milling Co., Boston, Mass., no additional award justified; Alexander Caldwell, Benmore, Utah, stimulation not established; Dibblee & Arata, San Luis Obispo, Calif., no net loss established; Casey, Brown & Saunders, Batesville, Ark., not commercial; Sulphur Gulch Manganese Mines, San Francisco, not within the act; James T. Dobbins, Salt Lake City, decision of former commission approved; Joan Mining Co., Duluth, Minn., stimulation not established; Manganese Products Co., Immodesto, Calif., not commercial; Boulder River Chrome Co., Great Falls, Mont., no additional award justified; Arata & Palmer, San Luis Obispo, Calif., recommendation of former commission approved.

Government's Silver Purchases

Purchases of silver by the Bureau of the Mint during the week ended June 10 amounted to 1,955,000 fine ounces. This brings the total purchases under the Pittman Act to 114,178,756 fine ounces.

Tariff Paragraph on Potash Faces Fight

Arsenic Amendment Adopted—Duties on Cadmium and Bismuth Remain

It is becoming apparent that the duties on potash will not be accepted by the Senate without a fight. Propaganda against the duties is afoot, and farmers in large numbers are writing to their Senators asking that they oppose the duty.

Those favoring the potash duty were encouraged greatly by the action taken by the Senate on manganese. A new element has been interposed in the situation by the promising discoveries of potash in Texas. The farmers and business men in southwestern Texas are acting in a united and active manner in their support of the potash duty. Each member of the Senate and of the House of Representatives has been mailed a brief signed by "owners of potash beds in the State of Texas," in which the point is made that foreign producers have effected an international combination in restraint of trade and that the consumers in the United States will suffer in the end unless American sources of potash are developed.

With the understanding that further discussion of the proposed duties on white arsenic and metallic arsenic will come up again when the free list is reached, the Democrats allowed the committee amendment making metallic arsenic dutiable at 6c. a pound to be adopted without a rollcall. With white arsenic dutiable at 2c. a pound, a compensatory duty of 3½c. additional would be required to accord the same treatment to metallic arsenic. The additional ½c. represents the protection which would be accorded the conversion process.

No serious objection was offered to the proposed duties on cadmium, bismuth, German silver, and gold leaf, and they were adopted on June 10 by the Senate. The duty on cadmium was fixed at 15c. a pound, although it was opposed by Senator Simmons, of North Carolina, who stated that it is a by-product of zinc ore and consequently does not require a duty. He admitted, however, that the rate is low and did not press his objection. The duty on bismuth was fixed at 7½ per cent ad valorem.

Transportation Institute to Be Organized

Organization in the near future of a National Transportation Institute is practically assured. Though no date has been set for the organization meeting, it will be held before the end of the summer. Bird M. Robinson, the president of the American Short Line Railroad Association, and his associates, who are doing the active work of promotion, are engaged at present in lining up such support as will insure the new organization having a representative backing.

News by Mining Districts

London Letter

Knox & Allen Report on San Francisco Mines—Selukwe Company's Interest in British Columbia

By W. A. Doman

London, June 2.—Shareholders in the San Francisco Mines of Mexico who put their capital in the original company have had a long time to wait for any tangible results, but it appears as though their patience will at last be rewarded. Not that there is any possibility of a dividend yet, so far as I can see. The hope that shareholders can now entertain lies in the fact that the Union Corporation, which has subscribed a large sum of money to open up the property and win the metals, has settled down to work with a right good will. It is not at all unlikely that dividends will be distributed in due course, but the issue of debentures must not be overlooked, and the further fact that unpaid interest exceeded £103,000 at the date of the balance sheet, Sept. 30 last. That, perhaps, is the dark side from the shareholders' standpoint. The brighter side is to be found in the report of the consulting engineers, Knox & Allen.

Difficulties were met in the way of labor, and development has fallen behind. The result is that so far as ore reserves proper are concerned, there are virtually none. This position is to be remedied, and at least two years' reserves are to be opened up. During the period covered by the report, the estimated quantity of sulphide ore developed was 91,940 tons, of which 41,000 tons was on the fourth level and above, and 50,940 tons on the fifth level. The ore on the fourth level runs 1.59 g. gold; 561 g. silver; 13.2 per cent lead; and 19.5 per cent zinc. That on the fifth runs 507 g. silver; 12.64 per cent lead; and 19 per cent zinc.

Values on the fifth level are rather inferior to those on the fourth, the explanation given being that the lower level has not been sampled to the face, and that the part sampled from which the above grade is averaged is lower than the section into which it is now entering. The new mill for concentrating the sulphide ore has a capacity of 275 tons daily, and it is so constructed that it can, without difficulty, be easily doubled. Knox & Allen assume that each 100 tons will be composed of 32 tons of lead concentrates, and 68 tons of lead residues, from which recovery is expected as follows: Lead concentrates: silver, 72 per cent, lead 91 per cent, zinc, 32 per cent. Lead residues: silver 28 per cent, lead 9 per cent, zinc, 68 per cent.

With lead at £24.375 per long ton, and with exchange $4.13, the return per ton of crude ore should be $12.22, and costs at 90,000 tons per annum are expected to be $4 per ton.

The Selukwe Gold Mining & Finance Co., which originally dealt mainly with Rhodesian properties, has acquired a substantial interest in the British Canadian Silver Corporation. The capital of the corporation is £400,000 in 1,600,000 shares of 5s. each, and the Selukwe now has one million shares, or about 62.6 per cent. The main attraction seems to be the situation of the company's property, which adjoins the Premier gold mine, in British Columbia.

NORWAY

Kongsberg Mines Make Important Connection Underground

The total silver production from the Kongsberg mines, Norway, during March, was 3,823 kg. There were festivities in town and camp on May 10 when the break through between the Christian and Underberg levels took place and linked up the Overberg and Underberg sections from Postleromoen to Laggraenden—a distance of about seven kilometers. The work has been in progress for four years, and the economic results of the connection, both in labor and transport, are expected to be considerable. This, with the reported new find in Hans Sachsen mine (of which further particulars are awaited from the state surveyor of mines) would seem to have brought a new era of Kongsberg prosperity within reasonable perspective.

QUEENSLAND

Tin Mining Active in Herberton District—Mount Morgan Loses Income Tax Appeal

From Our Special Correspondent.

Brisbane, May 1, 1922—Despite the existing stagnation in mining, a good deal of work is still being done in the tin mines of the Herberton district, inland from Cairns in the Far North. Though from the lower-grade propositions the ore taken is being stocked awaiting a better market, the holders of the richer mines, especially those near Herberton, are able to continue operations and realize upon their ores at a profit, even at present market prices. In the Herberton district the mines giving the best yields are, in the order named, the New Bradlaugh, which last year produced 5,447 tons of ore; the old Vulcan mine, at Irvinebank, 2,727 tons; the Arbouin, 2,231 tons; and the You and Me, 2,081 tons. The Vulcan, which in the past from workings to a depth of 1,400 ft. made exceedingly profitable returns, was reopened some time ago. Although this company's efforts, carried out in the deeper parts, were disappointing, some tributers, working at the 600 level, got fair supplies of rich ore. The tin mines in this district, as well as those in the vicinity of the Sardine mine, in the Kangaroo Hills district, further south, hold much promise for the future when market prices improve.

The March sales of gold through the Gold Producers' Association, including local sales for the first quarter, were only 9,064 oz. of standard gold, the average net price realized being £4 11s. 6d. per standard oz., equal to [illegible] per oz. fine. A distribution of [illegible], or 7.28d. per oz., representing the unexpended balance of moneys set aside at June 30, 1921, for adjustments and contingencies, was made on April 8.

In connection with the distributions of the Gold Producers' Association, important decisions have recently been given by the courts against the Mount Morgan company and another gold-mining company operating in the south on appeals by those companies against their being charged with income tax on premiums received through the association from sales of gold abroad. The companies contended that as the amounts received through the association did not come from income derived within the state, or earned in the state, they were exempt from taxation. The view of the judges, however, was that the source whence the income was derived was from mines in the states, and that the premiums received by the companies came from gold taken from their mines and were therefore taxable. It is probable that there will be an appeal from these decisions to the Privy Council.

Under the authority of an act of Parliament passed last session, the government, in order to assist in the working of the Chillagoe State smelters, has exercised an option which it held to purchase certain mines in the Mungana district near those smelters. The purchase price is £40,000.

BRITISH COLUMBIA

Northern Light Group Bonded to Premier—Big Missouri Under Option

Stewart—The Premier Gold Mining Co. has taken a three-year option on the Northern Light group from Charles and William Bunting. The consideration is $125,000, and a cash deposit of $5,000 has been made. The property consists of eight full claims and two fractions, which are situated immediately north of the Premier company's present holdings. It was bonded to the Algunican Development Co. in 1920, and a considerable amount of diamond drilling was done, but the bond was relinquished when the Algunican company got into financial difficulties.

A. B. Trites, of Fernie, and New York associates have taken an option on the Big Missouri, at the head of Salmon River. This property was under option for some time to Donald Mann and associates, and after a considerable amount of diamond drilling and some tunneling and surface stripping and trenching were done, the option was relinquished on account of the inaccessibility of the property.

The Daly Alaska Mining Co. has started development work on the New

Alaska, under the supervision of Pat Daly.

Trail—A $7,500,000 issue of 7-per cent convertible bonds was authorized at a special meeting of the shareholders of the Consolidated Mining & Smelting Co. in Montreal on May 30. Only $2,000,000 will be issued at first. The debentures mature on July 1, 1941, and may be exchanged for fully paid shares in the capital stock of the company. One million dollars of the issue will be used for the construction of the first unit of the concentrator for the Sullivan mine.

Ore shipments received at the Consolidated's smelter May 22 to May 31, inclusive, totaled 13,495 tons, of which 12,530 tons came from company mines. Other shippers were: Black Rock, Northport, Wash., 72; Mountain Chief, West Robson, B. C., 130; Quilp, Republic, Wash., 103; Rambler Cariboo, Rambler Siding, B. C., 28; Surprise, Republic, Wash., 222; Silversmith, Sandon, B. C., 367, and Spokane Trinket, Ainsworth, B. C., 43.

The special plant of the Consolidated Mining & Smelting Co. for handling custom zinc ores was ready for operation on May 31, and the company has announced that it will now accept that class of ore for treatment. On account of the accumulation of such ores at a number of properties, notice has been given operators that tonnage can only be taken on allotment for a time.

Proctor—The Ivy Fern mine, which was under option to the Consolidated M. & S. Co., and which option was relinquished by that company a short time ago, is being further developed by Standard Silver-Lead Mining Co. In the event of favorable results following this work, it is likely that the property will be acquired by the Standard people.

Silverton—The old Standard mine which has been under option to interests represented by Clarence Cunningham, has disclosed nothing of importance as a result of the work so far done, according to a report issued recently by the Standard Silver-Lead Co.

Sandon—Resumption of payment of dividends by the Silversmith Mines is set for June, according to unofficial sources. The first disbursement will be 1 cent per share, and subsequent profit disbursement will likely be on a basis of 2c. per share quarterly.

Ainsworth—All leases held by miners on the Florence mine were terminated June 1. It is anticipated that both mine and mill will be operating on company account by July 1, employing about eighty men.

Salmo—On the Bayonne group, in the Bayonne district, east of Salmo, satisfactory indications have been found at depth. The property is under option to Spokane interests, including John B. White, president of Silversmith Mines. As a result a syndicate has been formed in Nelson, which will amalgamate a number of groups of claims for development purposes.

ONTARIO

Vipond in Need of Funds—West Dome and Dome Lake Merger To Be Ratified—Noranda Mines, Ltd., Organized

Cobalt—The government is arranging to build a road to the Oxford-Cobalt mine, and as soon as this is done work on the property will be resumed.

The winze on the A-53 property, in Gillies Limit, is down to the 100 level, and it is understood that good ore has been cut.

The Coniagas, which has taken an option on the Brookbank claims in the Matchewan district, has let a contract for the diamond drilling of the property.

The Mining Corporation is meeting with excellent results in the development of the Haileybury Frontier property in South Lorraine.

During the week ended June 2, the only shipments from Cobalt were two cars from the O'Brien, with a total weight of 128,000 lb.

Porcupine—An examination of the Davidson property has recently been made by New York engineers, representing South African mining interests.

The directors of the Vipond have appointed a committee of four to devise means of getting an additional sum of money, estimated at $200,000, which is considered necessary to fully equip and develop the property and put it on a paying basis. It is understood that the cash on hand will not carry development work beyond July.

Shareholders of the West Dome and Dome Lake met in Toronto June 15 to ratify an agreement of amalgamation of the two properties. The new company, called the Consolidated West Dome Lake Mines, Ltd., will be formed, with a capitalization of 5,000,000 shares of $1 par, of which 1,500,000 shares will be issued to each company. In addition, Dome Lake receives 250,000 shares of treasury stock as payment for its mill and plant, and this stock will be used to retire the bonds. Underwriting arrangements for the treasury shares are being consummated.

Kirkland Lake—The Noranda Mines, Ltd., is a new company with a capitalization of 500,000 shares of $1 par value, which has been formed by Thompson and Chadbourne, of New York, to develop a large number of claims which they have been acquiring in the Kirkland Lake section. It is understood that the company has acquired, under option or by staking, about sixty claims, which include fifty claims in Gauthier Township, a block east of the Tough-Oakes, in Kirkland, and the United Kirkland lying to the west of the Teck-Hughes and Kirkland Lake Mines. Included in the Gauthier claims is the Elkstone-Dunkin property, on which promising discoveries are reported to have been made.

The Matachewan Gold Mines, which has recently been reorganized, is preparing to resume work. Steam power will be used temporarily.

WASHINGTON

Mining Industry in State About 30 Per Cent of Normal

Mining in Washington has not in the last twenty years reached such a low ebb as during the winter just passed. Three months ago practically no production was being made. During the last two months the slow betterment of the metals and the passing of a severe winter have put heart into the operators and the shipments now total from 1,500 to 2,000 tons monthly. This is chiefly crude ore, but several concentrators will likely resume before summer is over.

On June 1 about ten companies were producing regularly. These shipments are going to the Tacoma, Trail, and Bunker Hill smelters.

The industry is functioning at about 30 per cent normal capacity. Three mines in the Republic district are shipping siliceous gold ore to Trail. The Washington Black Rock Mine, at Northport, is regularly shipping high-grade zinc ore. The Electric Point and Gladstone of the same district are shipping lead ore to the Bunker Hill smelter. Silver production is coming from the Pyrargyrite at Nighthawk, the Old Dominion, at Colville, and the United Silver-Copper, at Chewelah. This last named company is also making a small copper production.

There are a large number of small properties under development. The general feeling is that better days are just ahead, and if the metal market continues upward it will be answered by an increased production from this state. The labor supply for the metal mines is plentiful.

The Tacoma smelter is operating at about 50 per cent of normal capacity. The Northport smelter is still down.

The recent reports from Washington have brightened the hopes for a protective tariff on magnesite. If this tariff materializes this important Washington industry will be revived.

Several of the larger coal mines of western Washington are operating on an open-shop basis, but at present are making only a fraction of their regular output.

IDAHO

Nabob Consolidated to Resume

Wallace—The western and eastern interests in the Nabob Consolidated Mining Co. have effected a settlement under the terms of which the Stewart Mining Co. renounces all claims against the company for about $40,000, which it had advanced. Plans for refinancing the Nabob have been completed. Mining operations will be resumed July 1.

Byron Wilson, of Wallace, a mining engineer long connected with the Federal Mining & Smelting Co. and other companies controlled by the Guggenheim interests, has gone to Alaska to take charge of the property of the Rae-Wallace Mining Co. in the Willow Creek district. The company owns a large group of gold claims which have been extensively developed.

CALIFORNIA

Belmont Shawmut in Full Operation—Blue Hog Mine Returned to Feather River Company

San Francisco Correspondence

San Francisco—The Belmont-Shawmut, at Shawmut, is dropping eighty stamps and is in full operation. The Santa Ysabel and the Longfellow are being reopened, and reports indicate that the Black Oak, near Soulsbyville, and the Tarantula and Gold Ridge properties may resume operations in the near future.

Equipment has been installed, the main shaft has been deepened, and development is in progress on the Chilena group, on Jackson Hill, near Tuttletown.

Preparations to work the Malikoff drift mine at North Bloomfield are well under way. A sump has been sunk below the bedrock and bins of 150 tons capacity have been constructed. A gasoline hoist is ready for operation.

By a recent court decision the Blue Hog mine between Paradise and Magalia has been returned to the Feather River Land & Mining Co. by the Paragalia Mining Co.

NEVADA

Tonopah Shipments Above Normal—Suit at Hornsilver Settled

From Our Special Correspondent.

Virginia City.—At a meeting of the miners held in Virginia City, May 31 the strike against the United Comstock was unanimously declared off.

It is reported that the east crosscut being run in Savage ground by the Paramount Comstock Mines Co., owner of the Middle Mines group, entered ore at 100 ft. and has been in ore of about $90 grade for the last 20 ft. The option on the Middle Mines group, held by the Middle Comstock Mines Syndicate, expired on June 1.

Tonopah—Regular ore shipments are being made by the North Star to the Belmont mill, and mine conditions are good. Through use of the Belmont mine maps and geological charts, additional ore is being developed near the Belmont lines, and it is thought that a faulted segment of the rich so-called "Heney" stope has been found.

Bullion shipments made on June 5, representing clean-up of operations for the last sixteen days in May, were as follows: Tonopah Belmont, $140,300; West End, $104,900; Tonopah Extension, $73,000. The Tonopah Mining cleanup has not as yet been reported, but will probably be as usual, or about $60,000. Practically all shipments are at least 10 per cent above normal and indicate the prosperous condition of the mines in the Tonopah district.

Golden Arrow—The recent developments on the Storm Cloud group, five miles south of Golden Arrow, at present optioned to Tonopah and Reno mining men, have created considerable interest in the district. High-grade silver ore has been uncovered in shallow workings, and preparations are being made to sink to greater depths.

Hornsilver—The suit between the Southwestern and Silvermines Co. and the men who jumped the sixteen claims last July on the assumption that the regular assessment work had not been performed has been settled. A 1,500,000 share corporation will be organized to take over the sixteen claims, and the locators will receive 100,000 shares of stock in the company and $1,000 in cash, they agreeing to relinquish all right and title to the ground.

COLORADO

Ouray Leasing Co. to Start Mill—Road Building to Silverton

Ouray—The Welch-Worland Mines Syndicate has shut down the mill at the Wanakah and announced that it will concentrate on a certain development drift for the next month. If this does not yield new ore, the company will probably abandon the property, permitting it to revert to the Ouray Union Mining & Milling Co.

Rydin and Sederholm are driving a development or exploratory adit low down on the old Great Western, to look for downward continuation of the old oreshoot.

The Ouray Leasing Co. has quit drifting on the lower adit of the Barstow and is opening a stope in the ore discovered by the drift last winter. The mill will be started about July 10.

NEW MEXICO

Conditions Improving—Silver City District More Active—Coal Plentiful

Silver City—Mining conditions generally in New Mexico are improving. Production in the state's major district, surrounding Silver City, will not reach normal for some time, but there is encouragement in the statement that Chino will be producing at 50 per cent of normal soon. Necessity for doing assessment work before July has temporarily caused greater activity. Small shipments of silver by many individual operators have materially increased the silver output. Manganese shipments are totaling 600 to 1,000 tons a day from Grant County.

Labor presents no serious difficulties now. Mine forces are being increased gradually, and advance notices sent out some time ago warned against an influx of workers, as the companies planned to hire their "old" men first. All local labor has been absorbed in manganese operations at Silver City and Fierro.

The coal strike has affected mining only as an incident. The New Mexico coal mines produce plenty of coal, and the camps are not organized, although an attempt at organization was made recently, and resulted in small trouble. Recent reductions on freight rates to the El Paso smelters were announced, and were helpful, but no noticeable effect has been reported as a result of the announcement of a forthcoming general reduction. Such a general reduction, however, will increase tonnage somewhat in the future.

ARIZONA

Gallup Coal Supply Ample—Skilled Miners Scarce at Bisbee—Ray Consolidated Wins Suit

The coal strike appears to have not seriously affected the patrons of the Gallup, N. M., field. At no time has there been failure to deliver orders for domestic, steam, railroad, or smelter fuel, and the price of the product has been dropping. The miners struck in sympathy with their Eastern co-workers, but their places were filled by surface hands or new men. For a while protection was afforded by the New Mexico National Guard, but that was withdrawn early in June. Freight rates, too, have fallen. Coal is being delivered at Clarkdale for about $3 per ton freight, a drop of 50c., with a possibility of a further 10 per cent reduction, ordered by the Arizona Corporation Commission. The late freight reduction of 12½ per cent is effective until Oct. 15. Much of the Gallup coal is marketed in Southern California, in competition with Oregon, Washington, and British Columbia shoals.

The Arizona & Swansea railroad again is in operation, from Bouse to Swansea, Ariz., carrying ore and concentrates for the Swansea Lease, billed to Humboldt. The railroad, mainly owned by the Mitchell interests, of Los Angeles, is operated under order of the Arizona Corporation Commission, which repeatedly has refused permission for its abandonment. The road is twenty-three miles long.

Skilled miners and mechanics are wanted by the Copper Queen and other mines of the Bisbee section. Possibly 300 more miners could find employment, though few laborers are needed. The same condition is said to exist in the Globe and Jerome districts.

The Copper Queen smelter is to produce 10,000,000 lb. in June. There is a report that concentrates soon will be coming from Morence.

Ray—The Ray Consolidated Copper Co. has won its suit against the Ray-Broken Hills Mining Co., P. A. Schilling, and Joseph Sherlock, a jury finding for the plaintiff in all twelve questions submitted. The question of the ownership of the water supply of Indiana Springs was involved.

UTAH

Park Standard Mining Co. Incorporated—Alta-Wasatch Railroad Seeks Permission to Shut Down

From Our Special Correspondent.

Eureka—Shipments for the week ended June 2 amounted to 168 cars. Shippers were: Chief Consolidated, 56 cars; Tintic Standard, 36; Iron Blossom, 18; Eagle & Blue Bell, 11; Victoria, 10; Grand Central, 10; Colorado, 10; Centennial-Eureka, 4; Swansea, 3; Mammoth, 2; Empire Mines, 2; Sioux Consolidated, 2; Sunbeam, 2; Bullion Beck, 1, and Tintic Drain Tunnel, 1.

Park City—Shipments for the week ended June 2 amounted to 3,437 tons. Shippers were: Ontario, 1,435 tons; Park-Utah, 819 tons; Silver King Coali-

[illegible] Daly and Daly West, [illegible]

The eastern section of the camp, practically undeveloped for many years, is now receiving more attention since the Park-Utah in this section became one of the large producers of the state. Also the finding of ore in the Ontario mine east of the north-south fault disclosure, the property has stimulated activity. Recently, a new company, the Park Standard Mining Co., has been incorporated to exploit ground in the eastern section adjoining the Valleo. This company owns ten claims and has 120 acres under lease besides. The incorporators are: N. A. Danyon, M. J. Dailey and John D. Foster, of Park City; and R. P. Morris and Judge William H. Bramel, of Salt Lake City. The company is capitalized at $150,000.

Alta—The Little Cottonwood Transportation Co., which owns a narrow-gage road running from Alta to Wasatch, has applied to the State Public Utilities Commission for permission to remain inactive during the present shipping season. The reason given is that a number of Alta mines have made arrangements to have their ores taken to Wasatch by teams. The latter are available throughout the year, whenever the roads are sufficiently open, whereas the railroad, owing to climatic conditions, is necessarily inactive for about half of the year. For this reason transportation by team appears more practicable. From Wasatch the ores are taken over to Denver & Rio Grande to the smelter at Murray.

Work is being done at the West Toledo, which lies in Little Cottonwood Canyon between the Cardiff and the Columbus-Rexall. Directors recently elected are J. C. Dick, A. J. Hurley, Arthur Thomas, James A. Foley, and Thomas L. Mitchell.

Salt Lake City—Roads in Big Cottonwood Canyon are opening up. The Alta Tunnel & Transportation Co. has broken its way through to its upper ore piles, and has made its twenty-third shipment.

WISCONSIN-ILLINOIS

Rate of Production Increased in Zinc-Lead District—Labor Still Plentiful

Platteville—The rate of production of finished zinc ore concentrates for May has slightly increased over production for any other month this year. The production for May will be approximately 3,200 tons of 60 per cent zinc ore concentrates. The surplus of zinc concentrates available for sale has been reduced to about 3,000 tons. Lead ore concentrates are being sold as rapidly as produced, and no surplus exists in the district. Future production of the district will be highly dependent upon an increased market, as few mines can produce ore at a profit on the now prevailing market of $31 per ton. Should the market advance from $5 to $10 per ton in the next few months, no doubt production would be stimulated 50 per cent, the rate of production now being about 35 per cent of normal.

A concentrated effort of mining companies in the district is being brought to bear to reduce freight rates on ores to Eastern smelters. A joint conference of railroad officials and representatives of the mining industry was held in Chicago May 22 with this purpose in view.

Labor in the district at present is plentiful, considering the small production. Should production be materially increased, there would be a shortage of miners.

Prospecting for new orebodies will be started by the Vinegar Hill Zinc Co. in the near future after a lapse of nearly two years from this line of development.

JOPLIN-MIAMI DISTRICT

Extensive Drilling Started by American Zinc, Lead & Smelting Co.—Butte-Kansas and Acme to Resume

By P. R. Coldren

Joplin—The American Zinc, Lead & Smelting Co. has taken a drilling option on 320 acres immediately adjoining its High Five mine, in Missouri, in the Waco camp, and has started eight drills in operation in a development campaign. The company, according to a rumor, is planning extensive drilling from this location toward the east, possibly as far as the old Neck City camp in the Missouri field, northeast of Carterville, but officials of the company deny that any such plans have been completed.

The company's High Five mine is operating steadily and with good results. It is in Missouri, but the west side of the lease is bounded by the Kansas-Missouri state line. The Barnsdall Zinc Corporation, which is the big operator in the Waco camp, has one mine on the Missouri side and two mines in Kansas.

Announcement has just been made by officials of the Butte-Kansas Mining Co. that the Butte-Kansas and the Acme mines will resume at once, following a shut-down since October, 1920. Since being down the company has carried on an extensive drilling campaign on the north part of its lease, and has put down about 150 holes.

SOUTHEAST MISSOURI

Improved Price of Lead Causes Greater Activity

Activity in the southeast Missouri lead belt is slowly increasing in view of the excellent pig lead market of 5½c. The coal strike thus far has not affected operations there, as the four large companies laid in a supply for sixty days or more, before the strike started on April 1, and should their supplies become exhausted before the Illinois mines reopen, which it now seems, may be delayed until Sept. 1, they will be able to get western Kentucky coal for $5 per ton, which will not be more than 30 or 40 per cent advance over recent Illinois prices.

The proposed horizontal reduction of 10 per cent in freight rates will not have an important bearing, it is said, as pig lead is generally sold in the St. Louis market, and producers already have special rates to the Illinois coal fields. The expected advance in Illinois coal prices after the strike is over will have a much greater influence.

The Annapolis Lead Co. is now erecting a 1,000-ton mill and recent drilling has considerably enlarged its orebody. It has also taken an option on the Schulte lands, near Fredericktown, where a shaft was started by the late H. J. Cantwell.

ALABAMA

North American Steel Merger of Importance to Birmingham District —Operators Activity Increasing

By George Huntington Clark

Birmingham—Of most importance to Alabama at the beginning of June is the reported merger of the Midvale, Republic, and Inland steel corporations into the newly organized North American Steel Corporation. Through this merger, Birmingham is to become the southern end of a great steel interest, the Republic Iron & Steel Co. owning three large and modern blast furnaces situated at Thomas, ample coke oven plants, and coal and iron mines, together with extensive dolomite quarries at various points in the district, practically all of which properties are now in active operation.

Whether these properties are to be made the nucleus around which to build up a southern steel business is as yet, of course, purely conjectural, but many conditions surrounding these Republic properties strongly indicate such a purpose. On the basis of present operation, the companies in the merger are said to have a combined ingot production of 5,000,000 tons per year.

Notwithstanding May increases in iron making, yard stocks of iron held decreased in May 20,000 tons, being estimated June 1 at 60,000 tons, against 235,000 tons of accumulated stocks on hand, June 1, 1921.

The Sloss Sheffield Steel & Iron Co., by blowing in another North Birmingham stack, has advanced its production from five active furnaces to a monthly iron output of approximately 50,000 tons. Coal production has increased from 275,000 to 325,000 tons per week.

The Federal Coal Terminal recently completed at Mobile, with a loading capacity of 40,000 tons for bunker and export coal, has now been placed in operation as an assisting factor.

Operations of the Tennessee Coal, Iron & R.R. Co. are continuing at capacity.

With labor advances recently and voluntarily made, both by the Tennessee company and by the Woodward Iron Co. to all classes of mine men and furnace men, unemployment is stated to be virtually now at an end, and skilled labor in demand.

THE MARKET REPORT

Daily Prices of Metals

June	Copper, N. Y., net refinery* Electrolytic	Tin		Lead		Zinc
		99 Per Cent	Straits	N. Y.	St. L.	St. L.
8	13.625@13.75	31.125	32.00	5.75@5.80	5.50@5.65	5.40@5.425
9	13.625	31.00	31.875	5.75@5.80	5.625	5.40@5.425
10	13.625	31.00	31.875	5.75	5.625	5.40@5.425
12	13.50@13.625	30.50	31.50	5.75	5.625	5.425
13	13.50@13.625	30.25	31.00	5.75	5.625	5.425
14	13.50@13.625	30.375	31.125	5.75	5.625	5.425

*These prices correspond to the following quotations for copper delivered: June 8th, 13.875@14; 9th and 10th, 13.875; 12th to 14th inc., 13.75@13.875c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

June	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
8	62⅜	62¾	69½	153⅜	154½	24⅞	23⅞	28⅛	27⅞
9	62	62⅜	69½	153	154¼	24⅞	23⅞	28⅛	27⅞
10	....	....	..	.....	.....	...	...	...	..
12	61⅜	61⅝	69½	151¼	153⅛	24¾	23⅝	28⅛	27⅞
13	61	61⅜	69	150¼	151½	24½	23½	28	27⅝
14	61⅜	61⅝	69	150½	151¾	24½	23½	27¾	27⅝

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

June	Sterling Exchange "Checks"	Silver			June	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
8	449¾	99⅝	72¼	35⅞	12	448¾	99⅝	71½	35⅜
9	449	99⅝	71⅞	35¾	13	448	99⅝	72¼	35⅞
10	449½	99⅝	71⅞	35¾	14	447	99⅝	72⅛	36⅛

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, June 14, 1922

Buying has not been so active during the last week, and prices in general have shown a somewhat easier tendency as a result, though zinc continues firm. The violent decline in security prices on the New York Stock Exchange on Monday without doubt had a depressing effect on the metal market. The reaction was to be expected, however, after the long upward swing; it is not likely to assume large proportions, for metal is going into consumption at a satisfactory rate and general business conditions continue to show improvement. The coal strike continues, and stocks are being depleted. Non-union production cannot keep pace with consumption. However, until an actual pinch is more in evidence there seems little likelihood of a settlement.

Copper

The amount of copper sold in the last ten days has been exceedingly small, and although the larger producers are holding their prices steady at from 13⅞ to 14c. delivered, the presence of speculative lots and offerings by trading interests has had the effect of depressing the price at which the metal could be obtained. The sales at the higher prices were confined chiefly to carload business, but there was little demand for larger lots. Quick to sense a probable weakness in the market, on Monday and Tuesday two large electrical companies put out inquiries for large tonnages with deliveries running into the future months, and received very attractive offers at prices substantially below those which had been ruling up to that time.

Export demand did not fall away to the extent that domestic did, but the prices realized did not average quite so high as last week. In the last two or three days, second-hands have offered copper at 13.5c., f.a.s.

Lead

The official contract price of the American Smelting & Refining Co. continues at 5.75c., New York.

Demand in the East has not been quite so active during the last week, and the premiums asked by outside interests have become largely nominal. Lead has been freely available the last few days at 5.75c., New York, from more than one producer, and deliveries at this price could be arranged for as late as September. One producer who has been inactive for some time was a ready seller. Spot delivery has been held at a 5- to 10-point premium, but sales have been comparatively small.

In the St. Louis district, practically all of the business has been done by one important producer, who has been selling freely at 5.625c. Efforts by others on Thursday and Friday to secure 5.65c. were not favorably received; in fact, some sales were made on those days even below 5.60c.

The market appears to be likely to stand at present levels for a time, and the unloading of surplus stocks and the diversion of supplies ordinarily going to Europe has had the stabilizing effect desired.

Zinc

The most important news of the week is the statistics released by the American Zinc Institute, which are as follows: Stock on hand, May 1, 51,728 tons; produced during May, 27,419; shipped during May, 38,738; leaving stock on hand May 31, 40,409. Shipped during May for export, 3,518. Stored for account of customers (not included in stock on hand), 1,808. Total retort capacity, 152,008; number of retorts available, 133,456; average number of retorts operating during May, 47,885; number operating at end of month, 48,765. The decrease in stocks is looked upon as exceedingly favorable to higher prices, and if consumption continues to outstrip production the price will soon reach such a figure that some of the Northwestern producers now shut down will find a resumption profitable. Demand during the week has been good [illegible] both galvanizing and brass interests, and the price is slightly above the figures of the week before. High grade is quoted at 6.25c. with a 50 point freight allowance. The New York prices are 35 points above the St. Louis quotations.

Tin

Prices have declined, owing to weakness in London prices and a fall in sterling exchange. Spot tin has been in free supply during the last two or three days and is now obtainable at the same prices as are asked for forward deliveries. Thursday and Friday a 1c. premium was asked. The stocks held in the Malay States seem to be in a condition of active liquidation, and it is reported that 2,500 tons left those shores during the first week in June. This has had a somewhat depressing effect. Banca tin, which is of higher grade than Straits, though not so well known, has gone begging, and sold yesterday for ⅜c. less than was obtained for Straits. Chinese tin is still offered.

Arrivals of tin, in long tons: June 12th, Liverpool, 25; 13th, Liverpool, 20.

Gold

Gold in London: June 8th, 91s. 6d.; 9th, 91s. 9d.; 12th, 91s. 9d.; 13th, 92s. 1d.; 14th, 92s. 6d.

Foreign Exchange

Sterling reacted during the week and other foreign exchanges shared in the decline. On Tuesday, June 13, francs were 8.77c.; lire, 4.97c.; marks, 0.31625c.; and Canadian dollars, 99.125c.

Silver

The market continues uncertain, with only moderate business, although the demand in the early part of the week for prompt New York delivery brought the local price well above the parity of the London quotation. The market closes quiet.

Correction—The price of silver in London on June 7 was quoted last week as 35⅜d. This should have been 35⅝d.

Mexican Dollars—June 8th, 55¼; 9th, 55; 10th, 55; 12th, 54⅝; 13th, 55¼; 14th, 55½.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum — 20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17.25@18.25c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 5.25@5.30c. W.C.C., 6@6½c. Cookson's "C" grade, spot, 8.75c. Chinese needle antimony, lump, nominal, 3.5@4c. per lb. Standard powdered needle antimony (200 mesh) nominal at 5½c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 6.75@7c.

Bismuth—$2@$2.10 per lb.

Cadmium—$1.20@$1.25 per lb.

Iridium—Nominal, $150@$170 per oz.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Outside market quiet at 29@32c. per lb.

Palladium—$55@$57.50 per oz.

Platinum—$87.50 per oz.

Quicksilver—$55@$56 per 75-lb. flask. San Francisco wires $55. Strong.

The prices of **Cobalt, Magnesium, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium** and **Tungsten** are unchanged from the prices in the issue of June 3.

Metallic Ores

Lake Superior Iron Ore—Prices for the 1922 season were developed last Friday at a 50c. decline from the 1921 schedule, making Mesabi non-bessemer $5.05, f.o.b. Lake Erie docks. The Lake vessel rate is down 10c. and shippers expect 25c. reduction in upper Lake rail freight rates, thus having 15c. of the decline to absorb themselves.

Chrome, Magnetite, Manganese, Molybdenum, Tantalum, Titanium, Tungsten, Uranium, Vanadium, and Zircon ore are unchanged from the quotations published June 3.

Zinc and Lead Ore Markets

Joplin, Mo., June 10—Zinc blende, per ton, high, $33.55; basis 60 per cent zinc, premium, $33.50; Prime Western $32.50; fines and slimes, $31@$29; average settling price, all grades of blende, $31.27; calamine, basis 40 per cent zinc, $15.

Lead, high, $73.95; basis 80 per cent lead, $75@$78; average settling price, all grades of lead, $72.96 per ton.

Shipments for the week: Blende, 11,044; calamine, 33; lead, 1,344 tons. Value, all ores the week, $443,360.

Scarcity of purchasable ore has developed sharp competition among buyers to secure a supply in anticipation of a possible railway strike. Smelters have already purchased a considerable tonnage and are making unusual effort to move material to the works as speedily as possible.

Limited production of lead in the West keeps the demand centered on the supply of this district.

Platteville, Wis., June 10—Blende, basis 60 per cent zinc, $33 per ton. Lead ore, basis 80 per cent lead, $77.50 per ton. Shipments for the week: Blende 241 tons; lead ore, none. Shipments for the year: Blende, 6,945 tons; lead ore, 977 tons. Shipped during the week to separating plants, 1,117 tons blende.

Non-Metallic Minerals

Feldspar—Canadian feldspar, 13 per cent K_2O and 65 per cent SiO_2, continues at $10 per net ton, f.o.b. Quebec quarry. Market improving.

Graphite—Ceylon lump, first quality, 7@10c. per lb., f.o.b. N. Y.; chip, 5@6.5c. per lb.; dust, 4@5c. per lb.; amorphous crude, $18@$70 per ton; flake, 6@9c. per lb. The market is somewhat improved, although most consumers still have large stocks on hand. Present purchasing is only for certain grades on which demand could not be anticipated. Expected import duties no doubt are contributing to increased buying before they become effective.

Talc—High-grade foundry talc, $20 per ton, or $18 in carload lots, f. o. b. Virginia mills. Demand better.

Asbestos, Barytes, Bauxite, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, and **Talc** are unchanged from the prices published June 3.

Mineral Products

Arsenious Oxide—7@7.25c. per lb.

Copper Sulphate — 6.25c. for large crystals. Prompt shipment scarce.

Sodium Nitrate—$2.50 per 100 lb. ex vessel, Atlantic ports.

Potassium Sulphate and **Sodium Sulphate** are unchanged from quotations of June 3.

Ferro-Alloys

Ferrosilicon—10 to 15 per cent, $38@$40 per gross ton, f.o.b. works; 50 per cent, $58@$60; 75 per cent, $115@$120.

Ferrocerium, Ferrochrome, Ferromanganese, Ferromolybdenum, Ferrotitanium, Ferrotungsten, Ferro-uranium, and **Ferrovanadium** are unchanged from the prices published June 3.

Metal Products

Copper Sheets—New York base, 20.50c. per lb.; wire, 15.75c.

Nickel Silver—26.75c. per lb, for 18 per cent nickel Grade "A" sheets.

Yellow Metal—Dimension sheets, 17.75c.; rods, 14.75c. per lb.

Lead Sheets and **Zinc Sheets** are unchanged from the quotations published in the June 3 issue.

Refractories

Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick, and **Zirkite** are unchanged from the prices appearing in the issue of June 3.

The Iron Trade

Pittsburgh, June 13, 1922

The steel market position continues a strong one throughout, but with a lessened turnover, mills being comfortably sold up and buyers somewhat more cautious. Bars, shapes, and plates range from 1.60c. to 1.80c., depending on tonnage, time of delivery and other conditions, and hoops and sheets also show a price range.

The Steel Corporation's unfilled obligations increased by 157,311 tons in May, against an increase of 602,769 tons in April.

Pig Iron.—The market continues stagnant, quotable prices, now partly nominal, remaining at $25, Valley, for bessemer and basic and $24 for foundry.

Coke

Connellsville Coke—Demand and offerings are limited, prices remaining at about $7 for furnace and $7.50 for foundry.

COMPANY REPORTS

Nevada Consolidated Copper Co.

The combined statement of the Nevada Consolidated Copper Co. and the Nevada Northern Railway Co. for the year 1921 is as follows:

ASSETS

	Dec. 31, 1921	Dec. 31, 1920
Property, equipment and construction	$21,389,593.62	$21,087,195.03
Less ore extinguishment and depreciation	12,858,047.98	11,915,323.21
	$8,531,545.64	$9,171,871.82
Investments in securities and rights	58,599.23	58,599.23
Deferred charges to mining operations	5,620,701.49	5,655,536.03
Copper Export Association, Inc., suspense	524,794.34	
Materials and supplies on hand	1,540,028.11	2,124,540.33
Accounts and notes collectible	656,854.83	446,297.49
Deferred accounts	179,816.18	96,708.37
Metals on hand and in transit	2,644,688.50	7,017,301.57
Marketable securities	235,534.00	235,534.00
Cash	3,419,452.02	867,353.84
	$23,412,014.34	$25,673,742.68

LIABILITIES

Capital stock outstanding (Nev. Con. Cop. Co. only)	$9,997,285.00	$9,997,285.00
Surplus (from capital stock and securities sold in excess of par value or cost)	7,071,850.17	7,071,850.17
Accounts payable (not due)	456,650.46	814,567.95
Unpaid treatment on metals (not due)	343,172.48	548,240.43
Deferred accounts	73,744.05	66,537.73
Surplus from operations	5,469,312.18	7,175,261.40
	$23,412,014.34	$25,673,742.68

The statement of operations for the year ended Dec. 31, 1921, is as follows:

Operating revenue		
Copper produced—9,362,325 lb. @ 12.535c. f.o.b. refinery	$1,173,595.62	
Gold and silver produced	106,550.95	
		$1,280,146.57
Operating expenses		
Mining, including proportion of stripping expense	$375,291.82	
Ore delivery—mine to mill	80,786.34	
Milling	374,698.48	
Smelting	264,323.47	
Freight and refining	167,328.67	
Selling commission	1,315.28	1,263,744.06
Net profit from operations		$16,402.51
Miscellaneous income		34,121.46
Total income		$50,523.97
Charges against income		
Depreciation	$857,341.08	
Shutdown expense	714,440.05	
Loss on copper sold during shutdown period	111,907.24	1,683,688.37
Net loss to surplus account		$1,633,164.40

SURPLUS FROM OPERATIONS

Balance Dec. 31, 1920	$6,538,602.24
Loss for year (exclusive of depletion)	1,633,164.40
Balance, Dec. 31, 1921	$4,905,437.84

Operations were suspended on March 31, 1921, at the company's properties at Ruth and McGill in Nevada. The ore mined amounted to 450,590 tons, assaying 1.62 per cent copper. Dry tons milled was 392,645, averaging 1.49 per cent copper.

Production of refined copper during the 1921 operating period was 9,362,325 lb. as compared with 48,311,985 lb. for 1920. Excluding depreciation of plant and equipment, but including all taxes and overhead, the total operating cost per pound of copper produced was 13.50c. Applying the usual credits for gold and silver and miscellaneous earnings, amounting to 1.16c., the net copper cost for 1921 was 12.34c. as compared with 15.67c. per lb. on similarly calculated costs for the year 1920.

Oriental Consolidated Mining Co.

The balance sheet of the Oriental Consolidated Mining Co., with head office at 15 Broad St., New York, and mines and works in the Unsan district of Korea, was as follows, as of Dec. 31, 1921:

CAPITAL AND LIABILITIES

Capital stock (authorized)		$5,000,000	
Less unissued stock		706,100	
			$4,293,900
Sundry creditors			35,689
Surplus profits on hand June 30, 1920		520,693	
Less:			
Dividend No. 40 paid July, 1920	$214,695		
Dividend No. 41 paid August, 1921	214,695		
United States income tax paid	33,120		
Loss for eighteen months, June 30, 1920 to Dec. 31, 1921	234,064		
		696,574	
Deficit Surplus, Dec. 31, 1921		$175,881	
Reserves for			
Depreciation	$1,825,000		
Depletion	683,626		
		2,508,626	
Net Surplus and Reserves			$2,332,745
			$6,662,335

PROPERTY AND ASSETS

Mines and property	$4,293,900
New construction and development	1,029,769
Additions as of March 1, 1913—plant and equipment	750,000
Cash	257,259
Sundry debtors	49,254
Supplies	261,429
Tax 1922 paid in advance	12,500
Insurance paid in advance	8,222
	$6,662,335

Profit-and-loss-account for the eighteen months ending Dec. 31, 1921, is as follows:

DEBIT

	Cost Per Ton	
Mining costs, 327,193 tons of ore mined and milled	$2.98	$975,292
Milling costs	.66	214,489
Concentrates expenses	.25	80,971
Transportation of ore	.02	5,472
General expenses	.49	159,069
Total operating and general expenses	$4.40	$1,435,295
Depreciation	1.14	375,000
Depletion, 5 per cent of output	.25	81,345
Total debits	$5.79	$1,891,640
Loss for eighteen months to balance sheet	.72	234,064
	$5.07	$1,657,576

CREDIT

Bullion from mills	$2.41	$788,770
Concentrates	2.56	838,135
Interest and other receipts	.10	30,669
	$5.07	$1,657,576

The total receipts for the eighteen months were $5.07 per ton; the costs, $4.40 per ton; and the depreciation and depletion reserves, $1.39 per ton; leaving a net loss of 72c. per ton. The efficiency of native labor was reported to be lower than ever before, and the adverse exchange tended to keep away Chinese labor. Timber was unusually expensive. The combined ore averaged $6.05 per ton. The report is particularly complete and gives detailed costs of all operations.

The company reports that operating costs continue to be high. Two 5 per cent dividends, aggregating $429,390, were paid during the eighteen-month period between July 1, 1920, and Dec. 31, 1921, the report explaining, however, that most of the money for these was obtained from accumulated surplus and not from profits earned during the period.

Fire broke out in Tabowie mine on Nov. 10, 1920, causing heavy damage. Six months' efforts were required to put out the fire. Tonnage mined and milled was consequently much reduced.

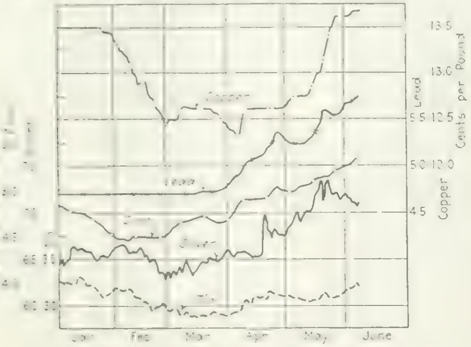
The Advance in Metal Prices

Among the Metals of Chief Interest to American Producers, Copper, Zinc, and Lead Have Shown Increasing Strength During the Spring

By Edward H. Robie

THOSE LIVING in metal-producing districts and investors in shares of metal-mining companies may well feel encouraged over the price tendencies of the more important non-ferrous metals in the last three months, as illustrated in the accompanying chart.

The long ...ying movement in copper which took place in the fall and early winter of 1921 left the refinery price at 13.5c. at the beginning of this year. The January demand was small, however—only about 75,000,000 lb.—and immediately the price slumped, owing to the desire of certain producers to sell a pre-determined amount, or their current output, in the domestic market. Though sales for February showed an improvement, amounting to slightly over 100,000,000 lb., the demand came too late to affect the price before the end of the month.



Variations in Metal Prices Since Jan. 1

Despite the large sales of March, reported at 184,000,000 lb., the price did not materially advance, and the announcement of a resumption of production by the porphyries had a most depressing effect, causing the price to fall to what will in all probability be the low of the year—12.25@12.375c., refinery. Then it began to be realized that the resumption was justified by the fact that most of the companies were practically sold out of stocks of copper available for domestic deliveries, and that average demand would necessitate an increased supply. Some fear was felt that the large producers, which depend for efficient operation on large tonnages, would attempt to run to capacity, make copper as cheaply as possible, and force some of the higher-cost producers to close down. So far no tendency to do this has been noted; the porphyries have announced a resumption at only 50 per cent of capacity, which will hardly prove a burden on the market unless the summer demand is much below expectations.

The Copper & Brass Research Association no longer issues statistics of consumption even to its members, so that no official figures are now available for total monthly sales of copper. However, it is likely that the sales in May were above those of any other month in 1921 or 1922. Most of these were for June and July delivery, with some sold as far ahead as August. At present, consumers' demands for the summer have been pretty well booked, and it would not be surprising to see somewhat of a lull in demand during the next month or two. However, the experience of recent weeks has indicated little pressure to sell by cutting prices, and even with a slump in demand, the price should at least remain substantially constant. Should demand improve—and there is reason to believe that it will—15c. copper may be reached before the end of the summer.

It is of interest to note that the increased price of copper is meeting with extreme disfavor in the London metal market. Hardly an issue of *The Metal Bulletin* is received that does not contain such comments as these: "It is difficult to feel confidence in the position in the face of the steady increase which is going on in production." "Whilst the upward movement might be carried a little further, there does not seem any ground to anticipate a great rise." "Owing to the big quantity of copper earmarked for export . . . it seems inevitable that the price asked for them [the exportable stocks] will ease off." "If the large interests in America would only be content to feed the market as it showed appetite, they would undoubtedly do more business. The effect of the present policy [of increasing prices] is to keep consumption from expanding as it might do, and to encourage production." "The trouble with the big American copper people is that they can never let well alone, but as soon as demand begins to rear its head, they raise their price out of reach."

Lead has shown more strength than the closest followers of the industry had expected. All during the winter the price held constant, with production and consumption practically balanced, with Mexican production going abroad, and with the comparatively small stocks of lead, held in this country, produced at a high cost, in strong hands. In the middle of March, however, the demand began to pick up, and soon was a little greater than those selling at fixed prices were able to supply. Paint manufacturers had been taking large amounts of lead for some time, but with the coming of spring, lead for automobile batteries was in much greater demand, building materials absorbed considerably increased amounts, cartridge makers were preparing for an active season, and the lead-covered cable business improved. Prices therefore began to be advanced, with the leading domestic lead producer holding its official price somewhat behind the outside market. One or two slight recessions have occurred, as indicated on the chart, but the price seems headed for 6c.

In an effort to prevent a runaway market, several thousand tons of lead which has been held in storage for a year or two in the hope of improved prices has been released, and Mexican lead has been sold in this country, as is indicated by a preponderance of imports over exports. But the market seems to have a hearty appetite. Lead production in foreign countries, principally Spain and Australia, has been greatly curtailed owing to labor troubles; these have now been settled, in some measure, and with the higher prices foreign lead production is likely to increase rapidly during the rest of the year. By the end of summer, consumption is likely to fall away somewhat, for some of it is seasonal. Then, too, the increase in the price of zinc will stimulate lead-zinc producers; and the increase in foreign silver will stimulate foreign silver-lead producers. So, with the price now 35 per cent above the 1912-1914 average, markedly higher prices are hardly to be expected, though the next two or three months may record a continued advance.

Zinc has had the smoothest rise of all of the metals, and the most long continued, beginning in a small way early in February, when what will doubtless be the low for the year was reached. Both the galvanizing and brass trade has improved materially since early spring, taking increased amounts of zinc. The brass trade has taken increased tonnages of zinc, too, because of the exhaustion of war stocks of scrap brass, which are no longer much of a factor. Stocks of zinc at the beginning of the month, together with production and consumption during the month, are indicated in the following table, for which appreciation should be extended to the American Zinc Institute:

Month	Stocks	Production in Tons	Consumption in Tons
January	66,608	23,706	24,636
February	65,678	22,513	24,067
March	64,124	26,532	30,394
April	60,262	25,506	34,040
May	51,728	27,419	38,738
June	40,409		..

The healthy condition of the zinc industry is at once apparent, and the price should gradually work its way above that of lead, as it was before the World War. With or without a tariff, there seems little to fear from foreign zinc; in fact, during the last two or three months several thousands of tons of zinc have been sold abroad, including that to countries ordinarily thought of as important producers.

MINING STOCKS

Week Ended June 10, 1922

Stock	Exch.	High	Low	Last	Last Div.	
COPPER						
Ahmeek	Boston	65	62¼	62¼	Sept '20, Q	$0 50
Alaska-Br. Col. new.	N Y Curb	5⅛	4½	4½		
Allouez	Boston	28½	27¼	27¼	Mar '19	1 00
Anaconda	New York	56⅛	52⅝	53	Nov. '20, Q	1.00
Arcadian Consol	Boston	4⅝	4	4	..	
Ariz. Com'l	Boston	10½	10	10	Oct '18, Q	0 50
Big Ledge	N Y Curb	*20	*17	*17		
Bingham Mines	Boston	16¼	15½	15½	Sept. '19, Q	0.25
Calumet & Arizona	Boston	..		65½	Mar '22, Q	0.50
Calumet & Hecla	Boston	290	280	280	June '20, Q	5.00
Canada Copper	N. Y. Curb	*38	*35	*35		
Centennial	Boston	12	10¼	10¼	Dec '18, SA	1.00
Cerro de Pasco	New York	39¾	36¼	37	Mar '21, Q	0.50
Chile Copper	New York	23	21	21		
Chino	New York	32⅝	30⅛	30⅛	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*29	*28	*28½		
Con. Arizona	N. Y. Curb	*5	*5	*5	Dec. '18, Q	0 05
Con. Copper Mines	N. Y. Curb	1 9/16	1	1 1/16		
Copper Range	Boston	46½	44⅜	44⅜	Mar '22, Q	1 00
Crystal Copper	Boston Curb	1⅝	1⅜	1 9/16		
Davis-Daly	Boston	8⅞	8¼	8½	Mar '20, Q	0.25
East Butte	Boston	11⅝	11	11	Dec '19, A	0.50
First National	Boston Curb	*70	*70	*70	Feb. '19, SA	0.15
Franklin	Boston	2⅜	2⅛	2⅜		
Gadsden Copper	Boston Curb	1⅛	*95	*95		
Granby Consol	New York	32¼	30	30	May '19, Q	1.25
Greene-Cananea	New York	34⅜	32⅞	32⅞	Nov. '20, Q	0.50
Hancock	Boston	3	3	3		
Howe Sound	N. Y. Curb	3⅜	3⅛	3⅛	Jan. '21, Q	0.05
Inspiration Consol	New York	44¾	41¾	41¾	Oct '20, Q	1.00
Iron Cap	Boston Curb	8	8	8	Sept. '20, K	0.25
Isle Royale	Boston	26	24½	24½	Sept '19, SA	0.50
Kennecott	New York	38⅞	35⅜	36	Dec. '20, Q	0.50
Keweenaw	Boston	3	2½	2⅞	.....	....
Lake Copper	Boston	5	4½	4⅞	....	..
La Salle	Boston	1⅝	1½	1½		
Magma Copper	N. Y. Curb	31⅛	28¾	28¾	Jan. '19, Q	0.50
Majestic	Boston Curb	*12	*10	*12		
Mason Valley	Boston	†2½	†2	2½		
Mass. Consolidated	Boston	4	3¼	3¼	Nov. '17, Q	1 00
Miami Copper	New York	31	29½	29½	May '22 Q	0.50
Michigan	Boston	3	2¾	3		
Mohawk	Boston	67⅜	66	66	Feb. '22, Q	1 00
Mother Lode Coa.	N. Y. Curb	10	9⅜	9½	....	
Nevada Consol	New York	19	17⅜	17⅜	Sept. '20, Q	0 25
New Cornelia	Boston	20¼	19½	19½	May '22, K	0 25
North Butte	Boston	14⅜	13¼	13¼	Oct. '18, Q	0 25
North Lake	Boston	.		½		
Ohio Copper	N. Y. Curb	*9	*9	*9		
Old Dominion	Boston	27	25	25	Dec. '18, Q	1 00
Osceola	Boston	36½	36½	36½	June '20, Q	0 50
Phelps Dodge	Open Mar.	†185	†175	.	Apr '22, Q	1 00
Quincy	Boston	49¾	47½	47½	Mar '20, Q	1 00
Ray Consolidated	New York	18⅞	17	17½	Dec. '20, Q	0 25
Ray Hercules	N. Y. Curb	2¼	1¾	1⅞	....	..
St. Mary's Min. Ld.	Boston	48	47¼	48	Apr. '22, K	2 00
Seneca Copper	Boston	..		14		
Shannon	Boston	*95	*90	*90	Nov. '17, Q	0 25
Shattuck Arizona	New York	11⅞	10⅝	10⅝	Jan. '20, Q	0 25
South Lake	Boston	1¼	1⅛	1⅛		
Superior & Boston	Boston	1¾	1⅝	1⅝		
Tenn. C. & C. cfs	New York	12⅝	11⅝	11⅝	May '18, I	1 00
Tuolumne	Boston	*79	*70	*70	May '13,	0 10
United Verde Ex.	Boston Curb	30	28	28	May '22, Q	0 25
Utah Consol	Boston	3¼	3⅛	3⅛	Sept '18,	0.25
Utah Copper	New York	68⅝	65¼	65¼	Mar. '22, Q	0.50
Utah Metal & T.	Boston	1½	1⅛	1⅛	Dec. '17,	0.30
Victoria	Boston	1⅜	1¼	1¼	....	....
Winona	Boston	1 15/16	1¼	1 15/16	....	....
Wolverine	Boston	15	14¼	14¼	....	....
NICKEL-COPPER						
Internat. Nickel	New York	18	16½	16½	Mar. '19,	0.50
Internat. Nickel, pfd	New York	82	80	80	May. '22, Q	1.50
LEAD						
National Lead	New York	95½	93½	94½	Mar. '22, Q	1.50
National Lead, pfd	New York	109⅜	109⅜	109⅜	Mar. '22, Q	1.75
St. Joseph Lead	New York	15⅜	14⅞	14⅞	Mar.'22, Q	0.25
QUICKSILVER						
New Idria	Boston	1½	1⅛	1⅛	....	....
ZINC						
Am. Z. L. & S.	New York	19⅞	18¼	18¼	May '20,	1.00
Am. Z. L. & S. pfd	New York	46	44¼	44¼	Nov. '20, Q	1.50
Butte C. & Z.	New York	8¾	7½	7½	June '18,	0.50
Butte & Superior	New York	32¼	29⅜	29⅜	Sept. '20,	1.25
Callahan Zn-Ld	New York	11¼	8¾	8¾	Dec. '20, Q	0.50
New Jersey Zn	N. Y. Curb	144½	143½	144	May '22, Q	2.00
Yellow Pine	Los Angeles	*54	*54	*54	Sept. '20, Q	0 03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills; Spokane, Pohlman Investment Co ; Salt Lake, Stock and Mining Exchange; Los Angeles, Chamber of Commerce and Oil; Colorado Springs The Financial Press, N. Y.

Stock	Exch.	High	Low	Last	Last Div.	
GOLD						
Alaska Gold	New York	⅝	½	½	......	
Alaska Juneau	New York	1½	1¼	1¼		
Carson Hill	New York	*15	*12	*15		
Cresson Consol. G.	N Y Curb	2½	2	2½	Apr '22, Q, X	$0 10
Dome Extension	Toronto			1		
Dome Mines	New York	29¼	28	28	Apr '22, Q	1 00
Florence Goldfield	N. Y Curb	*19	*17	*17		
Golden Cycle	Colo Springs	*80½	*78	*80½	June '21, Q	0 02
Goldfield Consol	N. Y. Curb			*8	Dec. '19,	0.05
Hollinger Consol	Toronto	9 60	9 25	9 30	May '22,	0.05
Homestake Mining	New York	71	70	71	May '22, M	0.25
Kirkland Lake	Toronto	*41	*35	*40		..
Lake Shore	Toronto	2 26	2 04	2 10	Nov '21, K	0.02
McIntyre-Porcupine	Toronto	17 75	17 20	17.45	May '22, K	0.05
Porcupine Crown	Toronto	*25	*22	*22½	July '17,	0.03
Porcupine V. N. T.	Toronto	*23	*21	*22½		
Portland	Colo. Springs	*25	*25	*25	Oct. '20, Q	0.01
Schumacher	Toronto	*65	*63	*64½	..	....
Silver Pick	N. Y Curb	*18	*17	*17	....	.. .
Teck Hughes	Toronto	*52½	*48	*49	. .	.
Tom Reed	Los Angeles	*50	*50	*50	Dec '19,	0 02
United Eastern	N. Y. Curb	1 11/16	1⅝	1⅝	Apr '22, Q	0.15
Vindicator Consol	Colo. Springs			*7	Jan '20, Q	0.01
White Caps Mining	N. Y Curb	*9	*9	*9	...	..
Wright-Hargreaves	Toronto	2.85	2.60	2.75	Apr. '22,	0 02½
Yukon Gold	N. Y. Curb	1	*92	*92	June '18,	0.02½
SILVER						
Batopilas Mining	New York	1¼	1¼	1¼	Dec. '07, I	0 12½
Beaver Consol.	Toronto	*31	*30	*30½	May '20, K	0 03
Coniagas	Toronto	1 30	1 20	1 25	May '21, Q	0 12½
Crown Reserve	Toronto	*17	*12	*15	Jan. '17,	0 05
Kerr Lake	N. Y. Curb	3⅜	3¼	3¼	Apr. '22, Q	0 12½
La Rose	Toronto	*37½	*32	*33	Apr. '22,	0 10
McKinley-Dar.-Sav.	Toronto	*28	*21	*25	Oct. '20, Q	0 03
Mining Corp. Can.	Toronto	1.05	1 00	1 03	Sept '20, Q	0 12½
Nipissing	N Y. Curb	6½	6⅛	6¼	Apr. '22, Q, X	0 30
Ontario Silver	New York	8⅝	7⅝	7⅞	Jan. '19, Q	0 50
Ophir Silver	N. Y. Curb			*12	Jan. '12,	0 10
Temiskaming	Toronto	*30	*20	*29½	Jan. '20, K	0 04
Trethewey	Toronto	*4¼	*3½	*4¼	Jan. '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*20	*17	*18	....	....
Cash Boy	N. Y. Curb	*6	*6	*6	....	. . .
Dolores Esperanza	N. Y. Curb	2⅞	2⅛	2⅛	......	...
El Salvador	N. Y. Curb	*5	*4	*4	.	.
Jim Butler	N. Y. Curb	*6	*6	*6	Aug. '18, SA	0 07
Jumbo Extension	N. Y. Curb			*5	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*10	*7	*10	May '10,	0 02½
Tonopah Belmont	N. Y. Curb	1⅞	1 13/16	1⅞	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*80	*76	*76		
Tonopah Extension	N. Y. Curb	1 13/16	1 11/16	1 11/16	Apr. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1⅞	1¼	1[illegible]	Apr '22, SA, X	0 07½
West End Consol	N. Y. Curb	1½	1	1⅛	June '22, SA	0 05
SILVER-LEAD						
Caledonia	N. Y. Curb	.		*10	Jan. '21, M	0 01
Cardiff M. & M.	Salt Lake	*96	*94	*94	Dec '20,	0 15
Chief Consol	Boston Curb	5	4¾	5	May '22, Q	0 05
Consol. M. & S.	Montreal	24	23¼	24	Oct '20, Q	0.62½
Daly Mining	Salt Lake	†2.00	†1.90	...	July '20, Q	0 10
Daly-West	Boston	2½	2½	2½	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	3½	3½	3½	Apr '21 K	0 05
Electric Point	Spokane	*9¼	*8	*8	May '20, SA	0 03
Federal M. & S.	New York	†14½	†10	14½	Jan '09,	1.50
Federal M. & S. pfd.	New York	51¼	47¼	47¼	Mar '22, Q	1 00
Florence Silver	Spokane	*22½	*22	*22½	Apr. '19,	0 01½
Grand Central	Salt Lake	†*61	†*60	*60	Jan. '21, K	0 01
Hecla Mining	N. Y. Curb	6½	6½	6⅜	Mar. '22, Q	0 15
Iron Blossom Con.	N Y Curb	*24	*22	*24	Apr '22, Q	0 02½
Judge M. & S.	Salt Lake	†2 75	†2 50	2 [illegible]	Sept '2[illegible], Q	0 12½
Marsh Mines	N. Y. Curb	*28	*17	*20	June '21, I	0 02
Prince Consol	Salt Lake	†*5¼	†*4¾	[illegible]	Nov. '17,	0 02½
Rambler-Cariboo	Spokane	*6	*6	*6	Feb. '19,	0 01
Rex Consol	N. Y. Curb	*11	[illegible]	[illegible]	...	
Standard Silver-Ld.	N. Y. Curb	*20	*20	*20	Oct '17,	0 05
Stewart Mines	N. Y. Curb	*9	*7	*8	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.62	2 55	2 62	Jan. '21, K	0 04
Tintic Standard	Salt Lake	2 12½	2 07½	2 12½	Dec '21, Q	0.05
Utah Apex	Boston	3¼	2⅞	3	Nov. '2[illegible], K	0 25
Wilbert Mining	N. Y. Curb	.	..	*2	Nov. '17,	0.01
VANADIUM						
Vanadium Corp	New York	52½	48½	48½	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp	Montreal	57½	56	57½	Apr. '22, Q	1.50
Asbestos Corp. pfd	Montreal	78	78	78	Apr. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	26⅝	23¾	24	Nov. '19, Q	1.00
Texas Gulf	New York	52	46½	46½	Mar. '22, QX	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref	New York	65½	60	60¼	Mar. '21, Q	1.00
Amer. Sm.& Ref. pf.	New York	98½	96¾	97⅞	June '22 Q	1.75
Am. Sm. Sec. pf. A	New York	93⅝	93¼	93⅝	Apr. '22, Q	1.50
U. S. Sm. R. & M.	New York	44½	41⅝	41⅝	Jan. '21, Q	0.50
U.S. Sm.R.& M. pf	New York	47⅜	47	47⅜	Apr. '22, Q	1.75

NEW MACHINERY AND INVENTIONS

Arc Welding a Mine Pipe Line

Method Used at Property in Central America Proves Effective and Saves Expense of New Installation

By A. M. Candy

A GENERAL VIEW of the mill and camp of the Honduras Rosario Mining Co., San Juancito, Honduras, is shown in an accompanying cut. The water pipe line which supplies the Guadulupe plant has been in service for a number of years, most of it having been placed on the surface of the ground over the mountains, as a result of which the pipe sections became so badly corroded that it was necessary to make extensive replacements or repairs.

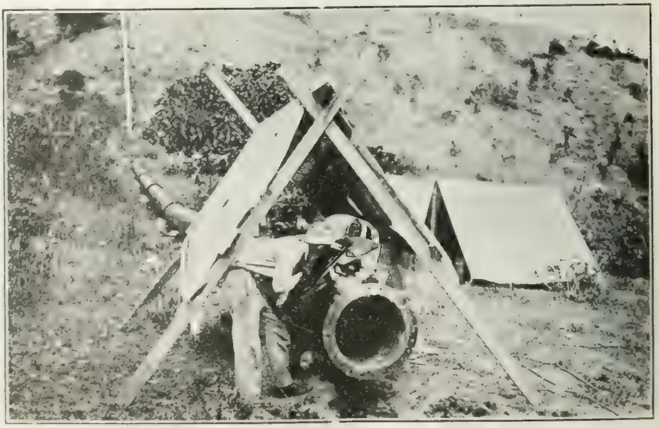
Mill and camp of Honduras Rosario Mining Co.

Part of welded pipe and native workmen

After a preliminary examination of the pipe line the operators thought that only approximately 400 ft. of the pipe would require repairing. However, upon more extensive examination it was found that practically the entire line would require extensive repairs. The total line is somewhat over 3,000 ft. long, the pipe being 22 in. internal diameter, of the built-up riveted type, constructed of 6½-ft. steel plate built into pipe sections 30 ft. long. Each section of pipe is provided with a steel flange riveted to the end of the pipe to form a coupling for joining the various lengths of pipe to one another.

In some places this pipe was found to have rusted so badly that the remaining section of metal was as thin as a sheet of ordinary paper. In other places the pipe was found to be in perfect condition. The question naturally arose as to whether it would be cheaper to buy and install new pipe or attempt to repair the old pipe. To find the expense of repairing by the electric arc-welding process, one of the badly corroded sections of pipe was removed from the line and repaired by forming steel plates for patches which were bent to the proper curvature and applied on the outside of the pipe. These were welded to the pipe around the edge of the patch by means of the Westinghouse arc-welding equipment, as shown in the accompanying illustration. A careful check was kept on the cost of doing this repair work, and after the work was finished everyone was surprised to find that the piece of repaired pipe, made practically as good as new, cost only approximately one-tenth of the amount involved to purchase and transport a new length of pipe to the location where the welding work was done. The operators therefore decided to go ahead with the project of repairing the entire pipe line.

To carry on this work the pipe line was disconnected at every third joint, so as to leave sections of 90 ft. of continuous pipe in each piece. These sections could be readily turned around on the pliers on which they were originally



Arc welder at work on old water pipe

installed. The defective places in the pipe were then marked off and plates cut out to the required size and bent so that they could be applied over the places in the pipe on the outside thereof. These plates were then welded to the pipe by running a full fillet of deposited metal around the edge of the plate, which tied it securely to the shell of the pipe. After each 90-ft. length of pipe was finished it was tested to double the working pressure, and barring a few beads of moisture occurrring in a few places, the pipe was otherwise satisfactory. These leaks were easily stopped by a few light blows from a machinist's hammer.

Any other method of repairing this pipe was impracticable because the rivet heads were corroded to such an extent that the rough treatment to which they would have been subjected during the operation of attempting to rivet on patches would have resulted in innumerable leaks around the rivets. Furthermore, the patches required on many of the lengths of pipe were so numerous that to attempt to rivet on patches would have been prohibitive in cost.

Temporary tents and awnings were put up to protect the welding equipment during the night from the weather, and also to protect the operators during the daytime, and from the wind, which would make it difficult to carry on the welding operation in the open country. Transformers were required to be installed to step down the transmission line voltage of 2,200-v. to 440-v. required by the motor of the portable arc-welding equipment.

All of the welding work proper was performed by native Hondurans, who, when they have a mechanical turn of mind, have been found to make excellent arc-welding operators. However, the operating characteristics of this particular welding equipment which make it easy for an operator to strike and hold an arc and at the same time cause the deposited metal to produce deep penetration and good fusion with the plate material must not be overlooked.

Ventilating Tubing for Mines

Successful operation, under severe underground conditions, of the new fabric ventilation tubing for mines, Ventube, is reported by E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. One test given this material was carried out in a large Butte copper mine on the 1,600 level, about 1,000 ft. from the shaft. The temperature there was 112 deg. F., the air absolutely still and the acid-water drip excessive—conditions ideal for fungus growth and chemical corrosion. At the end of seven months this sample of Ventube was removed and found to be in as good and serviceable a condition as when originally installed for the test. Other sections hung underground in 1919 are still delivering air and are in good working condition. Reports from users show it is not extraordinary to get an increased production of 50 per cent output where Ventube has been installed.

Ventube was produced by the du Pont company as a result of researches and studies made at the request of Western copper interests, who were looking for an efficient flexible tubing to increase production in underground workings.

As a result of practical tests and of the increased use of Ventube, interesting information has been compiled in a series of tables and charts, by which any one can determine the Ventube equipment necessary to meet any given condition, embracing carefully worked out data for fans and tubes of different capacities and diameters.

New Arc-Weld Bonds

Two new rail bonds, for arc-weld application, have been developed by the Ohio Brass Co., Mansfield, Ohio. They are known as Type AW-7, for base of rail application, and Type AW-8 for ball of rail application. They are shown in Figs. 1 and 2 respectively.

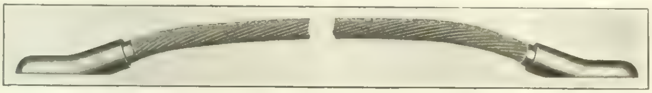


Fig. 1. Type AW-7 rail bond

The AW-8 bond consists of two copper strands formed into a U and welded into steel terminals which in turn are welded to the rail. The AW-7 bond is the same in principle. It has a single strand, of any desired length, welded into suitable steel terminals. It is a proved fact that steel to steel is the easiest kind of electric welding, and the new bonds conform to this principle.

The steel terminals are slightly rounded, and provide a wide angle or scarf in which to build the weld. The steel is heavy, and will not be burned through by the arc. A copper sleeve, which surrounds the strands at the terminal, shields the wires and absorbs vibration.

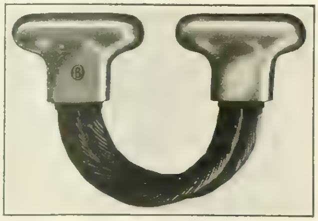


Fig. 2. Type AW-8 rail bond

Flexible Steel Belt Lacing

A flexible steel belt lacing which is suitable for use with belts up to $\frac{5}{32}$ in. in thickness is manufactured by the Flexible Steel Lacing Co., 4607 Lexington St., Chicago, Ill. This product is known as the "Alligator," and claims a number of advantages, among which are: Stronger than other joints; a separable hinge joint; quick application, and long life.

INDUSTRIAL NOTES

The Titan Iron & Steel Co., Inc., of Newark, N. J., manufacturing mechanically puddled wrought iron, has announced the appointment of W. Woodward Williams as vice-president.

Recent sales of Ruggles-Coles driers include the following: An ore drier to the Mutual Chemical Co. of America, Baltimore, Md.; Class A-2 drier for drying crushed limestone to the Peerless White Lime Co., Mosher, Mo.; Class A-10 drier for the drying of coal, to the Graphite Mines Corporation, Providence, R. I.; Class A-2 drier for drying coal at a large cement plant in Japan.

The Pulverized-Fuel Department of the Quigley Furnace Specialties Co. has lately been operated as the Quigley Fuel Systems Department of Hardinge Co., Inc. This pulverized-fuel business has now been incorporated as the Quigley Fuel Systems, Inc., with general officers at 26 Cortlandt St., New York City. William H. Baker is president, W. O. Renkin, managing engineer, and L. W. Marso represents the company in the Pittsburgh district. The new company is entirely independent of the Hardinge Co., although Mr. Baker continues as vice-president and consulting engineer for the Hardinge Co.

Industrial Advertising Conference

The First Annual Industrial Advertising Conference is to be held at Milwaukee, Wis., June 11 to 15, in connection with the Eighteenth Annual Convention of the Associated Advertising Clubs of the World. The program will be of definite interest to the sales and advertising executives of industrial companies generally, particularly those dealing with raw materials, machinery, and other products which are sold to other industries. The program is focused upon inter-industrial marketing, and this will be the first time that this phase of selling and advertising has been given proper attention at these conventions.

The following papers will be presented: "Advertising as a Factor in Inter-industrial Marketing," Max W. Babb; "What the U. S. Department of Commerce Is Doing to Aid Inter-industrial Marketing," by F. M. Feiker; "Cutting the Costs of Distribution," by the Hon. Sydney Anderson; "Advertising in Its Relation to the Four Points of Contact in Industry," by Bennett Chapple; "Advertising the Technical

Selling to the Non-Technical Buyer," by Charles H. Mackintosh; "Selling to the Professional Man in Industry," by J. C. McQuiston; "Expanding the Markets for Raw Materials," by H. Cole Campbell; "Putting Ideas Into Industrial Advertising," by W. Lee, and "The Outlook for Business in the Industrial Field," by Edwin F. Gay.

TRADE CATALOGS

Gears and Pinions. Circular 1,579-B, containing general information and technical data for cutting micarta gears and pinions, has recently been issued by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa. The book contains a great amount of useful information for gear manufacturers. Micarta, a non-metallic material for gear and pinion application that can be advantageously substituted for untreated steel, cast iron, bronze, and all other materials used for gearing, has been developed by the Westinghouse Electric & Manufacturing Co.

Spectrometers.—A description of the Hilger chemical spectrometer is given in a 4-pp. leaflet issued by Adam Hilger, Ltd., 75A Camden Road, London, N. W. 1, England. The following features are claimed for this chemical spectrometer: lower cost, compactness, economy of table space, and convenience in manipulation; readings direct in wave lengths, to an average accuracy of 0.15 micromillimetres.

CONSTRUCTION NEWS

Palmarito Company to Build 500-Ton Mill

Two Other Plants of Small Capacity Recently Erected—Hydro-electric Station Under Construction

The Cia. Minera de Palmarito, in the Mocorito district, Sinaloa, Mexico, is doing development work on a large scale with a view to installing a 500-ton mill and cyanide plant at the close of the rainy season, which begins in July. This property is said to have a large silver deposit. W. D. Blackmer is vice-president and in charge at the mine. J. L. Cadogan is general superintendent. The company's address is Mocorito, Sinaloa.

A group of properties in the Mautal section of the Badiraguato district, Sinaloa, Mexico, is being worked by Milward and Haggin, of Culiacan, Sinaloa. These properties have been operated only for the last ten years, during which time they were worked for the shipping ores alone. The present owners have recently installed a ten-stamp mill and cyanide plant. This plant will treat about forty tons daily of a free milling gold and silver ore by plate amalgamation and cyanide.

In the Cosala district of Sinaloa, the mine being operated by E. A. Montgomery and associates is being worked at capacity. They have erected a new flotation mill, which is expected to treat the extremely complex ores successfully. This is a silver property with low ratio of gold values.

At the mines of Jesus Maria y Anexas, at San Jose de Gracia, in the Sinaloa district of the State of Sinaloa, Miguel Tarriba is installing a hydro-electric plant of 300-hp. capacity, with which to operate the mine and mill. Wood has been the fuel in the past, but has become so scarce as to be prohibitive in price. This property is equipped with a 100-ton stamp mill and an all-slimes cyanide plant, and has a record of a good many millions of dollars in gold production.

Rand Company to Enlarge Mill

The Geduld Proprietary Mines, Ltd., has decided to increase the capacity of its mill on the Rand, South Africa, from 40,000 to 65,000 tons monthly. The company's head office is at Pinners Hall, Austin Friars, London. The present plant includes 100 stamps, tube mills, and cyanide equipment.

Small Cyanide Plant Planned for Tombstone Property

It is proposed to build a fifty-ton cyanide plant at the Mamie property near Tombstone, Ariz. A lease has been taken on this by Frank Cavanagh.

Consolidated to Increase Shop Equipment at Trail

Plans of the Consolidated Mining & Smelting Co. of Canada, Trail, B. C., include extension of the machine-shop equipment at Trail with a view to manufacturing as much as possible of the equipment to be used in the new mill to be built at the Sullivan mine, at Kimberley, B. C.

United Verde's Crushing Plant to Handle 500 Tons an Hour

The new crushing plant of the United Verde Copper Co., below Jerome, Ariz., is designed to crush 500 tons an hour. In the primary breaking section are four crushers, with 34 x 26-in. jaws. In the second stage are three fine reduction crushers, and the operation then is finished by 54 x 24-in. heavy-duty rolls, specially designed for handling extremely hard ore. David Cole, the designer, states that fine crushing for roasting is a new departure in the Southwest. He is also remodeling the concentrator of the Cananea Consolidated Copper Co., at Cananea, Sonora, at a cost of $800,000. He superintended construction of the mill in 1904, and since then has remodeled it three times.

Durgy Mine, in North Carolina, to Have Concentrator

T. G. Pool, the principal owner of the old Durgy mine, in Person County, N. C., is planning to resume development and to install electric power and a mill with flotation equipment. The mine is now opened to 515 ft. in depth and a large tonnage of milling ore has been developed. The last operations were by the Tennessee Copper Co. which shipped the siliceous ores to Copper Hill, Tenn. The mine has been in operation intermittently since 1850. None of the other mines in the Virgilina district are now operating. The ore is about 2½ per cent copper, with gold and silver amounting to $2 to $3 per ton.

During the war the Navy branch at Norfolk, Va., extended the railroad to the Durgy mine and shipped out more than 50,000 tons of dump and tailings for constructional purposes at the naval base. The property was recently examined for the owners by Kirby Thomas, of New York City.

Cori Gold Will Equip Property

The Cori Gold Mines Co. is planning to build a permanent camp at its property near Acoponeta, Nayarit, Mexico. A compressor and milling machinery will be installed. The office of the company is 318 Symons Building, Spokane, Wash. Raymond Guyer is vice-president and consulting engineer.

United Verde Co. May Build Flotation Plant

An unconfirmed rumor is in circulation that the United Verde Copper Co., of Jerome, Ariz., is considering the erection of a flotation mill for handling low-grade sulphides midway in value between the furnace ores and the leaching ores that now are going into heaps on the plain. Concentration experiments have been proceeding for more than two years. Much concentrating ore may come from the steam-shovel operations, which lately were speeded up.

Right Good Company Completes Zinc-Lead Milling Plant

The Right Good Mining Co., composed principally of investors from Clay Center, Kan., has completed and placed in operation a new concentrator on a forty-acre lease southwest of Hockerville, Okla., just east of the Blue Bonnet mine.

Aërial Tramway Needed

The mill of the Aztec Gold Mines Co., at Baldy, N. M., is being remodeled, and the company is in the market for a small-tonnage aërial tramway. Later, if expectations are realized, the company hopes to build a 500-ton mill, which would require a Diesel-engine-driven electric power plant, also the usual equipment for a gold-milling plant using amalgamation, concentration and flotation.

Volume 113 June 24, 1922 *Number* 25

ENGINEERING & MINING
JOURNAL-PRESS
JOSIAH EDWARD SPURR, *Editor*

TENTH AVENUE AT 36TH STREET, NEW YORK CITY

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3-Ton Storage Battery Locomotive hauling ore in the mines of the Portland Gold Mining Co.

20-Ton Armorplate Type Locomotive hauling slagpots at plant of the United Verde Copper Co., Clarksdale, Ariz.

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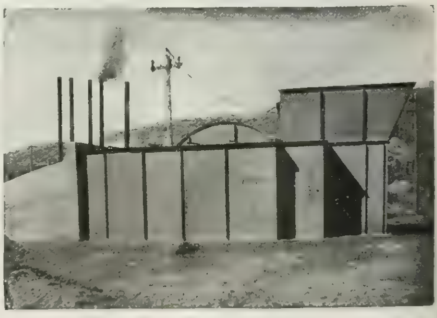

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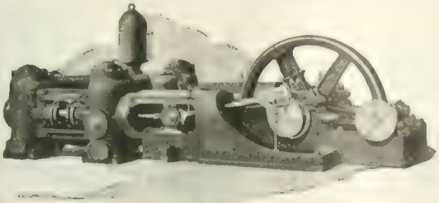

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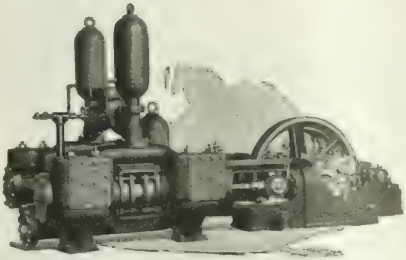

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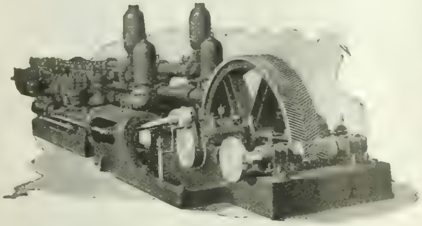

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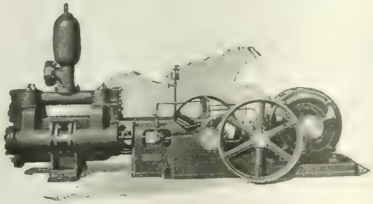

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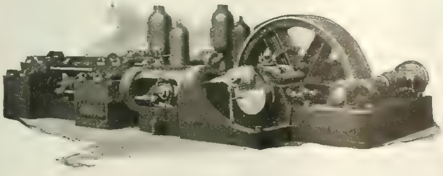

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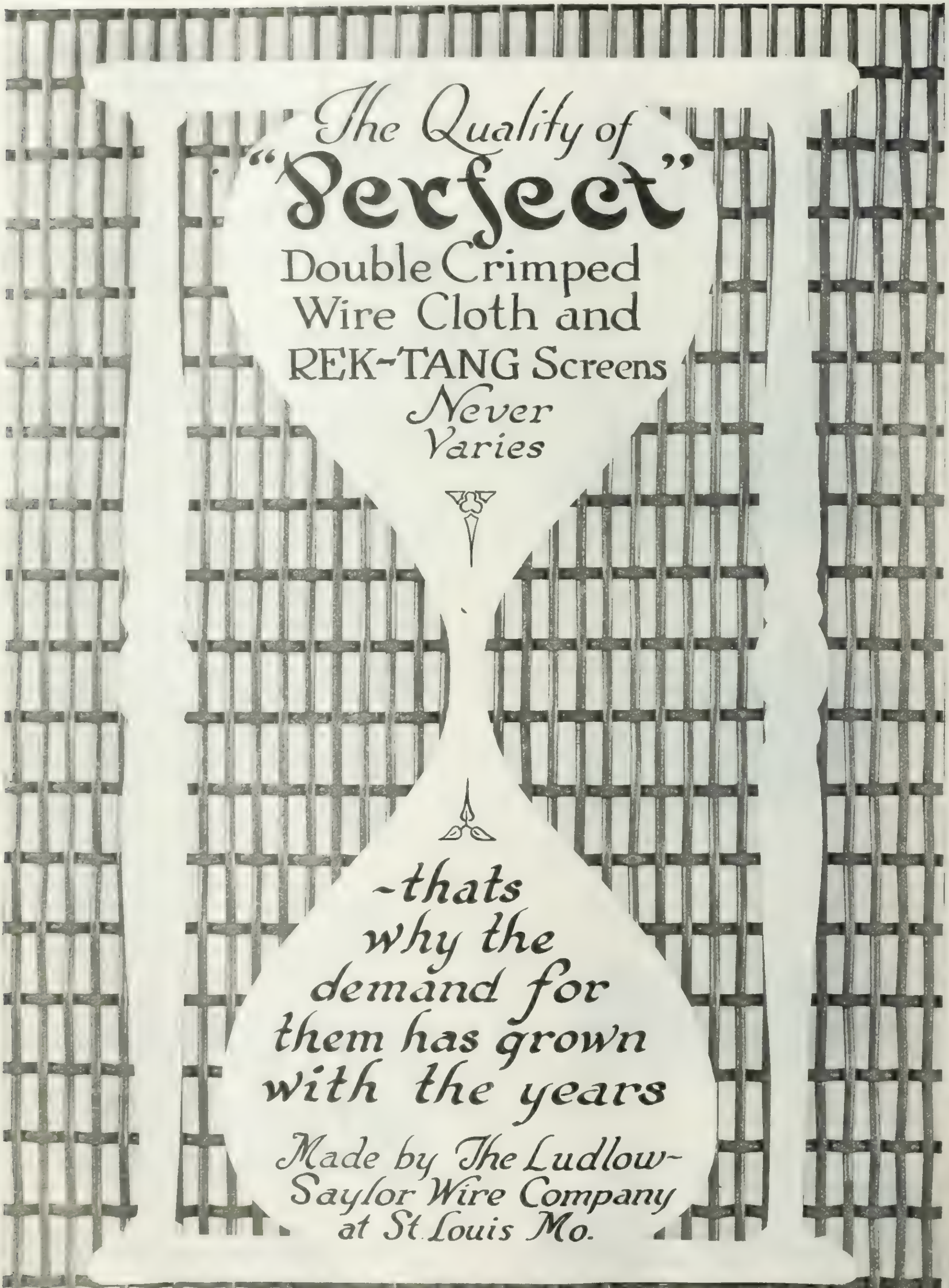

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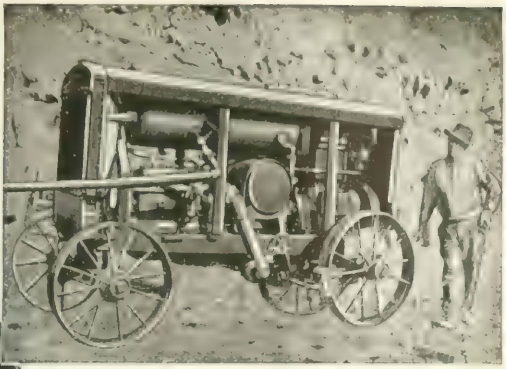

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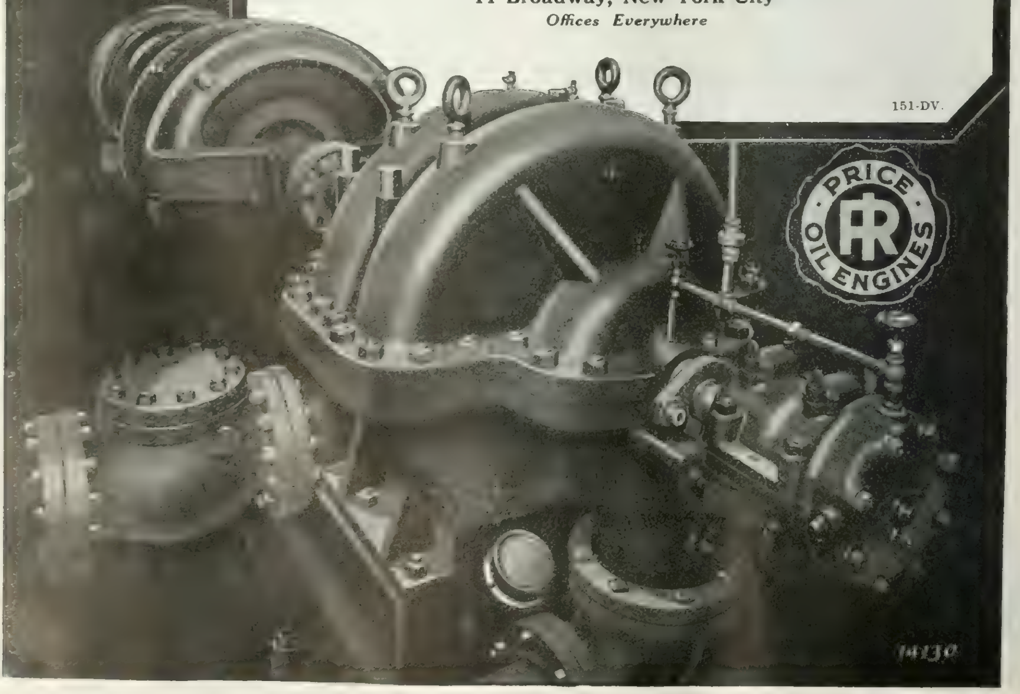

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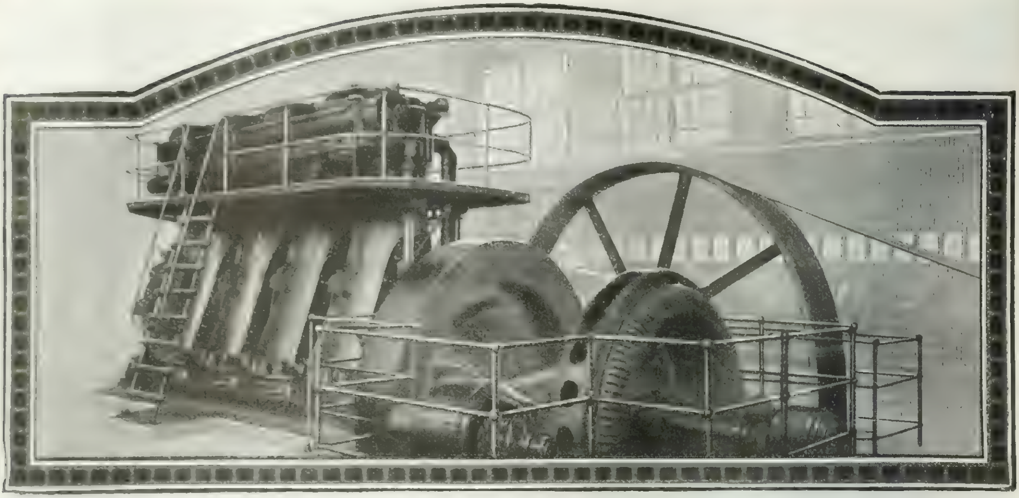

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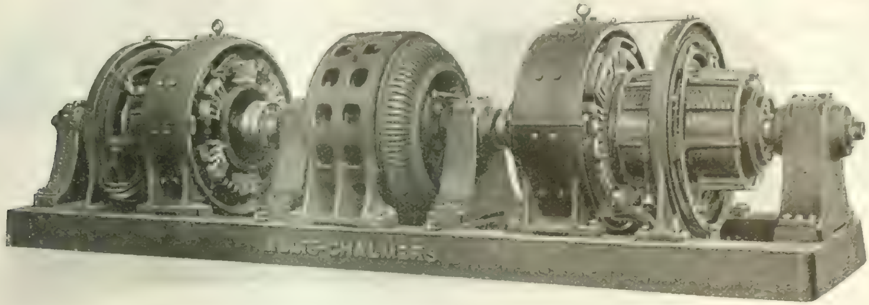

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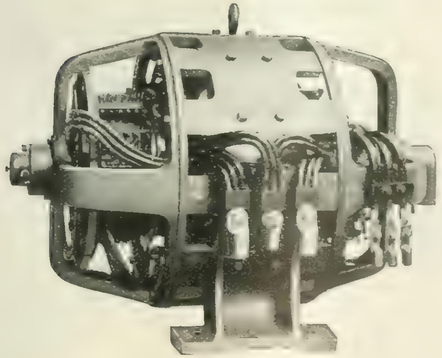

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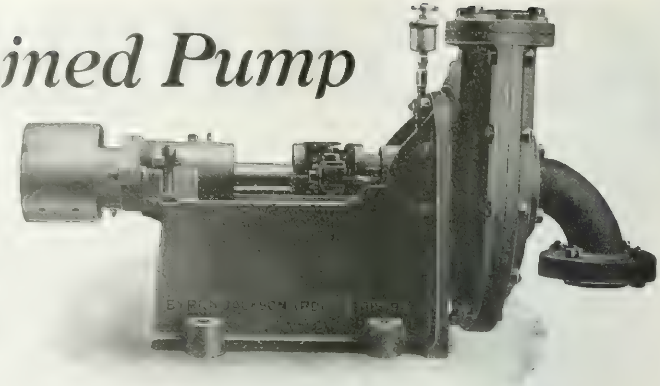

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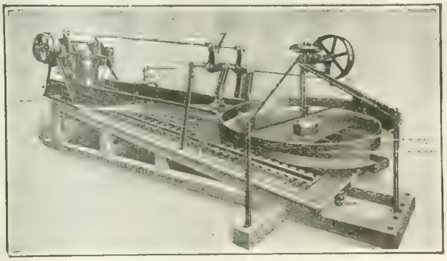

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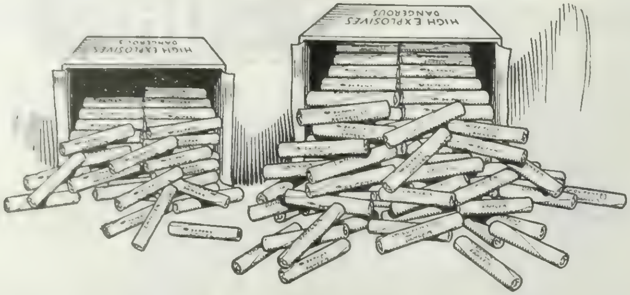

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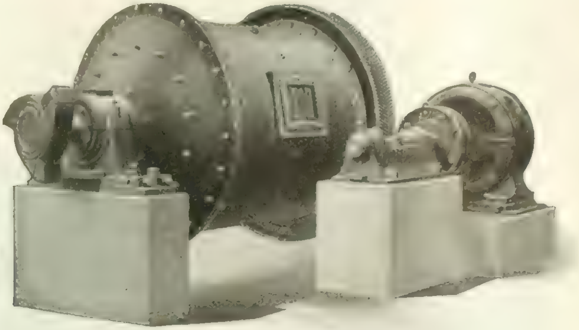

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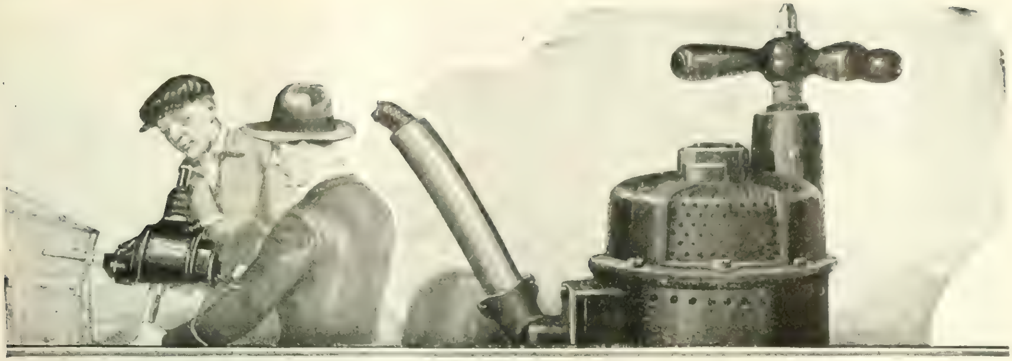
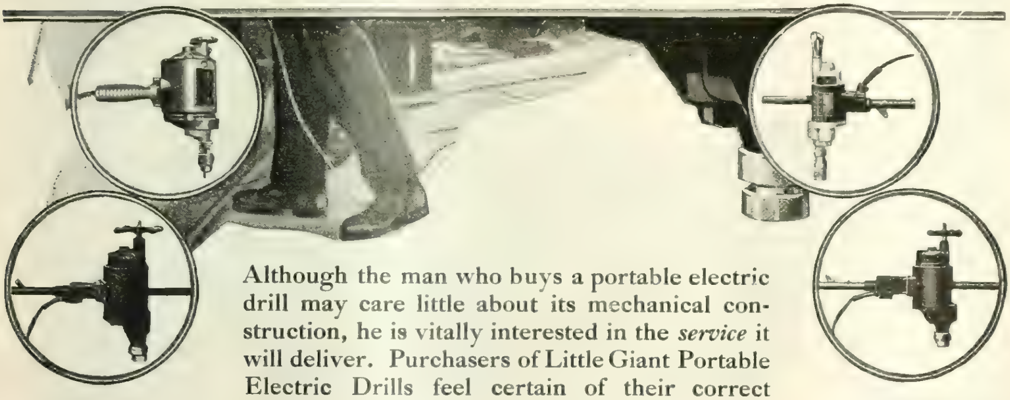


The World's Most Extensively Used Portable Electric Drills



Although the man who buys a portable electric drill may care little about its mechanical construction, he is vitally interested in the *service* it will deliver. Purchasers of Little Giant Portable Electric Drills feel certain of their correct mechanical and electrical design. Their judgment in selecting "Little Giants" is confirmed by a large majority of the world's portable electric tool users and by performance records through which "Little Giants" have become famous on all classes of work.

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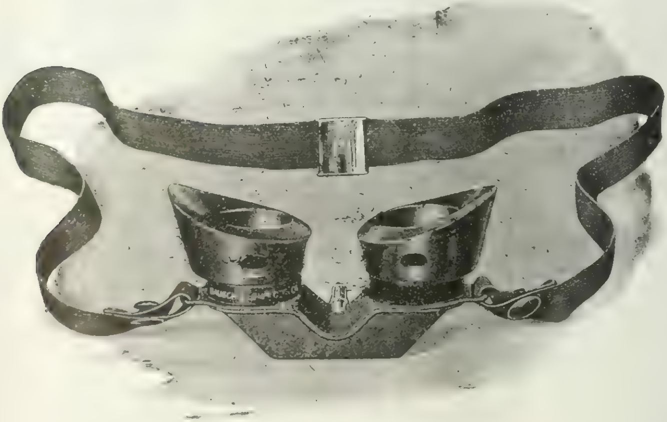

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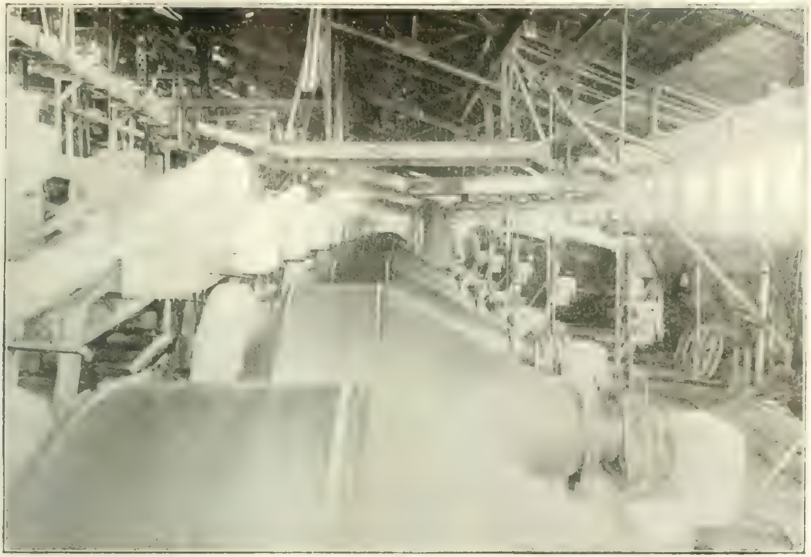

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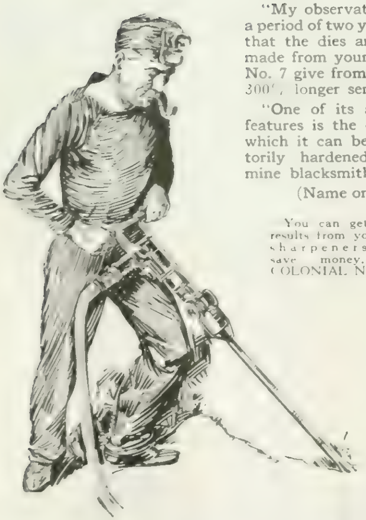

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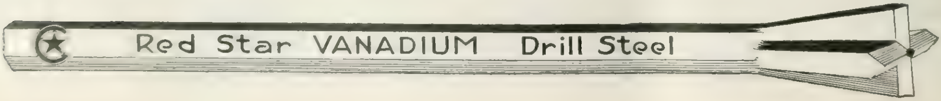
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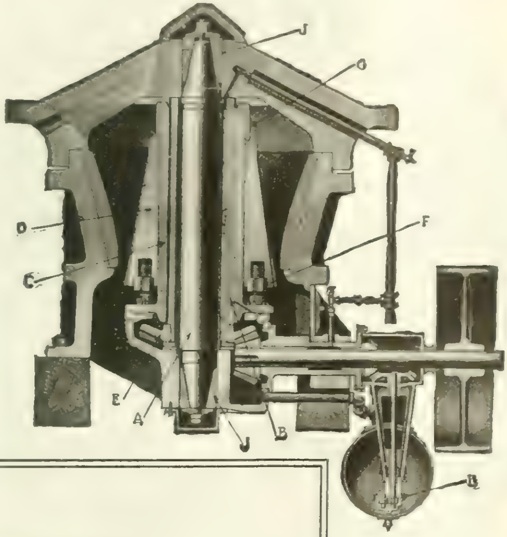

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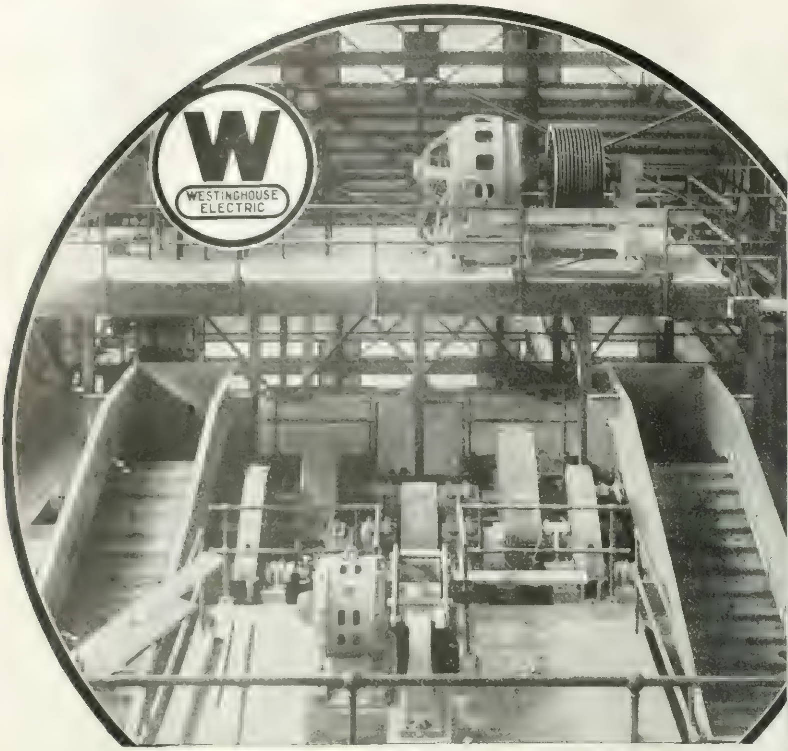

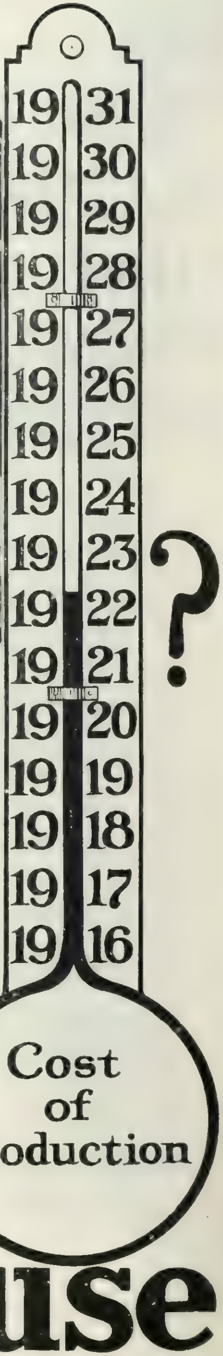

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Volume 113 New York, June 24, 1922 *Number* 25

Ore Deposits

EVERY METAL which we mine enters into the crust of the earth as a widely, almost generally, disseminated element. Gold, for example, occurs in all rocks: even, probably, in all waters save the rain—a sun-distilled water—including the waters of the ocean. Gold is a rare element, of course. As an example of the very common metals, iron forms a most important part, by weight, of the total crust of the earth. It is present in all igneous rocks and in most sedimentary rocks, and, not infrequently, in the heavier igneous rocks runs up to 20 per cent, and higher, of the total mass.

An ore deposit, then, is not simply an occurrence where we may detect, on analysis, iron, or manganese, or zinc, or gold. If it were, we might rightly classify the whole earth as one vast ore deposit. We can dig iron in our back-yards—every one of us; but it will be of too low grade, will contain too low a percentage of iron, to be commercially profitable, to compete commercially with the deposits containing a much larger percentage of iron which are found abundantly elsewhere. So, if our back-yard be in granite, the 4 or 5 per cent, perhaps, of iron in the granite is of no use to us. It is not ore. But if the granite contained 4 or 5 per cent of gold, instead, it would be ore! Indeed, we should have then the world's greatest gold mine in our back-yard.

What we mean by an ore deposit, then, is a local concentration of a metal, to such an extent that it becomes commercially valuable. And the amount that is necessary for commercially profitable exploitation is based, first of all, upon the relative abundance in the earth's crust of the metal in question—that is, its comparative rarity. An ore deposit may be thought of as representing a fractional number, of which the average percentage in the crust is the denominator, the required commercial percentage in an ore deposit the numerator; and whatever the denominator for each metal, the numerator will vary accordingly. This, of course, is a rough statement, because the value of the fraction is modified by the relative desirability of each metal, which is translated into market demand, which is translated into one of the components of price.

Ore deposits, as above defined, are concentrations formed by various processes of nature. Iron-ore deposits, for example, are laid down in the shallow seas and in the swamps, chiefly through the precipitative power of minute organisms. Probably the greatest iron deposits of the world, in all continents, are marine sediments in which the iron of dark muds has been fixed as iron silicate, by organic agencies. Typically, the silicate breaks up afterward, into iron oxide, or carbonate, and silica.

Iron is also formed in the depths of the earth, as a concentration in and from molten rock magmas, and so may occur as streaks in the igneous rock, as masses on its borders, saturating and replacing the wall rock, or even as true dikes, in the igneous rock or its intruded walls. This origin, in connection with igneous rocks, is called magmatic, while the origin in marine or swamp deposits is roughly called sedimentary. The process of segregating and drawing together of the iron from a molten igneous mass (which cools as an igneous rock) is conveniently known as magmatic differentiation. There is nothing unusual or obscure about magmatic differentiation. It is noted in every slag pot, every ingot of cast metal, in which the local differences of composition, such as those frequently shown by analysis between the margin and the center, arise from molecular segregation in the molten or semimolten state—from "magmatic differentiation."

Mining in Eastern Siberia

TWO PAMPHLETS giving information concerning the mineral deposits of the "Far Eastern Republic" have been issued by the "Special Delegation" of that republic, from its headquarters in Washington. One covers the mineral resources in general, one the gold resources alone. In a way they are compilations of some interest, being an attempt to present the list and approximate value of the mineral deposits of Eastern Siberia, in the endeavor, plainly, to interest American capital in entering that troublous and uncertain field. A great many detailed notes are given as to the mineral localities of the region, yet without making possible any definite conclusion other than that the country has a considerable and varied mineral wealth. Engineers' reports, even in our own favored and technically advanced country, are far too often quite unsatisfactory; and naturally this chance is much increased in a region like the "Far Eastern Republic."

Concerning the "Far Eastern Republic" we know little, but we do know a great deal concerning the "Russian Socialistic Federative Soviet Republic," which is mentioned in these pamphlets as if working very harmoniously with the "Far Eastern Republic"; so we wish to protest, first of all, against the degradation and slandering of the word "republic." The United States is a "republic"; hence we ought to defend the fair name of our type of government. The government of Moscow is not a republic; it is a tyranny, as far from a republic as was the Czar's government, and far less intelligent. It is not Socialist; the Bolshevist graves and prisons are full of Socialists, thrown there for their opinions. It is not Federative; it is a central-controlled dictatorship. It is not even Soviet, which implied originally a form of government built up of a series of simple representative councils. The only true designation is Russian. Therefore we must at once strip off the word "republic" from the Far Eastern organization also.

What, then, has the Far Eastern government to offer as an inducement to American capital to prospect and [illegible] in American engineers in labor, worry, and [illegible] in endeavor." The advantage which the government will enjoy is plain: it receives a certain substantial proportion of the results of mining—determined, apparently, largely by dickering with the government when obtaining the "concession." The concession is a lease—nothing more. No ownership goes with it. For gold mining the tax varies from 5 per cent for mechanical placer mining to 12 per cent for hand labor on the "piece" system, of the *gross value* mined, besides an annual area tax.

A casual inspection of the mining regulations leads to the conclusion of "too much government," even if all other conditions were pleasing. We doubt if any honest mining man will adventure in the Far Eastern government his own money or future after encountering the following illuminating provision:

"18. The Ministry of Industry has the right to maintain at the enterprise of the concessionaire a number of persons—the number to be specified by the contract—for the supervision of the activities of the enterprise. For these persons the concessionaire is to provide, free of charge, lodgings, with fuel, light, and water."

For the rest, one may perhaps devise some impolite amusement from the descriptions of the geology of one ore deposit. We read that:

"According to the opinions of local geologists, the original source of the earth's gold is the mineral-mass of the gneiss' nature, and in particular, the horneblende contained therein. That rocks that contain horneblende in great quantities are exceedingly auriferous is a fact beyond question. It has been definitely established." It also is stated that "Vein-quartzes as a rule show but little gold content." Among the rarer "metallic" rocks are listed "diabastos and prophyrites." Elsewhere we note the term "polyphyries."

As to the total estimation of ore in the ground: "The data derived from geological and other researches enables us to state that ore deposits contain many tens of thousands of poods of gold"—and a footnote states: "One pood = 36.11 pounds," thus enabling us to compute accurately the amount of gold in this promised land.

◆

Sulphur-Dioxide Leaching of Copper Ores

LARGE TONNAGES of copper ores in the Southwest consist of mixed sulphide and non-sulphide copper minerals; the original sulphides have in most instances been oxidized in the upper zones of the mine. No definite line of demarkation exists, and it is not possible to mine ore entirely of one kind, although sometimes a selection can be made, sending part of the ore to a leaching plant and the rest to a concentrator of the usual type embodying tabling and flotation. Much work has been done on the so-called mixed-ore problem, the aim being to devise a process which would make a good recovery of both sulphide and non-sulphide copper minerals in one continuous process and at a cost which would make the process commercially successful. Though several methods have reached the stage of semi-commercial application, none has been so outstandingly successful that it has been widely accepted as a solution of the problem. Some of those which have attracted the most attention have been the sulphide filming work done at the Shattuck-Arizona plant, at Bisbee; a combination of roasting and leaching carried on at Clifton and elsewhere,; various modifications of sulphuric-acid leaching which have been tried on an experimental scale at several plants; and sulphurous-acid leaching, largely sponsored by the Southwest Experiment Station of the U. S. Bureau of Mines.

A brief history of the process in which sulphur dioxide is used has been prepared for the *Reports of Investigations* series of the Bureau of Mines and is soon to be published. A more complete report will appear later as "Technical Paper No. 312." In view of the fact that these reports will be available through Government agencies we shall not needlessly republish them, but the subject is one of importance.

It is interesting to observe that [illegible] van Barneveld has not been deterred by early obstacles and has apparently made progress during the last year. In the way in which the sulphur-dioxide leaching process was first applied, fairly good metallurgical results were obtained, but adoption of the process on a commercial scale was not attractive. The Miami Copper Co. gave the process an exhaustive trial up to a comparatively recent date, but gave up the work in favor of sulphuric-acid leaching following the successful application of that method at the neighboring Inspiration mine. Practical absence of soluble iron and other impurities in the ores of this district make a dilute electrolyte carrying about 1 per cent copper practicable. Much valuable information on the use of sulphur dioxide was also obtained in the work done in conjunction with the Arizona Copper Co. at Clifton, which was terminated when the property was closed down about a year ago.

One of the most unfavorable features of the early work in using sulphur dioxide was the refractory nature of copper silicate minerals toward this reagent. In both the Clifton and Miami experiments, as well as in the earlier ones, the barren leaching solutions were run to waste, and not reclaimed, as would be natural in large-scale commercial work. These barren solutions contain ferrous sulphate, and when returned to the sulphur-dioxide leaching drum, it has recently been found by the Bureau, can be used to produce a weak sulphuric-acid solution which is much more effective against the refractory copper silicate. The ferrous sulphate is easily oxidized, in the presence of sulphur dioxide and oxygen, to ferric sulphate; and this ferric sulphate then reacts with the sulphur dioxide to form ferrous sulphate and sulphuric acid under conditions which can be brought about in the leaching drum. Thus the Bureau has devised a process which uses sulphurous acid direct so far as it is an efficient solvent, and which in itself is a cheap producer of such sulphuric acid as may be required.

The further steps in the proposed process include aërating the pulp from the leaching drum; precipitating the copper on sponge iron; and recovering the cement copper so produced, by flotation. These steps have been found, for one reason or another, preferable for research work, to other better-known methods of recovering the dissolved copper, such as by electrolytic means, or by precipitation on scrap iron.

Those who are keeping themselves informed concerning the wet metallurgy of copper will follow this work at Tucson with interest. Sulphur dioxide is a cheaper reagent than sulphuric acid, and some of the obstacles to its use are being gradually overcome. In places where gases from roasters are now discharged to the air, it will cost nothing. It must be used hot, the effluent pulp from the leaching drum having a temperature of about 50 deg. C., for best results. Most hot processes are doomed to failure by the cost of heating, but here the gases are naturally hot and we take it that extraneous fuel is not required.

A difficulty that we foresee is the upkeep of the leaching drum. The device which has been developed contains numerous baffles and lifters designed to provide intimate contact between the gas and pulp, and we assume that it is made of wood. Possibly in large installations it might be made of metal. In any case the presence of hot acids (sulphuric as well as sulphurous) and the action of the gritty particles of the ore pulp would not be conducive to long life. The production of sponge iron on an economic scale cannot yet be said to have been solved, though we understand that the process developed by the Chino Copper Co. has attractive possibilities; possibly the Bureau has a satisfactory method in mind. And the last step, the flotation of the cement copper, has so far proved disappointing, possibly, as Mr. van Barneveld and Mr. Leaver state, on account of the nature of the precipitate produced by the use of scrap iron. Sponge iron may make a product offering less difficulty in flotation.

We hope that Mr. van Barneveld and his associates will be successful in their further work, for the problem which they are attempting to solve is undeniably an important one.

Mine Stock Promotion

WHILE PARTICIPATION in most of the most favorable ventures in mining never is offered to the public, the capital being subscribed by small private groups, or furnished by some large company, yet the offering of stock to the public is on occasion as legitimate in mining finance as in any other sort of enterprise. The requirements for honest promotion and stock-selling are as simple in mining as in other enterprises; only in most other enterprises they are more frequently observed. They are that the facts and business figures pertaining to the enterprise be impartially submitted, supported by the reports of experts known to be independent—accountants, lawyers, and engineers. No participation in the stock of a public-utility enterprise is ordinarily offered to the public without the report of a firm of engineers of recognized standing and independence, and ordinarily a clear statement of the present financial condition submitted by a well-known firm of public accountants.

Mining stock offerings should of course be accompanied by the same reasonable and fair submission of facts and conditions. Even with all these, investments in any enterprise, mining or otherwise, partake of the nature of a speculation. But the public has a right to at least a plain statement, and thereafter the buyer of stock takes the risk which goes with his purchase. But it seems to be true that the picturesque elements of mining have been seized upon by a cheaper, less scrupulous type of promoter than the ordinary, to induce the public to buy through the emotions rather than the judgment; and, therefore, in disgusting sequence come out bids for the public money, supported only by the cheapest kind of sentimental rubbish—get-rich-quick, "come-on" stuff, such as is the usual scenery set by confidence men and swindlers. Such methods should be left to this class of undoubted rogues; for men who hold themselves honest to practice this kind of emotional, fact-evading stock selling, is for them to skate so near the edge of the open water that ten to one they are in it sooner or later.

Moreover, the ignorant and credulous public has a right to expect protection from such hollow and sly enthusiasm; if not by the promoters, at least by reputable engineers and the reputable mining press; and all those who hold that mining is a most honorable and sober industry, and not a pool where the slick promoter may fish for suckers, for bucolic stockholders to hold the sack, so that in any case he shall not lose.

One trouble is, sad to say, that the promoter, who is apt to be something of a child as to fundamental ethics, meets a wiser but if anything less scrupulous mining engineer who is quite willing to fall into any promotion scheme which would yield him some money. Such an engineer will furnish glowing generalities to the promoter for a consideration—generalities singularly lacking in cold and measured appraisal of facts. Such engineers are a disgrace to the profession.

The type of engineers, of mining men, who regard any methods whatever as praiseworthy provided they succeed in bringing in money for development and activity are parasitic and pestilence-breeding—they betray an industry which in its normal and honest form is peculiar in its nobility and its lack of parasitism.

Atmospheric Oxygen for Cutting Steel

THE UBIQUITY of oxygen in the atmosphere, and its influence on sundry reactions, are often unrecognized. In a recent issue of the *South African Mining and Engineering Journal* a short article discussed the use of a mild-steel disk with notched edge for the cutting of metal. Many mining engineers are unware of the fact that if such a tool be mounted on an ordinary saw bench and revolved at a high speed it can be used to cut piping, joists, or other structural steel. The scope of application, however, would be limited if our contemporary's interpretation of the phenomenon be accepted, for it maintains that the result is attained "simply by the heat of friction."

As when the oxy-acetylene burner is used, the heating of the metal is the first step in the operation, not the last. A considerable amount of heat is generated when a steel disk is used for cutting, but this is insufficient to melt steel. The cutting in both cases is due mainly to the chemical erosion of the metal by oxygen. In the oxy-acetylene apparatus the cutting gas is supplied in an almost pure state from cylinders; when a steel disk is used, the oxygen needed comes from the atmosphere. A temperature favorable to rapid oxidation is reached almost immediately after the metal is placed against the disk, the rapid movement of which insures a steady supply of the necessary gas. The results are, of course, inefficient as compared with those obtained with the oxy-acetylene cutter; further, in consequence of the lack of portability of the saw bench and the clumsiness of the apparatus, the scope of the disk cutter is limited.

Recently, much interest centered on the achievement of cutting a large cast-iron pipe that lay in 50 ft. of water in New York Harbor. A new type of electric torch was used, but the pseudo-scientific publications overstressed the part that was played by electricity. Precise details are unavailable, but it would appear that although the arcing of an electric current was used to obtain the necessary preliminary heat, the cutting was performed by some gas or combination of gases, the composition of which is not known. In any event it is probable that oxygen played an important part.

THE JOURNAL-PRESS STAFF

GEORGE JOSEPH YOUNG

OF THE West Western is George Joseph Young, Western Editor of the *Journal-Press* and Editor-in-Chief of the *Pacific Mining News*, a supplement to the *Journal-Press* and the most recent member of the McGraw-Hill publications, devoted to the interests of the mining industries west of the Rockies.

Mr. Young was born in California, in 1876, his father, Joseph Young, having been a pioneer of northern Arizona, and his mother, Marion Wilburn, herself a native of southern California. His early education was obtained in the public and high schools of San Francisco, after which he entered the Department of Mining of the University of California, taking also German, English, and art studies in addition to the technical course, and being graduated in 1899. After graduation Young acted—in 1899 and 1900—as research assistant to Professor Christy in the mining department of the university, going in 1900 to the University of Nevada as assistant professor of mining and metallurgy, at which institution he also became a professor of mining and metallurgy, and where he finally assumed charge of the McKay School of Mines, in 1908. During the period from 1900 to 1913 he was in charge of the State Analytical Laboratory, and also, during 1912-1913, was director of the Co-operative Potash Laboratory, which was established jointly by the U. S. Geological Survey, the Bureau of Soils, and the University of Nevada, for the purpose of assisting prospectors and others in search for a source of commercial potash in the Western states.

GEORGE JOSEPH YOUNG

During most of the time which Young spent at the University of Nevada he was chairman of the scholarship committee of the university. Also, while there he reorganized the mining courses and equipped the school with new laboratories. In 1909 and 1910 he traveled in Europe, visiting mining and technical schools and studying coal mining in Germany and England. He spent his summers in the West, visiting and studying mining conditions in many of the districts of Montana, Utah, California, Arizona, and Colorado. From 1913 to 1917, Young served as professor of mining in the University of Minnesota and as professor of metallurgy at the Colorado School of Mines. In 1918 he became Assistant Editor-in-Chief of *Engineering and Mining Journal* and later Western Editor of the paper, and in April, 1922, he assumed the chief editorial responsibility of the *Pacific Mining News*.

Mr. Young's activities, aside from his work as a teacher, have covered many and varied subjects. A student of mining and metallurgy since 1895, he has made, also, a thorough survey of mining publications. His first contribution to *Engineering and Mining Journal* appeared in 1904. In 1918, 1919, 1920, 1921, and 1922 he had charge of the Annual Progress numbers of the paper. His contributions to the literature of the industry, in addition to mining papers and articles that are familiar to readers of the *Journal* and the *Journal-Press*, included "Elements of Mining," written in 1916; "Salines in the Great Basin Region," in 1913, a bulletin of the U. S. Bureau of Soils; and the following contributions to the American Institute of Mining and Metallurgical Engineers: "Ventilating System at the Comstock Mines," 1909; "Slime Filtration," 1911; "Fires in Metalliferous Mines," 1912; "Brown Coal Mining in Germany," 1916, and "A History of Mining in Nevada," published as a part of the history of that state. His research work has covered mine ventilation, the cyanide process, copper ore leaching, gold and silver metallurgy, filtration, magnetic and electrostatic separation, flotation, and magnetizing roasting.

Perhaps nothing can so mellow a man as the experience acquired in the moulding of the character and mind of the students who obtain their first conception of mining in Western universities. There the embryo engineers are frequently an especially vigorous type, and contact with them en masse usually produces the customary result. When Young entered the field of technical journalism, his first action was to declare that henceforth "Professor" was taboo. He has shed the title.

The subject of this sketch years ago on his mountain trips packed both rod and gun. He once landed a 5½ lb. trout in the Truckee, and has brought down many a deer, but game have in most ranges become too small and scarce for sport, and he now hunts with the camera, and some of the finest photography that has been published in this journal was the result of his summer excursions in the Sierras. When other members of the expedition are catching fingerlings or hugging camp, Young will be away somewhere, climbing a peak to get a particularly striking photograph. The last issue of the bulletin of the Sierra Club contained some notably beautiful pictures of Mount Darwin, caught from high ledges by Young's camera. Mr. Young is a member of the American Institute of Mining and Metallurgical Engineers, the Mining and Metallurgical Society, the Sierra Club, and the Engineers' Club of San Francisco. He makes his home with his wife and daughter in Oakland—and spends his vacations among the peaks of the Sierras.

The Mining Corporation of Canada

BY T. A. RICKARD

AMONG the so-called exploration companies engaged in finding, developing, and exploiting mines on the American continent, the Mining Corporation of Canada has won an honorable name for skilful enterprise and fair dealing. The company is registered in Canada and at a recent informal meeting in London its English shareholders had an opportunity of hearing an account of its operations from the president of the company, Mr. J. P. Watson. He has been identified for many years with successful mining at Cobalt, where the principal holdings of the company used to be: the Cobalt Townsite, City of Cobalt, and Cobalt Lake mines. The company was organized by Rose, Van Cutsem & Co., of London, in March, 1914.

Although the company's Cobalt properties yielded 1,250,000 ounces of silver last year, it has been stated repeatedly by the management that they are approaching exhaustion, except the Buffalo mine, a recent purchase, which shows signs of prosperous vitality. The cost of producing silver in 1920 was 65 cents per ounce; between 1919 and 1921 the price of the metal fell 40 cents per ounce; so that it can be understood why the company has had 'hard sledding' of late in trying to make money at Cobalt. However, thanks to a reduction in wages and an increase of efficiency in labor, the cost of winning the silver has been reduced about 30%, according to Mr. Watson.

Mr. Watson spoke with an air of frankness at the annual meeting and created an excellent impression thereby. Among other things he acknowledged two mistakes. A mine in British Columbia had been prospected under option, on the report of two engineers, the second of whom confirmed the report of the first, but both were wrong, as was ascertained when an examination was made by the company's chief engineer, Mr. Scott Turner. Another property, in the same Province, proved to be a 'teaser,' as Mr. Watson termed it most appropriately. It contained a small ore-shoot sufficiently promising to justify development, but not large enough, as was shown eventually, in a report by Mr. Oscar Hershey, to warrant the purchase of the property. However, the Buffalo, at Cobalt, has redressed the balance, for the owners sold it to the company in the belief that it was on its last legs and contained only 350,000 ounces of silver. In 1921 the company won 700,000 ounces from this supposedly exhausted mine, and there is now 1,500,000 ounces in the ore-reserve.

Next we come to the Company's principal new holding, the Flin Flon, a big copper mine in Manitoba. Readers of the 'Mining and Scientific Press' will recall an article entitled 'A New Canadian Mining District,' by Walter Karri-Davies, in the issue of October 13, 1917. In that article Major Karri-Davies described the new district and indicated how difficult of access it is. This part of Canada could be described by a geologist as a country of inundated *roches moutonées*; it is a glaciated country dented with strings of lakes. Therefore it is most accessible in winter, when the roads are bridged by ice. The chief point of departure is the town of The Pas, on the Hudson Bay railroad. From there the traveler goes tortuously, by steamer and wagon, to Flin Flon lake, where this property lies. Four miles to the south, on Schist lake, is the Mandy copper deposit. This was discovered and located by a prospecting party led by Mr. J. E. Spurr, for the Tonopah Mining Company, of which he was vice-president and engineer, in 1915, as described by Mr. Spurr in an article entitled 'The Discovery of the First Operating Mine in Manitoba,' which appeared in the Engineering and Mining Journal of March 13, 1920. From this mine a quick and handsome profit was made by the Tonopah Mining Company, by shipping the ore to the smelter at Trail, in British Columbia, but the high-grade ore being exhausted, the mine is idle now.

From The Pas to the Flin Flon mine is about 70 miles by air, but fully 140 miles by land and water. Five years ago the orebody was known to be 200 feet wide; it had been diamond-drilled for a length of 2000 feet and to a depth of 600 feet. At that time, the average assay was 2% copper and 5% zinc, with $2.50 in gold and 1¾ ounces silver per ton. Major Karri-Davies stated at the time: "It is recognized by those directing the enterprise that a larger tonnage of such ore will have to be proved before it warrants the big expenditure necessary to develop a productive mine." This has been done since then. Mr. Watson states that his company joined in the venture with a New York syndicate, headed by Mr. W. B. Thompson. The previous diamond-drilling was confirmed, at a cost of one year in time and of $400,000 in money. The favorable confirmation of the technical evidence came at a time of financial crisis, and that was why the New York people withdrew from the venture, which was then carried forward by the Mining Corporation of Canada. It is estimated that 16,000,000 tons of ore is assured, and the possible resources of the mine are placed at 22 million tons. So far about $600,000 has been spent in engineers' reports, preliminary workings, and temporary equipment. The drill-holes showed 1.82% of copper, $1.60 in gold, and 1.16 oz. of silver per ton. During the later prospecting another and richer vein of ore was cut in the foot-wall; this raised the average to 2.4% — an increase of 30% — so says Mr. Watson—in the general average of the ore in reserve. The estimated value of the metals in the 16 million tons of ore is $150,000,000, of which $26,000,000 is gold, $13,000,000 is silver, and $111,000,000 is copper. The metallurgical recovery of these metals is expected to be from 78 to 80%, but, as Mr. Watson says, "there is a vast difference between £30,000,000 odd in the wilderness—in Manitoba—and that same amount of money in the bank." Several years must pass before the wealth of the Flin Flon is realized in terms of dividends. Between Winnipeg and the Arctic, between Lake Superior and the Yukon, there lies a great stretch of country that has been only slightly searched by competent prospectors; it is a region in which travel is difficult except in winter, and in winter the surface of rock is mantled with snow, so that intelligent examination is hindered. If the Flin Flon proves a success, the district will be connected by rail with the outer world and the prospector will be given another *pied à terre* from which to extend his exploration into the lone land northward that awaits the awakening touch of human industry.

DISCUSSION

Vein Nature of Commercial Borates

Novel Characteristics of the Colemanite Deposits of California and Nevada

THE EDITOR:

Sir—There is one feature concerning the colemanite deposits of California and Nevada which merits especial notice as having critical yet hitherto unrecognized bearing upon the theory of metasomatic replacement of limestones by calcium borate. This feature is a decisive test of the alleged vein character of colemanite deposits. I refer to the faulting of the colemanite beds themselves. Faulting occurs in all the borax fields, although it is not noted in any of the descriptions.

In one instance noted, the inclined strata are shifted horizontally, so as to separate the two parts of a borate bed over 300 ft. The slips are oblique to the dip and strike, and about midway between the two. Although the direction of the movement is horizontal, the dislocations are manifestly due to relief of torsional stresses, perhaps set up when the great blocks now occupied by the borate basins were faulted and depressed (1,000 ft. or more). These faults cut off sharply both the borate beds and the associated clays and sandstones. These features are not displayed at the surface of the ground, because obscured by weathering of the deposits and on account of overwash; but they are clearly shown in the mine tunnels, a hundred yards or so beneath the surface, where they are so clear and fresh that they are fit objects for photography.

Were the borate beds really mineral veins in the true sense of the word they would have been developed as such after the tilting of the strata in which they occur, and after the fissuring due to the faulting, but there is no evidence of this. The borate beds were without question formed before the faulting: nodules and individual crystals are sharply chopped off.

There appears to be a secondary deposition of colemanite which doubtless originated from the solution by the rains of the outcropping inclined bed. These secondary solutions seeped down along stratification planes into the fault fissures. Where the faults were slightly open, secondary colemanite was thus redeposited in a continuous sheet, an inch or two thick, passing directly across the bedding planes of both the original colemanite beds and the associated shales and sandstones. These vertical slabs of secondary colemanite are easily distinguished at a glance from the original beds. They are composed of fine, long, closely appressed, needle crystals disposed at right angles to the fault planes, and taken as a whole resemble the thin veinings of satin-spar which traverse red shales occurring 100 ft. beneath the borate beds.

In a single cubic yard of the borate-bearing deposits there are to be found the massive bedded colemanite (which might well recall to mind a limestone bed and at first glance be easily mistaken for such), the clay layers carrying large nodular masses of colemanite, the blue shales through which is disseminated finely divided colemanite, the lamellar clays in which are interspersed paper-like films of colemanite, and the veining plates of needle colemanite, which cut across all the others.

The vein theory of colemanite formation possesses, to be sure, one commercial advantage. As is well known, most borate claims are located in accordance with the lode rules; yet many other borate claims are held by placer regulations. These often overlap in a bewildering manner. Frequently, the lode claims are plastered over by placer locations. The latter are larger than the former, and perhaps have better intrinsic rights. When mining of these shall begin upon these properties, there must inevitably and automatically arise an immediate conflict between different interests. The outcome bids fair not only to turn into turmoil the entire borax industry of our country, but speedily to accomplish its irremediable ruination.

Des Moines, Iowa. CHARLES R. KEYES.

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Dealing With Prospectors

THE EDITOR:

Sir—Mr. Brunel's letter in your issue of June 3, in which he enlarges on the devious ways of the prospector, leads me to the conclusion that he has failed to understand the character of that individual and has met few prospectors. The subject is one on which much has been written, but perhaps it is not entirely exhausted.

In the first place, the prospector is just an average human, with a disposition to get the better end of a bargain if possible, like all the rest of us; and when dealing with him this should be kept in mind. In the case cited, business methods were omitted. Mr. X was not tied up with an option at $3,500. Hence, when he found that Mr. B, after a preliminary consideration of the vicinity in the books, was interested, he considered himself free, and accordingly advanced his price. Almost any vendor of real estate would have done the same under similar circumstances, though probably not to the same extent.

There are several kinds of people these days besides the prospector who are trying to get "all that the traffic will bear." It is a very human trait. The remedy is to bind him with an option, or to get his verbal refusal before witnesses for a definite price and a definite time. His word will be found quite as good as that of the average man. If these simple precautions have not been taken he should not be blamed for trying to improve his status.

In the second place, few prospectors are developers of their claims except to the small extent necessary to show that values have been found. Their rôle is that of the *discoverer*, and they are usually deathly afraid of having their claim explored while owning it. Their talk of a half interest for development money is a "blind," to make you think they have confidence in their find. Not they! They have seen too many promising "prospects" ruined by a few blasts. What they want is to sell outright on the strength of the showing now, and use the money to finance an effort to find something better. Every prospector has in mind several localities he desires to visit and explore, and in each of which he is confident he can uncover a wonder.

Hence, the best way to deal with this worthy individual is to go with him trustingly to his claim, and carry a little cash in your pocket. If his showing is promising, offer him from $25 to $100 on the spot for a written time option at a low price for the whole title, and in nine cases out of ten you will get the layout at your own figure. The money you will then have risked will be no more than the value of the time he has given to making the discovery, so the gamble is nearly an equal one.

The prospector is usually a good sport. Give him an opportunity to deal with you on equal terms and you will generally find him ready to play a straight game.

Denver, Col. THEO. F. VAN WAGENEN.

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Tellurium in Wireless Telephony

THE EDITOR:

Sir—I noticed in your issue of May 20 that you call the attention of mining companies and individuals to the wide use of crystals of certain minerals in the construction of wireless-telephone detectors.

It may be of interest to your readers to know that the element tellurium, which has long had but few uses and with which all Western miners are more or less familiar, has been found to have superior qualities as a crystal detector. I am informed that one of the large and well-known electrical companies now has on the market a crystal detector which is more sensitive and which remains in better adjustment than anything heretofore produced. This detector consists of a crystal of tellurium resting against a crystal of artificial zinc oxide.

It seems that crystal detectors have great possibilities, as they are much less expensive than vacuum tubes and require no batteries. It is quite conceivable that experimenters will develop crystal detectors which are far superior to any of those now on the market, and in this connection tellurium crystals, in conjunction with those of other minerals, will come in for their share of attention. F. F. COLCORD.

New York City.

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Sampling Wet Material

THE EDITOR:

Sir—With reference to my previous article "Examining Minerals in Ore Pulp," in *Engineering and Mining Journal*, Dec. 24, 1921, on page 1022, a further suggestion has been found convenient. Though simple, I pass it on in the hope that you find it of interest.

To examine a sample of *wet* material it is best to use a clean slide not greased; drop a small patch of sample upon it, and then, to remove any surplus liquid, apply a piece of blotting or filter paper to the edge of the patch. Turn the slide with the glass side up and examine with the microscope. It is advisable to exercise care as to shaking the slide before mopping up the water, as the movement may result in concentrating the mineral on the glass, which may or may not be advisable.

When a tailing or residue is being examined to determine what amount of mineral remains in it, it may be of advantage to put the sample in a thin watch glass, and while excess water is present give the glass a panning motion to bring the mineral together on the surface. Then remove water, invert and examine.

It is usually preferable to remove slime from the sample by gentle washing or elutriation before examination, as with low power, especially, slime particles are differentiated with difficulty, and interfere with the visibility of larger grains. ALFRED T. FRY

Queenstown, Tasmania.

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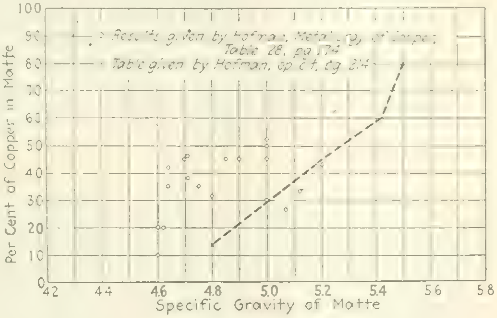
Copper Content and Specific Gravity of Copper Mattes

THE EDITOR:

Sir—Your editorial in *Engineering and Mining Journal-Press* of May 27, 1922, regarding the suggested feasibility of estimating the approximate copper content of mattes by means of a specific gravity determination has been read with interest. The accompanying plot was made from data published by Hofman. The group of results connected by broken lines was probably obtained on mattes in which the elements present other than copper and iron were fairly constant. The other results plotted were from mattes made in many different plants, and may or may not have contained lead, zinc, and other impurities.



These results seem to indicate that the method could not be universally applied on all copper mattes, but it might give concordant results on mattes from individual plants with a possible limit of accuracy of from 0.5 to 1.0 per cent copper. It is believed that the matter should receive further study. To this end a more extended investigation has been started on a large variety of commercial mattes as well as on a series of mattes produced in the laboratory. W. F. DEITRICH.

Stanford University, Cal. WELTON J. CROOK.

The Ajo Enterprise Series

The fourth installment of A. W. Allen's article, "Ajo Enterprise of the New Cornelia Copper Co.," should have been published in this issue. Unavoidable circumstances have prevented the manuscript and illustrations from reaching us, but we hope to publish it in a subsequent edition.

In the *Journal-Press* for June 10, certain erroneous footnotes were given in the article "Ajo Enterprise of the New Cornelia Copper Co." On p. 1004 the reference should be Vol. 52 instead of Vol. 51; p. 1007, p. 830 instead of p. 380, and on p. 1008, p. 830 instead of p. 380.

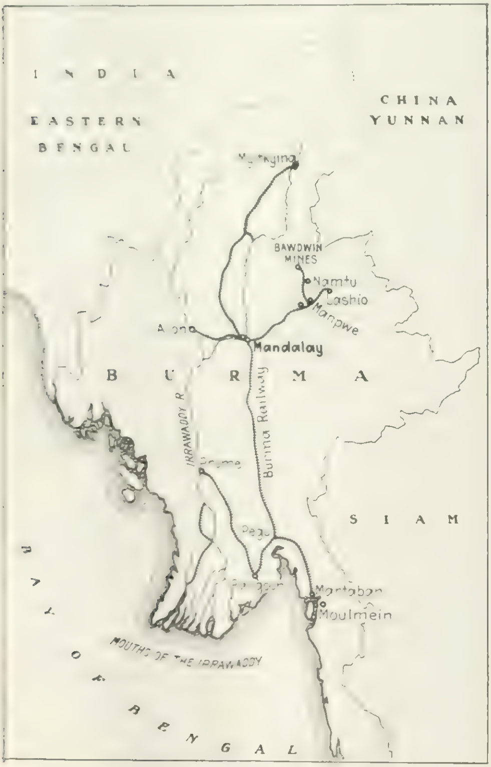
The Bawdwin Mine, in Burma

Early Methods of Mining and Smelting Silver-Lead Ore by the Chinese, Who Worked the Deposit in the Fifteenth Century—Present Mining Operations by the Burma Corporation, Ltd.

By Allan B. Calhoun
Mine Superintendent, Burma Corporation, Ltd.

THE BAWDWIN MINE is situated in the semi-independent State of Tawng-Peng, one of the small group comprising the Northern Shan States in Upper Burma. Each of these states has its own sawbwa, or chieftain, who rules the people under the advice and direction of a British "superintendent."

Bawdwin is 450 miles north of Rangoon, the capital of Burma, 169 miles northeast of Mandalay, and about fifty miles south of the Province of Yunnan, in China. The elevation of the mine is 3,100 ft. above the sea. The climate at this elevation is comparatively healthful during the dry season, but rather depressing during the wet. The dry season extends from November to May, and during the remainder of the year the precipitation amounts to 60 or 70 in. Most of this is in the form of heavy showers, which cause considerable damage to the railroad.



Map of Burma

Early records and inscriptions state that the mine was operated by the Chinese in the ninth year of the reign of Yung Lo, of the Ming Dynasty, 1412 A. D. It was known as Lao Yin Chang, meaning "old silver mine," and was worked most extensively during the reigns of Chia Ching, 1796-1821, and Tao Kwang, 1821-1851, during which time it was the source of great wealth. During the reign of Tung Chik, 1868, the mine was abandoned for one or possibly all of the following reasons:

1—The Panthay or Mohammedan rebellion broke out at this time in the neighboring Province of Yunnan, China, making life and property insecure and at the same time blocking the route to China.

2—As a corollary to the rebellion, the neighboring tribes of Kachins—a war-like mountain race—took advantage of the turmoil and the fact that the mine was cut off from China, and ruthlessly raided the mining population.

3—The third reason, and probably the most important, was the difficulty of operating the mine on account of water, poor ventilation, and entire lack of machinery.

From conditions in old workings recently opened, it appears that the Chinese were pumping water in a series of lifts through 6-in. bamboo pumps a vertical distance of 160 ft. The longest and lowest drainage adit was driven through the country rock a distance of several thousand feet, to tap and drain the orebody. The difficulties encountered in this work must have been great, and the work was probably done at the sacrifice of many lives. How the early miners ventilated these long tortuous adits, how they took care of large bursts of water, and carried out the ore, is inconceivable to one who does not know the Chinaman. There is nothing too laborious or too slow to try his patience and perseverance.

This long adit has been enlarged and extended, and is now No. 2 Level drainage adit, or, more familiarly, "Dead Chinaman" tunnel. The latter name was given to it on account of finding the skeletons of Chinese with manacles still encircling their bones.

Problems of Drainage and Ventilation Ended Early Operations

The Chinese mined ore 50 ft. below this level, but the amount of water must have been so large that they had to abandon these lower workings. To drain the mine for another 100 ft., it would have been necessary to drive a second long adit about three-quarters of a mile, and evidently this was more than the engineers would undertake, on account of the problem of ventilation, and more than the financiers would authorize, on account of the long time they would have had to wait to realize on the investment. All work was done by hammer and moil.

Previous to 1868 Bawdwin was a prosperous Chinese colony, with a population of 20,000, as evidenced by rec-

Ore bins at the portal of "Tiger Tunnel," Bawdwin mine

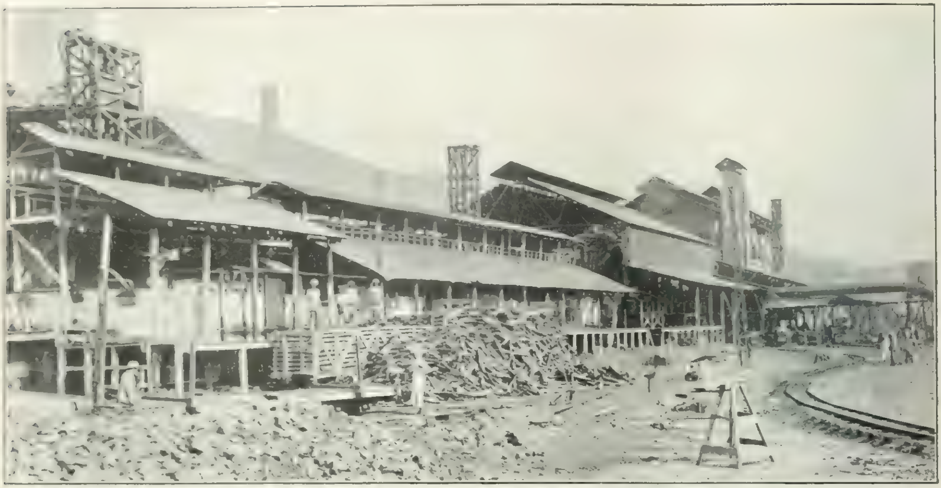
Portal of the tunnel, recently equipped with electric haulage

The bridge across the Namtu River, at Namtu

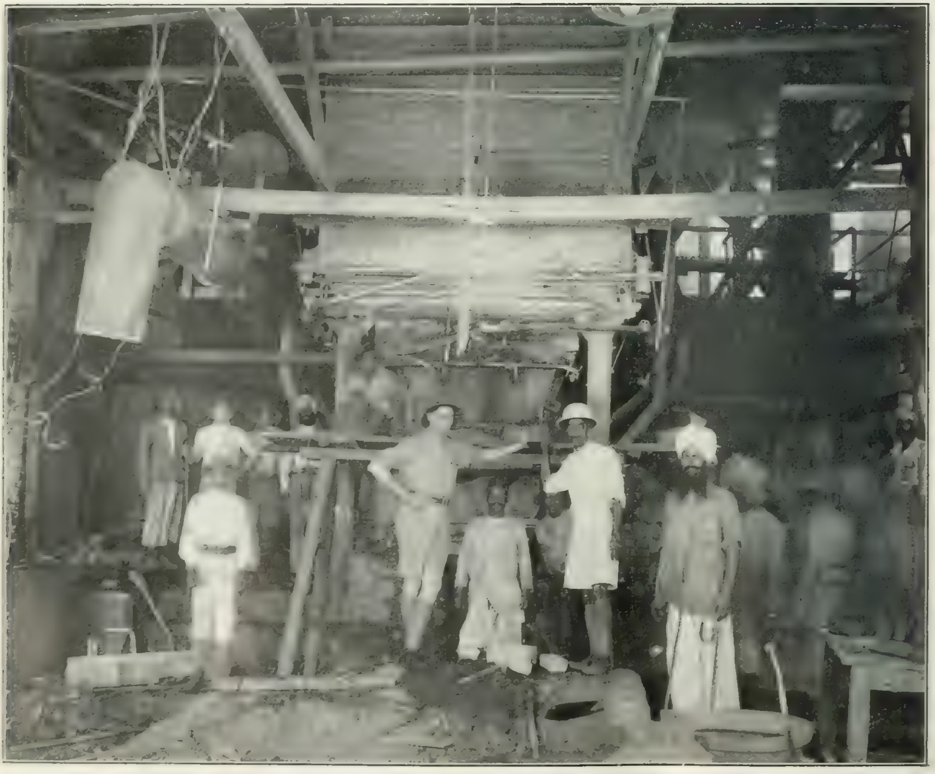
Remains of an old Chinese bridge at Bawdwin

Site of an old Chinese blast furnace at Bawdwin

What remains of three cupeling furnaces

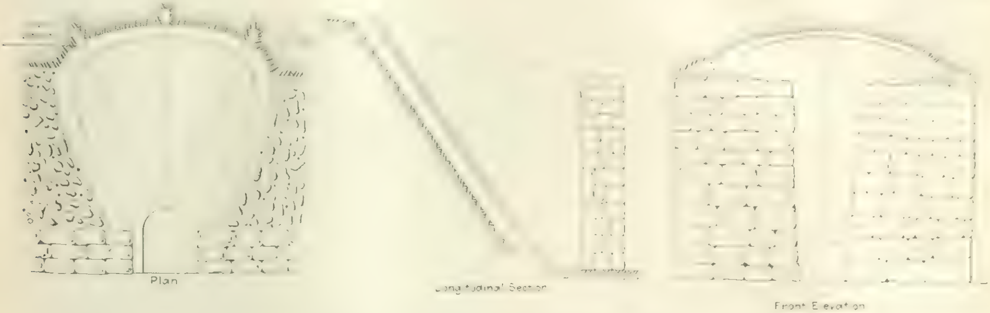


The smelter at Namtu, showing roasters and blast furnaces



No. 3 blast furnace in course of repair ords and remains of temples, mosques, theatres, and other public buildings and bridges and the thousands of graves that cover the hillside.

It is generally supposed, on account of various discoveries and inscriptions found in the neighborhood, that Bawdwin formed a penal settlement for the Chinese government. The entire workings are surrounded by many miles of entrenchments that parallel the mountain ridges. These fortifications are about 15 ft. wide and 10 ft. deep, and are situated on both sides of the mountain ridges that hem in the mine.

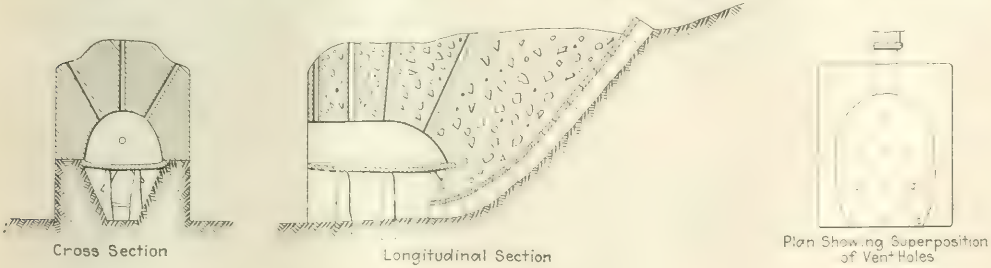


Details of ancient Chinese blast furnace

The present Chinese-Shan miners claim that soldiers lived in these entrenchments, and it is believed that the ones on the adjacent side of the mountains were to guard and keep in the prisoners, and that those on the opposite side were for the purpose of repelling attacks from wild marauding native tribes.

EARLY CHINESE METHODS

The Chinese worked the mine for silver alone, as the lead and zinc were evidently of no value to them. The hill containing the orebody is riddled with adits, the majority of which are so small that the ordinary European is compelled to get down on his hands and knees to pass through the tortuous workings. Nearly all these adits are on slight downward incline, probably to facilitate ventilation.



Details of ancient Chinese "cupeling" furnace

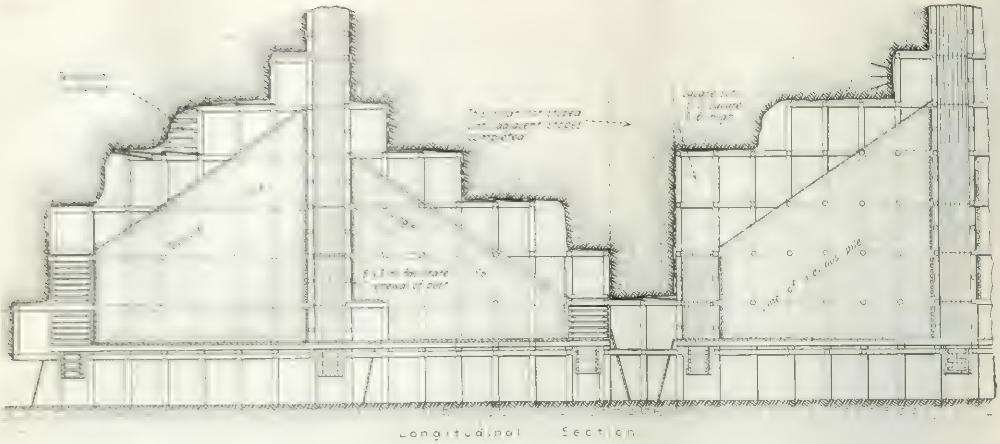
The drainage adits are larger and necessarily are inclined the other way. The incline shafts are also larger, and run on a grade that will permit the carrying of material to the surface without the use of a ladder. Several of the more important ones have steps cut in the solid rock, and one in particular is in the form of a spiral. This was to get the maximum vertical depth in the shortest distance and at the same time permit the coolie to walk up with his burden.

Few ladders were used, and those found were similar to the Mexican chicken ladder—simply a notched inclined log. On both sides of the portal of many of the adits are little niches, one or two feet square, similar to those found in Mexican mines, in which the Chinaman is supposed to have deposited his small Buddha or other lucky icon to ward off evil spirits. In all there are probably twelve or fifteen miles of these workings.

The method of timbering was ingenious. The drives being diminutive, only small timber was required, 5 or 6 in. in diameter being the maximum. This timber was generally of pine or of "male" bamboo, the latter species of bamboo being almost solid, whereas the female has thin walls. There is no evidence of vertical shafts or of any mechanical equipment for hoisting. The method of stoping was not much different from present methods, except that the work was done on a smaller scale. On a new level ore was followed by a drift, and a raise was driven to the surface or to connect with workings above. The back of the drift was then stoped for a vertical distance of several feet; the ore was removed, and waste for filling was dropped through the raises or carried up into the stope in baskets. The operation was apparently a straight cut-and-fill system, the work being done within a small area and in a laborious manner. Stopes were carried only three or four feet wide, and when one section reached the surface or vertical limit of the stope, another drift was run parallel to the old one, and another stope carried up adjacent to the filled one. Probably more than 1,000,000 tons of ore was mined.

CHINESE SMELTED ORE FOR SILVER ONLY

The ore was smelted locally in small furnaces, the remains of which are scattered for miles along the small river that runs through the property. In the beginning, the ore was smelted within a few hundred



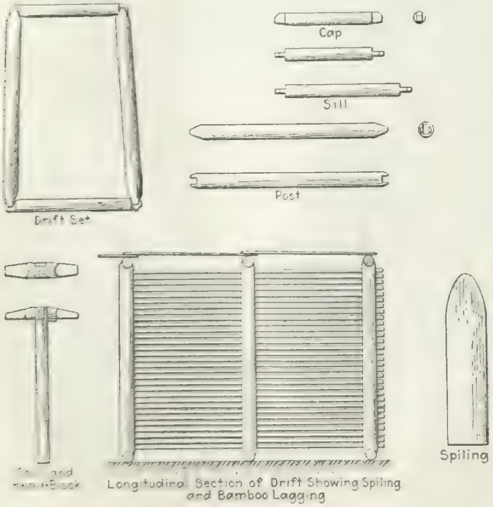
Square-set rill stope in the Bawdwin mine

feet of the mine, but gradually the supply of timber in the vicinity was exhausted to make charcoal; or perhaps the progenitors of our smoke farmers brought suit for damages. At any rate, it was found advisable to carry the ore to the fuel, and consequently the work was moved out along the river, with the result that the heaps of slag, so-called, can be found for miles along the stream.

The exact method of smelting is not thoroughly understood, but the results obtained in the extraction of silver compare favorable with modern smelting practice. A short description of the furnaces and the apparent method of procedure may be interesting to the smelter man. I leave him to draw his own conclusions.

Furnaces Were Excavated Into Banks

The blast furnaces were made by digging into a bank and making a crucible-shaped excavation flaring out at the top and open in front. Troughs for tuyères were cut in the back wall of the furnace and covered with flat stones. The front of the furnace was then built up of clay and boulders and the inside was plastered with several layers of fireclay, which completely sealed the long tuyères extending down the back to the bottom of the furnace. These long tuyères were evidently for the purpose of heating and conducting the blast to the bottom and narrow part of the furnace.


Cap
Sill
Post
Drift Set
Spiling
Longitudinal Section of Drift Showing Spiling and Bamboo Lagging

Sketch showing details of old Chinese timbering

The air was supplied by bellows or by the air pump that is still in use by the Chinese. These pumps were 8 to 10 in. in diameter and 6 to 7 ft. long, and were made by boring suitable logs. Inside a plunger was fitted, which was operated either by manual or mechanical power—usually a water wheel. Smaller pumps, up to 6 in. diameter, were made from bamboo. It is questionable whether these air pumps were operated by hand or by a water wheel, but as all furnaces were placed close to running water, I am inclined to think that water power was used.

The ore was first mixed with charcoal and roasted in small stalls and then carried to the blast furnace. Here it was again mixed with charcoal and, if necessary, according to the analysis of the sinter, a small quantity of flux was added before charging.

Samples of high-grade Bawdwin ore assay as follows:

Ag, Oz.	Pb, Per Cent	Zn, Per Cent	Cu, Per Cent	SiO_2, Per Cent	Fe, Per Cent	CaO, Per Cent	Al_2O_3, Per Cent	S Per Cent
45.4	47.2	21.2	0.2	5.0	3.2	2.0	1.0	20.5
44.1	46.8	21.0	Tr.	4.8	3.1	1.0	1.9	20.4

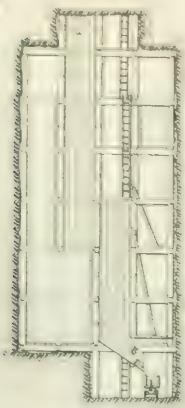
Sinter from the furnace assayed approximately:

Ag, Oz.	Pb, Per Cent	Zn, Per Cent	Cu, Per Cent	SiO_2, Per Cent	Fe, Per Cent	CaO, Per Cent	Al_2O_3, Per Cent	S, Per Cent
3.9	(a)44.5	18.9	0.2	10.0	4.5	2.3	4.8	3.2
2.5	44.9	16.5	0.3	12.0	4.5	2.9	3.1	2.1

(a) 2 to 3% of this was in the form of prills of lead.

These assays show that less than 1 per cent of the lead was actually reduced and collected in the lead well, but still sufficient to collect all but 2 or 3 oz. of silver. This small amount of lead was then ladled out and carried to adjacent banks of refining furnaces, where the lead was oxidized and silver recovered.

It is questionable whether the smelting operation was continuous or intermittent, as no evidence has been found on the property to warrant a conclusion. If it was continuous—and I am inclined to think it was—batches of freshly roasted ore and charcoal were added inter-



Rill Stope

mittently, and as the mass at the bottom became sufficiently plastic to give up its silver, it was scraped out in the form of a sticky sinter or "slag," and the charge was allowed to settle. If the process was intermittent, as maintained by some who have seen the work in China, the furnace was cleaned out of its former charge, the small opening in the front wall of the furnace was torn down and the sintered mass was scraped out ready for another cycle.

In the Bawdwin ore the silver is associated with the galena and not with the sphalerite. For every 1 per cent lead there is approximately 1 oz. of silver. The Chinaman had no use for the lead or zinc; consequently, he reduced the minimum amount of lead to collect the silver. It is almost inconceivable that with such crude furnaces the charge and blast could be so regulated that the sulphur would be reduced to 2 or 3 per cent, while, at the same time, only a few per cent of the lead would be reduced. The sinter carries 2 or 3 per cent prills of lead, and it was probably in them that the loss of most of the silver occurred.

LEAD WAS CUPELED ON MUD "TEST"

The refining furnaces were also built in a bank of earth, in rows of seven. The furnace was divided by a 2-in. "test" into two parts, called the top and bottom compartments. In the top compartment was placed the silver-laden lead. Extending vertically through the top of the furnace were a number of flues. At the back of the lower compartment was a large flue that extended up through the ground at the back to the surface.

The method of operating these furnaces was probably as follows:

A charcoal fire was placed upon a grate supported just above the test. The grate bars were made of fireclay, moulded in bamboos of 2 in. diameter, and then burnt. The door of the lower compartment was regulated to allow sufficient air to pass through and under the test (to keep it at the proper temperature) and thence up through the back chimney.

Sufficient heat was maintained upon the top of the molten metal to oxidize the lead. It is said that one man by rolling an iron rod over the molten metal could attend to the skimming of a series of seven of these furnaces. By this process of skimming and oxidization pure silver was obtained.

Evidently the fumes from all the smelting and refining furnaces had a tendency to prevent reforestation on the steep hillsides that had been cleared of semi-tropical jungle, as there are now no trees within three or four miles of Bawdwin and the hills are covered with a grass that grows three or four feet high, and which is burnt off every year. It is an ill wind that does not blow someone good. On account of the clearing of the forest by the Chinaman and the effect of the fumes, Bawdwin is one of the comparatively healthful places in Burma. As no rank vegetation can now get a start on the hills, there are no places in the vicinity in which mosquitoes can breed.

EUROPEANS BECAME INTERESTED IN 1904

Burmese brought the attention of Europeans to these enormous slag dumps, and, in 1891, A. C. Martin, of Rangoon, visited the property and took some samples. With J. Sarkies, also of Rangoon, he formed a partnership and applied for a lease of four square miles. Nothing was done for several years, until Mr. Martin met Captain M. F. Kinderley in Mandalay. Together with Mr. Sarkies and Maitland Kinderley, a brother, they formed the Burma Mines Development & Agency Co., of which the Burma Mines & Smelting Co. was a branch. In 1904 the company was reorganized as the Great Eastern Mining Co., and Lord Hersey became identified with it.

The local directors in Rangoon consisted of Mr. Sterne, Captain Barnett, S. W. Watts, A. C. Martin, and W. A. Freymouth.

In 1906 this company sold its right to the Burma Mines Ry. & Smelting Co., and in 1908 changed its name to Burma Mines, Ltd. At this time there was no intention to work the mines, but only to build a railroad and smelt the Chinese slag.

FIRST SMELTER AT MANDALAY

A narrow-gage (24-in.) railroad, forty-five miles long, was completed to connect with the government line, and a smelter was built at Mandalay, 169 miles away. Smelting actually started in 1909. No money was made, as the railroad haul was too great, and in 1911 a new smelter was built at Namtu, on the narrow-gage line, only twelve miles from the mine.

After 200,000 or 300,000 tons of slag had been smelted, the engineers began to consider the probability that the Chinaman had left some ore, so they started to prospect by cleaning out the old workings. About this time Herbert Hoover secured control of the mine and became chairman of the board. After two years of difficult and discouraging work, the main orebody was tapped by what is now called the "Dead Chinaman" tunnel, or the 171 level.

This adit was well below the main workings, although some of the Chinese stopes had actually reached a vertical depth of 50 ft. below this level.

From then on the development was rapid, and today the "Chinaman" orebody is considered to be one of the largest high-grade silver-lead-zinc orebodies in the world. The total ore reserves on Jan. 1, 1921, were:

Tons	Ag, Oz	Pb, Per Cent	Zn, Per Cent	Cu, Per Cent
4,429,458	23.3	25.3	17.7	1.2

Of this only a little over one-tenth is designated as probable ore. No mineral with a content less than 20 per cent lead and zinc is considered, except for part of 335,681 tons of copper ore, which averages Ag, 23.2 oz.; Pb, 12.8 per cent; Zn, 7.7 per cent; Cu, 11.0 per cent.

The mine probably contains another million or more tons of low-grade material, carrying between 8 per cent and 20 per cent combined lead and zinc, which has not been taken into consideration as ore. The ore occurs as solid masses of sulphide, with little admixture of gangue. On some levels the solid ore will average 50 [illegible] a continuous distance of 1,000 ft. along the [illegible] and in a few places it is 100 to 140 ft. wide. Many of the blocks are 75 per cent solid lead and zinc sulphide.

The present bottom of the mine is the 653 level, which shows what was once a continuous orebody over [illegible] ft. long, but which has now been faulted into two separate blocks, with a displacement of over 600 ft. along the throw.

The mine has been systematically developed down to the [illegible] level, or main adit, known as the "Tiger Tunnel," which is about two miles long. This adit is double-tracked for 7,400 ft. from the portal to the main internal shaft. No expense has been spared in developing and equipping the mine in the most up-to-date manner. Notwithstanding labor is cheap, machinery is cheaper, and little hand work is done.

Development Has Been Systematic

The "Chinaman" orebody is blocked out by crosscuts through the ore at 100-ft. intervals; these are placed vertically above each other on the respective levels. Raises have been driven from these crosscuts to make continuous passages from the top of the mine to the lowest level. The same raises are alternately used for passing ore or filling, and are so offset on every level that ore or waste can be drawn out at that level or passed through to the next or to the lowest level.

All ore goes straight through to 653 level, where it is loaded into four-ton cars and hauled in trains of ten cars by electric locomotives to the tipple plant. Waste filling is obtained from the surface by quarrying around the raises so that the filling will go directly into stopes without further handling.

A modified square-set rill system is used in stoping. For this system it is advantageous to lay out the main drift in the foot-wall country rock and to crosscut through the ore at 100-ft. intervals to the hanging wall. In these crosscuts are the main rises.

The 50-ft. blocks on either side, with the exception of a 12-ft. pillar directly over the crosscut, comprise the stopes. These rill stopes have their apexes at the main passes and slope down to the stoping crosscuts. In the early work no pillar was left at the toe of two stopes and one ore chute sufficed for two stopes. This section would become excessively heavy, and it has been found desirable to leave a 12-ft. pillar between the two stopes and carry up individual ore chutes.

Stoping Starts on the Hanging-Wall Side

Stopes are carried three or four sets wide, depending on the character of the ground. Four sets is the maximum width that the best ground will stand, and as the ground becomes heavier the stope is brought in to three or sometimes two sets wide; the length remains the same. Where the vein is wide the hanging section is taken first, and when completed a second section is taken alongside, retreating toward the foot wall. Under this arrangement the crosscuts and drifts are always in solid ore or rock and the part under the old stope can be filled, thus minimizing expensive repairs, through old stoped areas. To get the proper rill, square sets must be of the proper size and height. Those in the Bawdwin mine are 5½ ft. square and 7½ ft. high.

The manways are on the hanging-wall side of the chute, and not along one side, as is generally the custom. This gives access to either stope from the manway or chute without blocking either.

As the train of four-ton cars leaves the portal of the tunnel it is hauled to the tipple plant, where four four-ton cars are emptied at once. From the tipple plant the ore is carried by a 20-in. belt conveyor and discharged into bins by an automatic tripper. From the bin the ore is taken by trains to Namtu, seven miles away, where are situated the mill, smelter, and headquarters of the corporation.

Mining Operations of Nevada Consolidated in 1921

According to the annual report of the Nevada Consolidated Copper Co., operating at Ely, Nev., the most important feature of 1921 was the development of additional tonnages of high-grade direct-smelting ore along the margin of the Ruth concentrating orebody. Fully developed direct-smelting ore estimate as of Dec. 31, 1921, is 406,196 tons, averaging 7.27 per cent copper. In segregating ores, 3 per cent copper was assumed as the lower limit of direct-smelting grade. No additional ore was added to the disseminated porphyry reserves during the year, the total on Dec. 31, 1921, amounting to 63,401,209 tons, averaging 1.58 per cent copper.

Steam-shovel mining costs of concentrating ores, exclusive of depreciation and Federal, state, and local taxes, but including all other overhead expense, were as follows:

	Cents per Ton Ore		Cents per Cu. Yd. Capping	
	1921	1920	1921	1920
Drilling and blasting	6.45	6.14	11.26	8 78
Steam-shovel operations	2 77	3 04	5.78	5 90
Locomotive tramming	7 69	8 61	18.23	18 75
General pit expense	1 78	2 50	1 25	0 96
Miscellaneous	9 42	9 81	4 71	6 08
Totals	28 11	30 10	41.23	40 47

Steam-shovel efficiencies were as follows:

	Tons of Ore Per Eight-Hour Shovel Shift	Cu.Yd. Capping Per Eight-Hour Shovel Shift
1918	1,404	952
1919	2,254	1,155
1920	2,255	1,187
1921	2,392	1,148

Ruth mine underground costs showed improvement as follows:

	Cents per Ton	
	1921	1920
Branch raises and sublevels	22.35	24.12
Undercutting and caving	18.05	17.94
Tramming	6.23	7.94
Hoisting	4.60	6.11
General underground upkeep	18 81	24.36
General mine expense	7 02	7.08
Miscellaneous	8.63	9.65
Totals	85.69	97 20

Improved labor efficiencies are also reflected in the following figures:

	Dry Tons per Man-Shift Underground	Dry Tons per Tota Man-Shift on Ruth Mine Payrolls
1918	10 39	7.53
1919	11.51	8.34
1920	12.27	8.99
1921	13.08	9.38

In comparing costs and labor efficiencies, it must be remembered that operations in 1921 were confined to the three winter months, with the weather persistently cold.

After the shut-down small crews were organized to proceed with alterations and additions to plant which could not be economically accomplished when operating, as well as to maintain the plant in condition for reopening. No carbonate ore was extracted during the year, and the mine dump storage remains at 80,229 tons as at the close of 1920. The shovel pits furnished 64.8 per cent of the ore mined during the year.

Development of Metallurgical Practice at the Hollinger Mine

Early History of the Enterprise — The Original Mill — Amalgamation vs. Cyanidation — Treatment of High-Grade Ore — Development of Present Practice

By P. A. Robbins

PRIOR TO THE DISCOVERY of the Hollinger, no gold mine had been successful in Ontario. For twenty-five years many unsuccessful mines had been started in Hastings County, and the Thunder Bay, Lake of the Woods, and Sturgeon Lake districts, and many mills had been built. The standard milling practice was the use of crusher, stamps, plates and vanners, with possibly a 65 to 70 per cent recovery from a $10 ore. The Timmins-McMartin-Dunlop Syndicate (owner of the Hollinger mine) was without experience in mining except for its one successful venture with the La Rose mine, at Cobalt, where by rough hand sorting, carloads of ore carrying 3,000 to 6,000 oz. silver per ton were shipped from surface trenches.

A nephew of the Timmins brothers, Alphonse Paré, a recent graduate from McGill University, was in charge of the Hollinger during its first fourteen months of life, and to test the Hollinger ground had installed a two-stamp Tremain steam mill and a jaw crusher, which were in operation when I took charge of the property at the beginning of 1911.

As the mill had a limited capacity, only the best ore from the shaft and drifts was being treated. The recovery from one plate, about 4 x 12 ft., was about $30 per ton, and the tailing carried $20, thus indicating a gross $50 content. The selection of the best ore was not to mislead; it was logical to get as much gold as possible to help pay expenses. The results no doubt led the owners to believe that the vein would carry from $40 to $50 per ton. Subsequent sampling showed this particular orebody to average $35 on the surface and $31 on the 100 level over a length of approximately 950 ft. and an average width of 10 ft.

Because of the satisfactory results obtained, the owners decided (as a separate company) to erect a thirty-stamp mill to treat Hollinger and custom ore. Tom Scanlan, a mechanical engineer of wide experience in smelter and mill work with the Allis-Chalmers company, had been engaged to design the plant. Mr. Scanlan adopted the standard practice of California and the various ill-fated Ontario projects, and ordered the parts for a thirty-stamp mill, with crushers, plates, Overstrom sand tables, and Johnson vanners. These parts were ordered before the mill was designed, as it was not possible to bring in machinery except in midwinter, when the forty miles of swamps, lakes, and rivers were frozen over; to get delivery in the winter of 1910-1911 the orders were hurriedly placed by Mr. Scanlan in the fall of 1910.

This was the status of the work when I was engaged to take charge in January, 1911. Without losing a whole year I could not undertake to run ore tests and redesign the mill for cyanide treatment if found advisable, and hence we decided to put up an experimental mill, with the stamps in a separate building, leading the pulp off on one side to a light shed containing the plates and concentrators. This would leave the space in front of the stamps for a cyanide plant to be erected later. Work on this mill was well under way when on May 19, 1911, a forest fire swept the property and burned everything. Later fires in June and July cleaned up the remainder of the district and destroyed all possibility of building the mill in 1911.

A. G. Kirby, who was in charge of the Nova Scotia mine, at Cobalt (fresh from the new Goldfield Consolidated mill), was engaged to run a series of tests on the ore. I sent him, as a test sample, ore carrying $50 per ton. Rumors were in circulation that the Hollinger was a frost and that the fire had been inspired. When the test sample ran $50 per ton it was believed that we were trying to sell stock. The facts were that I knew we had much high-grade ore, and I wanted a mill to recover the gold in that ore. The treatment of $10 and $12 ore did not worry me, but when it came to ore carrying $80 to $100 per ton, I wanted to be sure of results.

CONCENTRATION GENERALLY FAVORED

Mr. Kirby's tests showed poor recovery by amalgamation, but cyaniding and concentrating gave 99 per cent plus when the ore was all slimed. As a result of Mr. Kirby's work, I decided to crush in solution and aim for 70 per cent through 200 mesh. The matter of concentration was given much thought, and though we felt that concentration could be omitted, we were worried about the frequent occurrences of ore carrying $100 or more per ton. I finally decided upon concentration for the following reasons:

1. The tables would catch the gold-bearing sulphides and gold flakes that escaped from the tube-mill circuit.
2. The taking out of heavy particles by concentration would make it possible to do less fine grinding than otherwise.
3. The separate treatment of concentrates would enable the lower-grade pulp to be passed on with a minimum of agitation.
4. Refinery practice would be simplified; there would be less precipitate to treat.

With each addition to the Hollinger mill, I consulted the mill superintendents, and every one of them unreservedly declared himself in favor of retaining concentration as a part of the flow sheet.

The decision to crush in solution and not use plate amalgamation was based upon a belief that free, amalgamable gold would readily cyanide. I did not believe the argument that a mill which recovered 95 per cent was losing 5 per cent of all the gold in the ore, and that, therefore, the gold recovered by plate amalgamation indicated a 100-per cent recovery for that gold instead of a 95-per cent one. My belief was, and still is that the gold that will amalgamate freely will readily cyanide and yield approximately 100 per cent. The losses are in the gold occluded in the sulphides and in the gangue particles, which will not amalgamate.

In plate amalgamation there is often, perhaps usually, the indeterminate loss by theft of amalgam; and the possibility of such loss occurring is so great that it outweighs any hair-splitting metallurgical arguments in favor of plate amalgamation. Having decided upon the important steps (all sliming, crushing in solution, concentration, and separate treatment of the sulphides), we proceeded to design a mill for treating 400 tons per day, and the following flow sheet was adopted:

Flow sheet first adopted at the Hollinger

Crushers were one No. 7, followed by one No. 5 gyratory, with provision for a second No. 5; belt conveyor from crusher station to mill and distributing belt over bins; Nelson feeders to forty 1,500-lb stamps; one 5 x 20-ft. tube mill to each ten stamps; tube mills and classifiers in closed circuit; overflow from classifiers to spitzkasten; underflow from spitzkasten to concentrators, overflow to Trent agitators; concentrate to drainage bins; table tailing to Trent agitators; discharge from agitators to Dorr thickeners; underflow from thickeners to Moore filters; overflow from thickeners to battery storage tanks or to precipitation if desired; filter pregnant solution to precipitation; barren solution wash to battery storage; cake to waste.

WHY CERTAIN MACHINES WERE ADOPTED

The decisions to use Trent agitators, and pan grinders for concentrate, were based upon Mr. Kirby's Nevada experience. Deister tables were used for concentrating because of the excellent results which Kirby and myself had obtained with these tables at Goldfield (Nev.), and at the McKinley-Darragh mine, in Colbalt, respectively. The Moore filter was adopted because of the Moore-Butters litigation. If Butters won we would be safe, for he was not the plaintiff. If Moore won we would be on the winning side. Furthermore, the Moore people needed money, and I was able to negotiate a deal at 10c. per ton royalty, paying in advance the estimated royalty for four years and thus doing away with further royalties. We also had the additional right to increase the plant from time to time upon the same basis. This seemed to be good business, and besides metallurgical advantages was one of the reasons for adopting the Moore system.

The mill was started July 1, 1912, and was tuned up on waste rock, followed by $10 ore for a week or so. After about two weeks of this preliminary work, $20 ore was treated, and everything seemed to be running as well as could be expected. The concentrate treatment plant was continuous in operation. Concentrate was shoveled into the grinding pans, which discharged into the settlers, from which the continuous stream of mercury flowed to the amalgam safes, being strained through canvas bags. The concentrate assayed $350 to $400 per ton, and about eight tons per day was being treated.

Then came the first clean-up. About fifty flasks of mercury was in the system. This was retorted. No gold! No gold in the safes; no gold in the grinding pans. The total yield should have been about $40,000; it was exactly $9.40. I still have the button, and have named it *"Nil desperandum."* A quick clean-up of the precipitation presses disclosed that the gold was not lost; it was in the presses. It was immediately evident that the cyanide in the concentrate was preventing amalgamation.

In Mr. Kirby's tests the concentrate had been thoroughly washed before amalgamating, whereas in the mill we relied upon draining to get rid of the cyanide. The cost and delay of remodeling the amalgamation plant so as to wash the concentrate presented a serious problem; we were heavily in debt, and our treasury was almost empty. It was therefore decided to try cyaniding the concentrate, and a 10-lb. solution was used in the pans and settlers, which now became agitators. The plan worked beautifully. Thus the amalgamating plant, without appreciable alteration, became a cyanide plant, and continued in use until it became too small for the increased tonnage of later years, when the pans and settlers were converted into Dorr thickeners for use in the new concentrate treatment plant, and thus nothing was lost.

DIFFICULTIES WERE NUMEROUS

Meantime the Trent agitators had been giving trouble. So unreliable had they become that a gong had been hung conveniently near, and when the man in charge would see an agitator stopped or threatening to stop, he would pound upon the gong, and all hands would rush to the rescue. Each agitator had been embellished with a set of grappling hooks and lines; these were dropped into the agitator when necessary, the arms engaged, and then for hours, and sometimes days, a gang of men would walk steadily around the tanks, dragging on the grappling lines and thus keeping the mill going. We did everything we could think of to make these agitators work, but they would not. An inherent trouble was that the sands would segregate and classify out, and build up until they stopped the apparatus from working.

Fortunately, our filter capacity was greatly in excess of our requirements, and by forming the cake slowly we could use the loading tanks as agitators. Later we equipped two conveniently located solution-storage tanks with Dorr agitators and were able to discard the Trent apparatus and convert the tanks into thickeners. The original mill had been designed for 400 tons per day, but by the end of the first year we were treating 650 tons per day.

The spitzkasten that fed the tables were constantly giving trouble; they were replaced by eight 13-ft. diameter Dorr thickeners, to fit the space available. The Dorr classifiers were overloaded in more ways than one.

Considerable experimenting had been necessary before the closed-circuit system of tube mill and classifier was arranged satisfactorily. The slope of the classifiers had been increased and the length had been doubled, so that they would discharge into the tube mills and the tube mills discharge into the classifiers. This greatly overloaded the driving mechanisms. The tonnage had been increased to 60 per cent over the designated capacity, and the classifiers had been speeded up; but they worked, although the breakages were a constant source of worry to the Dorr company.

In 1913 the demand for increased tonnage led to the installation of twenty more stamps (making sixty in all) and two more 5 x 20-ft. tube mills, making a total of six. More concentrating tables were not purchased, as it had been found that clean concentration was not necessary and that those in use could handle the increased tonnage satisfactorily. The Moore filter unit had been designed to treat 500 tons daily, but gradually the tonnage was raised to 750, and with satisfactory results. The mill had been whipped into shape by Noel Cunningham, who not only possessed unlimited nervous energy, but had faith in the apparatus under his care; he made things work. We were running with insufficient agitation, which kept the tailing higher than it has been since, but the mine was developing rapidly into a big enterprise, our debts were paid off, large dividends were being disbursed, a six months' fight with the Western Federation of Miners had been won (Nov. 15, 1912, to June 1, 1913), and we were doing more satisfactory work than the other mills in the district. In fact, the Hollinger mill was the only one that did not find it necessary to shut down and remodel; and, except for the change from amalgamation to cyanidation of concentrate, the Hollinger mill has not changed its process. The Vipond, Porcupine Crown, McIntyre, and two smaller properties all tried plate amalgamation and all found it neessary to resort to cyaniding. The Dome mill was remodeled to substitute sand leaching for part of its process—a change of doubtful value.

Up to the end of 1914 I had considered the mill as experimental, and it had been my intention to sink two main shafts (as our knowledge of the property increased) and erect a 4,000-ton mill between these shafts. But my directors were lacking in the necessary faith to put up the $1,500,000 required, and so the dream was never realized.

COUNTER-CURRENT DECANTATION ADOPTED

By the end of 1914 the development of the Acme mine (now a part of the Hollinger Consolidated) made a large increase in milling capacity imperative. Dorr had experimented at the Ophir with Nichols counter-current decantation, and C. H. Poirier had altered his mill at the Vipond mine (Porcupine) and was using this system. M. W. Summerhayes and S. W. Cohen had investigated the system and were putting it in at the Porcupine Crown. R. J. Ennis was falling in line with the McIntyre mill after he and André Dorfman had satisfied themselves that the scheme was satisfactory. As a result of Poirier's work and the opinions of the others I decided to try out the system.

The Vipond had allowed 4 sq.ft. of tank bottom per ton per day, but this was proving too little, and so we allowed 6 sq.ft. The 1914-15 addition to the Hollinger consisted of forty 1,500-lb. stamps, four 5 x 20-ft. tube mills and classifiers, sixteen double-deck Deister slime tables, and six 25 x 14-ft. Dorr agitators. To make room for the agitators, we converted the old slime tables into double deckers, thus saving half of the table space. The counter-current decantation plant consisted of two rows each of four 40-ft. Dorr thickeners. The Dorr company recommended five steps, but the fifth step did not seem necessary with cyanide at 13c. per lb. and zinc dust at 7c.—the prices then prevailing. We did not abandon the Moore filters, as they were economical and suited for handling colloids.

In the Hollinger section, after tube milling we decanted a muddy solution and settled this in eight 30-ft. thickeners. The overflow from these went to storage or precipitation as desired. The underflow went to agitators; most of this pulp went to the filters, but any excess flowed to the counter-current decantation vats. By this method we treated most of the Hollinger flocculent ore in the filters and were thus able to force a large tonnage of granular ore through the counter-current system. The Hollinger and Acme not having been consolidated, we operated as two mills under one roof from about March, 1915, to June 1, 1916.

BULLION MELTED WITH LEAD AND CUPELED

Before going on with the story of the mill, this is a convenient place to deal with the refinery. Originally we expected to recover most of our gold by amalgamation, and retorts had been installed for treating the amalgam. The precipitate from cyaniding was to have been melted in pots in Steele-Harvey furnaces; then fluxed and a low-grade bullion shipped. The failure of the amalgamating plant left us with improper refinery equipment. I immediately asked Henry Hanson (then with the Merrill company) to design for us a refinery similar to that of the Pittsburg Silver Peak, at Blair, Nevada.

The plan prepared by Mr. Hanson consisted of a lead stack, for melting the precipitate fluxed with litharge, borax, silica, and iron, from which a lead bullion was produced. This bullion was then cupeled, the lead being recovered as litharge. The bullion produced was 980 fine. The process was a success from the start, although many little refinements were introduced from time to time, such as granulating the litharge under water.

We started briquetting with the idea of drying the briquettes, but we had great difficulty in mixing the precipitate and fluxes. The borax would cause the mixture to set in chunks. A small brick clay-mixer was purchased in the belief that it would squirt out a hexagonal stream of mixed flux and precipitate, but it would not squirt. Oil was added to assist in the operation, but without success. It was found that this pug mill, working without the die, discharged the material in flat blobs, which immediately set hard enough to be handled with a shovel. So the refinery operation resolved itself into a simple process: The precipitate was dried in the presses by air; the presses were cleaned into side-tipping mine cars. The cars were tipped onto a mixing plate, and a rough mixture of the flux was shoveled into a pug mill, which wormed out a series of blobs, a little fuel oil being used as a binder. These were charged immediately into the lead stack without drying or briquetting. No dusting occurred. The lead bullion was cupeled as fast as produced, and in thirty-six hours the campaign was over. As a check on losses in fumes from the chimney, several times we collected all the top snow within a radius of 50 ft. of the refinery, but could detect no gold.

This brings us up to 1916, when plans were made for consolidating the Hollinger, Acme, and Millerton properties and doubling the capacity of the mill. The consolidation took place Jan. 1, 1916; but, owing to an ambiguity in the wording of the Dominion War Tax measure, the actual physical consolidation was held in abeyance until June 1, 1916. Meanwhile the plans for increasing the mill were under way. With three and one-half years' experience we felt satisfied with the results being obtained, but we were open to suggestions and anxious to learn the truth about proposed innovations.

Belt vs. Bucket Conveyors

The Hollinger ore had been handled on belt conveyors from shaft to mill, a distance of 360 ft. Acme ore had been handled in balanced buckets running on wire ropes over a distance of 840 ft. The Acme plan cost less per ton over 840 ft. than did the Hollinger plan over 360 ft. Moreover, the Acme costs were saddled with the expenses for repairs and alterations necessary to bring the system into smooth working order. We decided therefore to convey ore from the new crusher station to the mill (about 1,100 ft.) in balanced skips, running on a trestle.

Ball mills were being used at the McIntyre and Vipond mills and were being installed at the Dome. The Michigan copper and Western porphyry mines were going strong for ball mills. From the figures available I could not see the possibility of effecting an economy by their use; the cost of operating stamps invariably figured from 3 to 4c. per ton cheaper. Then, too, I knew something of the reasons for the adoption of ball mills by our neighbors.

The McIntyre company started with ten stamps, plates, and vanners, but later Chilean mills were put in. It was found impossible to get the tonnage through the mills; ore and cash reserves were at a low ebb. In the emergency, a certain manufacturer supplied ball mills on credit. New ore was discovered; both mine and mill proved a great success. But the reasons were financial, not metallurgical, which led to the adoption of ball mills. Further, the McIntyre was then working in a soft porphyry, which could be crumbled in the hand.

The original five tube mills at the Dome plant gave insufficiently fine grinding. C. D. Kaeding, newly appointed general manager, desired greater crushing and finer grinding. The company was not in a condition to stop the mill and reconstruct, nor were funds available for building an extension to the mill. By tearing out the stamps and installing ball mills, Mr. Kaeding could squeeze a plant with a large crushing capacity into the existing building. These were the reasons given by Mr. Kaeding to me at the time. He was after gross results, not metallurgical perfection.

I had installed an 8-ft. tube mill of a well-known design at the McKinley-Darragh, at Cobalt, and had found that in operation there it required three times as much power as was claimed by the seller, so my faith in claims made by the maker was strained. For some time I had tried to get from him the test results of ball mills, but could never get a complete set of tests from any one mill showing power, iron consumption, and grinding results. However, we proceeded to design our new mill, and we made up two complete sets of plans, one with stamps, the other with ball mills. In the midst of this work the manufacturer of the ball mills agreed to loan me a mill for test purposes. An 8-ft. mill arrived about six weeks later. We promptly set it up and got it ready to run, then discovered that the liners would not fit. Another delay of some weeks occurred before new liners arrived. The mill was started, but the scoop feeder would pick up only 250 tons per day. Another delay occurred before a feeder with three scoops arrived. This was promptly put on, and the mill started, when we discovered that the throat of the feed trunnion would not pass the ore. I communicated with the makers and learned that the trunnion would have to be changed, as it was not designed for large tonnages.

All this consumed much time, and it gradually dawned on me that the manufacturer was not showing great eagerness to have his mill submitted to a ruthless test. Meanwhile we had erected separate bins and installed two 6 x 16-ft. tube mills, classifiers, and crushing equipment for this test plant, and we wanted information.

I bought a 48-in. Symons disk crusher and a 7 x 5-ft. cylindrical ball mill. We tested the Symons machine. It did excellent work on dry ore and delivered a uniform product about the size of coffee beans; but much to our surprise the tube mills quickly choked on this product and we could not grind it except at a slow rate. The Symons machine was set aside to be used as a preliminary grinder in a scheme for the continuous sampling of the discharge from the main crusher station. The cylindrical ball mill was next set up and tested, but it was not as economical as stamps, and so we decided upon the latter.

I believe that, in a 50- or 100-ton plant, a ball mill is the better; but in a mill of sufficient size to employ a staff of trained battery men, the decision between stamps and ball mills should not be made lightly. The mill men like the ball mills because of freedom from noise and ease of operation; but this freedom would have cost an extra 3 or 4c. per ton at the Hollinger plant.

Shorter Tube Mills of Larger Diameter Installed

The original mill had 1,500-lb. stamps and 5 x 20-ft. tube mills, and the combination gave us about 16.5 tons per stamp per day, 70 per cent through 200 mesh. We had found that the tube mills were the limiting factor. By loading a mill with manganoid (steel) pebbles we were able to get a duty of twenty to twenty-two tons per day per stamp.

I had engaged J. N. Bulkley, of Johannesburg (then in New York), as consulting engineer on our mill and hoisting problems. Mr. Bulkley had just finished his work with the New Modderfontein mill, in the Transvaal. Guided by his advice, we had installed in our test plant, before mentioned, two 6 x 16-ft. tube mills, with roller supports on the discharge ends, and 42-in. discharge openings. The pebble consumption in these mills was three times as great per ton treated as that in the 5 x 20-ft. mills, and the power consumption was much more. On the Rand the pebbles used are selected pieces of ore, so a high pebble consumption is rather an advantage, but the Hollinger quartz is so brecciated that imported pebbles must be used, thus making low pebble consumption necessary for low costs.

The large discharge opening drained the moisture from the mill. A tube mill works better when it has a small discharge, thus impounding the pulp and forming a pool from which floats the material that is ground fine enough for discharge. The roller supports gave much trouble, so we scrapped the rollers and put in trunnion heads with small discharge openings, and got fairly good results, except in the matter of pebble consumption. As a result of this and other experimental work we decided that a 5½ x 16-ft. tube mill would probably give us the increased capacity required. We did not test a 5 x 22-ft. mill, as there are in existence a number of published tube-mill tests that do not show increased advantage in the use of long cylinders. I never had the opportunity to find out what these 5½ x 16-ft. mills would do, as war conditions grew steadily worse, and although I built the new mill, it stood idle during my stay at the Hollinger, which I left on Oct. 4, 1918.

The remainder of the flow sheet was carried out as established by previous practice. The Dorr company had developed the tray thickener, so the area of our thickening plant was made 50 per cent smaller than would have been required if single tanks had been used. In the old mill we used Merrill clarifying presses, but trouble was experienced in cleaning them. After introducing montejus for blowing the wash water into the presses at 100 lb. pressure, we obtained better results. In the new mill we constructed clarifying vacuum filters of the leaf type; these could be inspected and cleaned with wire brushes or sand blast when necessary. The concentrate treatment plant was designed to repeat the previous work, 4 x 16-ft. tube mills being used for grinding. The strength of solution, however, had been lowered to 5 lb. potassium cyanide per ton of solution in the concentrate circuit.

As a result of our work I am firmly convinced that stamps are more economical than ball mills on the comparatively hard ore of the Hollinger, and that crushing in solution and sliming is superior to crushing in water and amalgamating, then dewatering and cyaniding. Between filtering and continuous decantation, I believe that filtering is more economical. Our decision to use decantation was influenced by a 10c. royalty charge against the filters. Cyanide was being bought at 13c. and zinc dust at 7c. per lb.—figures that favored the adoption of decantation. Even with this I could never figure any economy in the decantation plant except in the simplicity of operation. The decantation plant must be charged with the increased cost of pumping the larger quantities of solution, the extra zinc dust for precipitating the increased volume of pregnant solution, the occasional waste of surplus barren solution, and the extra cost of heating buildings. With increased cost of cyanide and zinc over the figures quoted, the economy would be in favor of filters. The Hollinger is now installing Oliver filters to follow decantation, which would indicate that the cyanide and dissolved-value losses are sufficient to warrant this additional step.

During the first year or two of milling under Noel Cunningham's direction we experimented with solution strengths from ½ lb. to 2 lb. of cyanide per ton of solution, and found 1.1 lb. the most satisfactory. In 1916, when cyanide had risen to 33c. per lb., L. B. Eames, superintendent, experimented with solution strengths down to ½ lb. per ton, but our tailing showed an increase of 30c. per ton and we went back to 1 lb. solution strength.

In the original mill, concentration had been figured at about eight tons gross per day per table top, on the supposition that about five or six tons would actually pass over the tables. Gradually it was found that an allowance of one table to about thirty tons of ore stamped gave all of the concentration necessary, but never did any of us feel that concentration should be abolished.

Benjamin Arthur Hoskins

An Appreciation

By Arthur Thacher

BENJAMIN ARTHUR HOSKINS died at his home at Van Nuys, Cal., on June 9. He was born on March 16, 1849, at Dodgeville, Wis. His father, a Cornish miner, went to Dodgeville in 1846, with the influx of Cornish and Northumberland miners to open the lead mines of Wisconsin. His mother was an Arthur from Devon, and her mother was a daughter of Lord Warren, of Devonshire. Their old home, a stone house, is still standing near the tracks of the Illinois Central R.R.

It was a wild country, and the opportunities for an education were exceptionally limited. As a boy, "Uncle Ben" sorted galena from the waste dumps, which was received as cash at the stores. At about eleven years of age he joined his father in lead mining and received "boys'" wages. Later, he went to the Lake Superior copper mines and then to Utah and Nevada. At Bingham Canyon he introduced the hand jig for concentrating lead ores. Later, he was attracted to Arizona and reached Tucson in July, 1878. There were no railroads in Arizona at this time, and the Apache indians were pretty troublesome.

In the spring of 1879, I had the good fortune to meet "Uncle Ben" at Oro Blanco and since then I was associated with him until his death. In the early '90's he was running the "Reward" gold mine, in Inyo County, Cal. Later he came to Missouri and had charge of the mining work of the Central Lead Co. The property was sold to the Guggenheims in 1905, and on Jan. 1, 1907, he went to Mineral Point, Wis., for the Mineral Point Zinc Co. and continued in this field until operations were suspended in 1921.

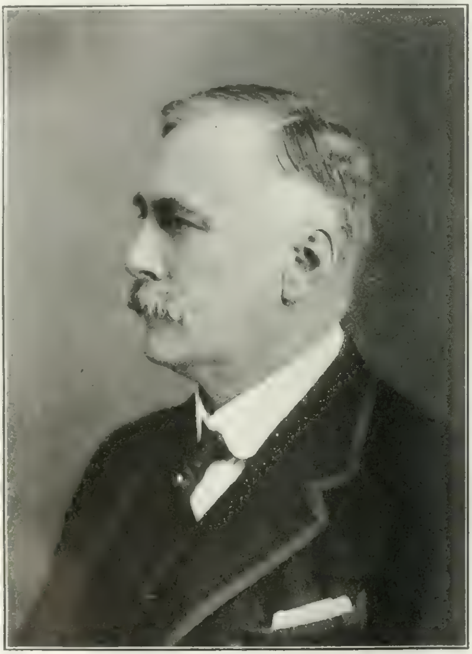
"Uncle Ben" had all the firm integrity of the Pilgrim fathers of New England, who were also from Devonshire. Together with this was coupled their passion for pioneer work, which caused him to roam through our Western mining camps. This was characteristic of the Wisconsin lead miners, for you found them in all the early Western mining camps. An expert miner, with rare judgment and vision, he left his impress in every place that he visited, and if he had had a broader early education his name would have stood out as one of our greatest mining engineers. Considering his opportunities, his achievements were to a high degree creditable.

It is, however, as a man that we wish to think of "Uncle Ben." He had the greatest love for humanity, and this, tempered with justice, was constantly spreading out to all with whom he came in contact. Standing for the highest ideals, the good that he did spreads out and will never die. It is the greatest monument that one can give to his fellow men.

Mining Engineers of Note

A. G. CHARLETON

BUT for an accident at football A. G. Charleton would have entered the British army. He is a Jersey man, born at St. Heliers, on Jan. 6, 1858, and is descended from a distinguished family of [illegible], his great-grandfather commanded a battery of artillery at Yorktown under Lord Cornwallis, and his grandfather was the sole survivor of two brothers blown up at Fort Erie together with a great-uncle on his mother's side. Fortunately for the mining profession, he followed the advice of the late Sir Andrew Ramsay and Thomas Etheridge and entered the Royal School of Mines, in 1876. At that period this institution possessed such noted professors as John Percy (metallurgy), Sir Warrington Smyth (mining), Judd (geology), Huxley (biology), Guthrie (physics), and Etheridge (paleontology). In 1880, Mr. Charleton decided to continue his studies at the celebrated Berg-Akademie, at Freiberg, in Saxony. At this time there were many noted American mining engineers studying there, among them John Hays Hammond and F. G. Corning, whose reminiscences of the old school, entitled "A Student's Reverie," have lately been published. Freiberg in those days was not only instructive but interesting. The Berg-Akademie also possessed many distinguished professors. Thus, Professor Richter taught metallurgy and blowpipe analysis; Professor von Cotta had but recently retired as professor of the study of ore deposits; Stelzner was professor in geology. Mr. Charleton was a hard-working and industrious student and he frequently burned the midnight oil, working at one time thirty-six hours at a stretch, to worry out the problem of "Pothenotesche Aufgabe"—all done, by the way, for the sake of procuring the use of some surveying instruments during the summer vacation. From Freiberg he went to Canada and afterward to Nevada, and the experience gained in those early days has proved of great service to him. Mr. Charleton's first appointment as assistant superintendent was on the recommendation of his old friend, R. P. Rothwell, who was consulting engineer to the celebrated Del Oro mine, at Marmora, in Canada, which produced an exceedingly refractory arsenical gold ore. In 1885, Mr. Charleton went to Queensland, where he was placed in charge of the Disraeli mine. He subsequently made some important and indeed prophetic reports on the Wynaad gold district, India, as he was obliged to condemn the "reefs" as too narrow and low grade to be payable. While in India he visited the Mysore gold fields, of which, on the other hand, he formed a favorable opinion that has since been confirmed. Later he reported on the concessions of the Pierrefitte company, in France, in the Pyrenees, containing several silver-lead and zinc properties. In 1895, Mr. Charleton began practice in London as a consulting engineer, visiting and reporting on mines situated in various parts of the world. He published at this time his "Report Book for Mining Engineers." In 1902, Mr. Charleton was elected president of the Institution of Mining & Metallurgy, of which he was one of the founders. He is a past member of the Advisory Board of the Royal School of Mines, was called to give evidence before the Departmental Committee on Technical Education at South Kensington, and also was a witness before the Board of Trade Commission, in 1904, for the revision of the latest Metalliferous Mines Act and Regulations. In 1907, Mr. Charleton's late firm, Charleton, Dickinson & Co., designed the equipment of the Robinson shaft. Since the war, Mr. Charleton has been occupied with the preparation of a series of technical publications for the Imperial Mineral Bureau and for the Imperial Institute.


A. G. CHARLETON

Mr. Charleton says he considers that the most important objects in life are good citizenship, good fellowship, good education, and personal ambition to succeed, *uncontaminated* by petty jealousy and selfishness. Couple with these a will to work and to put one's hand to any honest job that comes along, and then do it to the very best of one's ability. "Character," he says, "is of more value than wealth, and wisdom, born of experience, than power."

THE PETROLEUM INDUSTRY

Road over Tehachapi Pass between Los Angeles and Bakersfield

Oil Industry in California

BY DR. HENRY M. PAYNE

SUCH WIDE DIVERGENCE of opinion regarding the probable life of the California oil fields has been expressed that a résumé of present conditions is pertinent. Probably none of the oil-producing states has given more attention to the preservation and correlation of its oil-well records than has California. The closest co-operation exists between the producing companies and the state officials. The State Oil and Gas Supervisor and his six deputies offer prompt service and information regarding anything which will assist in drilling and maintaining wells in accordance with approved methods; and the geology of all the operating districts is graphically exhibited by "peg models" in each branch office of the bureau.

The peg models were first used by the Kern County Oil Protective Association, and were exhibited at the San Francisco Exposition in 1915, before the organization of the State Oil and Gas Department in California. The present models consist of pegs, set in boards, upon which a map of the area has been drawn to a scale of 100 ft. to 1 in. Each peg is inserted on the site of a well, and the board represents an assumed datum plane sufficiently low to include all development in the district. The Kern River field base is shown as 3,000 ft. below sea level. Blueprints, to scale, showing the log of the well, graphically, are pasted to the pegs. The vertical and horizontal scales used are equal, thus avoiding distortion of dips or structural conditions. Colored map tacks are inserted to indicate various formations, and strings of similar color are then stretched from the corresponding tacks in all pegs, thus making it possible to visualize the stratigraphy of the whole area.

The "chromography" in standard use is red for oil, yellow for water, brown for marker, white for point of shut-off, blue for bottom of well, and black for gas. The pegs used are of pine, $\frac{1}{2}$-in. in diameter; they range in length from 30 to 48 in. No attempt is made to cut off the pegs to show surface levels, as it is more advantageous to have them all of the same length, and braced across the top. After a few wells have been drilled in any area, the peg model assumes rapidly increasing importance, and the saving of one string of casing or the discovery of additional oil sands on a lease more than offsets the expense of building the model.

[illegible] that roads have been built to all the oil fields, and [illegible] bus service is provided from Bakersfield and other centers. The road over Tehachapi Pass, the "Grapevine," shown in the accompanying half-tone, and similar construction have placed all the active districts in close touch with Los Angeles. New work is curtailed since the strike, due largely to a surplus of oil; the storage capacity is limited, and all the tanks are full.

Headquarters of the Pacfic Oil Co.

The clearing of titles in parts of the Buena Vista Hills field, and the granting of leases on certain sections which were in litigation in the Naval Reserve, have served to open a few new districts. Notable among the new operations are those of the Pan-American company, in the Elk Hills region; the Tupman lease; and a new camp of the Pacific Oil Co. It is understood that the new operators on the Naval Reserves are paying the Government a royalty in oil in return for the leases.

PUBLIC UTILITIES PROVIDED

The town of Ford, for which application for a town site was rejected by the Government, is nevertheless going ahead with construction on leasehold property. Gas is supplied by the Midway Gas Co., electricity by the San Joaquin Light & Power Co., and water by the Western Water Co., to the towns of Taft, Maricopa, and the surrounding camps. The Pacific Oil Co., formerly the Kern Trade & Oil Co., closely allied to the Southern Pacific interests, is moving its Kerto camp from near Maricopa to a point about three-quarters of a mile northwest of Taft, and is building a new permanent camp for its main offices in the West Side field.

In the Midway field most of the drilling being done is to meet lease requirements as to new and offset wells, The greatest interest at present is in the Fern Front, an area about four miles northwest of the main Kern field. The Standard and Union Oil companies are bringing in a few new wells nine miles northwest of Bakersfield. Some of the old wells are being cleaned up and pumped, but most of the wells, except "line" wells, are closed down. The Comanche Point district, twenty-five miles southeast of Bakersfield, is a new development. Two wells are being drilled; both report gas, but are not deep enough to "prove up."

The process of cleaning up old wells consists of pumping hot oil at a temperature of 160 deg. F. under a pressure of 700 lb. to clean out the perforations and break up the bridging of the sands. This hot oil melts down the asphaltic material, on which water has no effect. The oil cools from 30 to 40 deg. in reaching the point of attack. In some instances a pressure of 250 to 400 lb. will do the work.

KERN RIVER FIELD HAS 2,000 PRODUCING WELLS

The average depth of the Kern River field is 1,000 ft., and there are about 2,000 producing wells. This field has been producing for twenty-two years, and on account of the thick sands it is predicted by many that it will be good for twenty or thirty years more. The decrease in production has been small. The average production per well per day in the entire field is 10 bbl. In Sec. 5, along the center of the field, the hot-oil cleaning process has induced triple production, which seems to be holding up. The Santa Fé flat field southwest of Kern River is at present held in reserve. Near Bakersfield oranges and oil are found in surface and sub-surface combination.

The Midway field, on the west side of Kern River, comprises principally the Midway, Sunset, McKittrick, Belridge, Lost Hills, and Elk Hills districts, and a part of the Devil's Den, with a total of about 3,500 producing wells. The average depths and productions are as follows:

District	Average Depth, Feet	Average Production Bbl. per Day Per Well
Midway ...	2.200	35
Sunset ..	2.800	35
McKittrick ..	2.000	25
Belridge (six years old	1 200	9
Lost Hills (ten years old .	2.000	9
Elk Hills		
East end	3.000	When new, 900
West end	3,600	Now 400
Devil's Den .	150 500-1,600	(a)

(a) The Devil's Den section is a [illegible] shallow pool in which seepage from adjoining fields collects. No figures on production are available.

Considerable wildcatting is being done by the National Exploration Co., the Petroleum Midway Co., and the Dutch Shell interests. The Elk Hills and Buena Vista fields are extensions of the anticlinals of the earlier operations. Nothing especially new has been found so far.

McKittrick is the only place in the West Side field where the hot-oil treatment is used, as the Midway and Elk Hills oil is 20 deg. Bé. and higher, and Buena Vista, 23 deg. The gravity of the oil is apparently determined by the grain of the sand, the fine-grained beds carrying the lighter oils, although it is logical to expect light oil at the highest point in the anticline. The addition of sulphur from contact with surface water also tends to the deposition of tar; hence the position of the oil sands with relation to mineralized water has much to do with the life of a well.

Rotary drilling is practiced in fields already proved, where, by reference to peg models, the distance to the oil sands may be forecast accurately. For wildcatting, however, the rotary drill is considered inefficient and unsuitable, as, instead of using casing, the hole is mud-cemented, thereby preventing the operators from obtaining any knowledge of the core.

The fact that existing storage space is kept full and that production thereby has been limited has had much to do with uniformity of price on California oil. There have been only two 25c. reductions in price, on the basis of 16 deg. Bé. oil, since the peak during the World War.

PIPE LINES TO SAN FRANCISCO BAY

The oil from the fields controlled by the Standard Oil Co. is piped to San Pablo, in San Francisco Bay. That from the Associated Pipe Line Co. (handling the Southern Pacific and the Pacific Oil output) goes to San Francisco Harbor, as does also the product of the Dutch Shell Co. The Producers' Transportation Co., as its name implies, is a transportation company only, and is controlled by the Union Oil Co.; it delivers the product of the latter to San Luis Obispo. The Honolulu Oil Co., the Sante Fé Oil Co., and others deliver through the lines of the General Petroleum Co., which run from the Midway district to San Pedro.

Buildings on the Tupman Lease

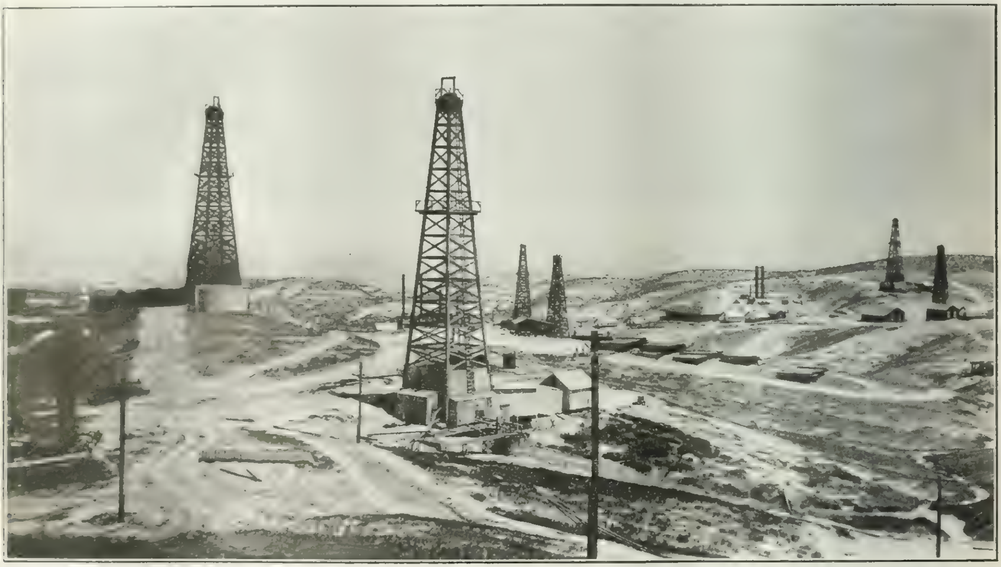
The gravity of the oil delivered at San Pedro varies from 12 deg. to 30 deg. Bé. and averages 17 deg. It is therefore necessary to operate pumping stations every fifteen miles. These pumps operate at 600 lb. pressure, with steam at 150 lb., and throw one barrel of oil per stroke. The oil, on account of its viscosity and low gravity, is heated to 140 deg. F. by exhaust steam, to facilitate pumping. The steam is afterward condensed. In the winter the temperature of the oil drops from 140 deg. F. to 80 deg. F. in transit from station to station, where it is reheated and pumped on. The temperature in summer drops from 140 deg. F. to 100 deg. F. in transit. Crossing the Tejon Pass, the pipe line gains 1,000 ft. in elevation every five miles, so that to maintain the standard 600 lb. pipe-line pressure, pumping and reheating stations are installed every five miles.

The 200-mile main line to San Pedro is 8 in. in diameter. Feeding this are 100 miles of 4-in. and 6-in. branch line. At San Pedro the oil is discharged into a concrete reservoir of 500,000-bbl. capacity, and into six tanks of 55,000-bbl. capacity each, making a total continuous reserve of 830,000 bbl. at this port. The last pumping station on the line is at San Pedro and is used for loading the boats. In addition to the 830,000-bbl. capacity of the San Pedro storage, the General Petroleum Co.'s line from Lost Hills to Vernon Refinery, at Los Angeles, has 50,000 bbl. in continuous transit.

Much trouble has been experienced from the action of alkali on the pipe lines, necessitating their frequent renewal. The Standard Oil Co. tried laying these lines in concrete, but the alkali penetrated this. A preparation called Oronite has now been developed by the Standard Oil Co., which is being used by the pipe-line companies to clean and treat the pipe, after which the line is coated with Petrolastic, another Standard Oil product, developed for this purpose. This method has proved more successful than any other, and has lengthened the life before re-treatment to five years.

Of the total production of the California fields, 1 per cent goes to the railroads for fuel and 99 per cent in the pipe lines. The companies producing light oil and needing heavy oil for fuel, or possessing no refineries themselves, often exchange with other companies that are producing heavy crude oil or a residuum from refining.

Standardization in the field has reached its highest development in the operations of the General Petroleum Co. Complete standards have been established in drilling, for tools, equipment, and speeds; in pipe-line construction and maintenance; for pipe fittings, field pumps, tool boards, and supplies; in camp construction; and in pumping stations. Each pumping station is provided with a tool board of uniform size and equipped with tools in such diversity and size as experience has indicated advisable. These tool boards are painted dark gray, with the exact outline of each tool painted in white. A glance at the board from across the room indicates instantly just which tools are in use or missing. In the supply houses, spare valves, fittings, chain tongs, and other parts and supplies are similarly indicated. These boards being exactly alike at all stations, employees become trained and habituated in the proper use and replacement of tools. A saving of time and of tools for replacement is thereby effected.



New rigs of the Pan-American Co. in the Elk Hills field

STANDARD METHODS ARE EMPLOYED

Uniform methods are also in vogue in the maintenance of power equipment. The outside installations are first painted with Sipes' oil (a low-grade raw linseed), and flake graphite is then rubbed in. This gives an attractive silver coating, impervious to the weather, which lasts for three years without further treatment than daily wiping. The inside power-house equipment is painted first with battleship-gray concrete enamel thinned down; and when partly dry, flake graphite is applied and the whole surface is polished like a pair of shoes.

Water is taken from the hot-well at 170 deg. F. and passed through a Cochrane heater and into the boilers at 210 deg. F. The General Petroleum Co. has a 4-in. water line from Belridge to Semi Tropic, a distance of twenty-five miles, which was welded by the oxyacetylene process. From Midway to the Tejon Pass the same company has a 15-in. gas line, fifty miles long, which was similarly welded. Neither of these lines has ever developed a leak, and the cost was less than that of a coupling and screw line. It appears to be the consensus of opinion that welded lines will ultimately be standard, as they eliminate patrols, "collar" leaks, and repairs. As portable electric-welding outfits develop, they will compete with the more unwieldy oxyacetylene equipment.

Until about 1919, it was customary for a pipe-line rider to "blow off" from 30 to 50 gal. of gasoline at the "drips," situated approximately twenty miles apart, every morning. As the demand for gasoline increased and threatened a shortage, absorber plants were developed to take out the gasoline. These plants consist of a vertical steel tank, into the bottom of which gas is introduced. Oil lean in gasoline is passed in at the top and down over baffles, the gas meanwhile passing up through the oil. The oil emerges at the bottom, saturated with gasoline, while the unabsorbed gas passes off dry at the top. The gasoline is then volatilized out of the oil in steam stills, and the oil is re-used. After this process had been installed, however, pipe-line leaks occurred with increasing frequency. Dry gas was observed seeping up through the ground from each joint. It then became necessary to take up and re-gasket the entire pipe line. To obviate this expense, it has become customary to pump kerosene or other light distillate through the lines for one day, at intervals, thereby keeping the gaskets sufficiently moist to prevent dry gas leaks.

In the Los Angeles field there are nine producing districts, data concerning which are compiled below:

	Field	Remarks	Average Number of Wells	Average Depth, Feet	Average Production per Day, Bbl.
	Signal Hill or Long Beach	New field due south of Los Angeles, dips east	75	2,[illegible]-[illegible]	[illegible]
(a)	Huntington Beach	East of Long Beach	180	[illegible],600-4,200 [illegible] 2,500-2,800	[illegible]
	Richfield	Southeast of Los Angeles	115	[illegible]-3,500	24[illegible]
(b)	Santa Fe Springs	New district	4 producing 46 drilling	3,800-4,000-4,500	1,743
	Montebello	Older field	170	[illegible] 2,500-3,000 [illegible] 3,000-3,500	17[illegible]
(c)	Whittier	Older field	170	2,[illegible]-3,000	21
(d)	Brea-Olinda	Older field	500	Brea [illegible] 4,000 Olinda 3,000-3,500	45
(e)	Coyote Hills	Older field	East 105 West 85	3,000-3,500 3,500-4,500	92
(f)	Salt Lake	Due west of Los Angeles	180	1,500-3,000	11

(a) None of these wells appears to have gone through the intermediate water belt.
(b) The first was a 4,000-bbl. well of 32 deg. oil. A gas zone which occurred below 2,000 ft. and above the top of the oil at 3,800 ft. has [illegible] as a source of commercial gas supply.
(c) Three distinct zones of production, with steep [illegible].
(d) The original well developed on the Brea-Olinda was in the Monterey series, north of a big east-west fault. Later developments started in the Fernando or Puente, the Puente being a transition between the Monterey and the Fernando. No water is found below 200 ft. in the Brea-Olinda field. Heavy oil occurs under low pressure and in small quantities above the brown shale parting which segregates the Fernando and the Puente.
(e) There is evidently a trough in the anticline, as the center appears barren.
(f) This is a larger area than Huntington Beach, and the wells are wider spaced.

Of these districts the Long Beach, Huntington Beach, and Santa Fé Springs are of special interest; likewise a new zone recently discovered in the Montebello field. All give promise of a large production. A new field, the Redondo, is being drilled, but no production has yet been made. A well being drilled by the Santa Fé has shown oil between the casings.

It is probable that in the Long Beach and Santa Fé Springs regions commercial gas will be developed, which will include the recovery of gasoline when possible. In some of these wells, the gas is dry and under high pressure; consequently, no gasoline is obtainable. The closer the proximity of the gas belt to the oil sands, the greater the probability of obtaining gasoline. Many of the old fields will be rejuvenated by improved methods of extraction. Some geologists estimate that up to the present time not exceeding 20 per cent of the available oil has been extracted.

The Western Union Co., in the Santa Maria field, began to take the temperature of the oil in the well, and so designed a pump plunger, based on the coefficient of expansion, to give a higher efficiency in pumping. Up to the time that company began to record temperatures, its maximum extraction had been 5 bbl. per well. With the newly designed pump this became 10 bbl.

One of the difficulties with certain oils, as in the Montebello field, is that an amorphous wax (not paraffine) deposits inside the pipe lines, and it is necessary to send a "go-devil" through the line at frequent intervals—always as often as once a month. This does not occur in the other fields. When distillate is available a passage of it through the line dissolves a portion of this wax, and postpones the "go-devil" cleaning.

In co-operation with the State Oil and Gas Department, Dr. E. Call Brown, geologist of the California Petroleum Corporation, is making a systematic study of shales by microscopic examination, and correlating the various strata. In the California oil fields the oil zone consists of sands or a series of sands lying between water strata without reference to lithology. The use of rotary drill for wildcatting is disadvantageous, and Dr. Brown is having cores taken at intervals of 50 ft. by substituting special core bits for the rotary fish-tail type. When approaching the oil sands, cores are taken every 10 ft., and then every 5 ft. The time required for the substitution of bits and taking a core is about five hours, but the method, first tried in September, 1921, has given excellent results.

The end of the core bit is usually fused and has to be cut off with oxyacetylene. This is one of the problems to be overcome. When the core barrel gets too hot, the sands are fused; or, when not fused, the oil is distilled, and consequently is not found in the core. The study of this method includes determination of the pressure to be applied, the heat conductivity of the material, and the speed of rotation. It has been found that 300 r.p.m. is too fast. A new type of disk-cutting drill is now being designed which will cut at the maximum rate under a slow speed, and deliver the core at a lower temperature, thus enabling the transverse cutting of the core and the microscopic determination of the formation passed through.

The oil industry in California is devoid of the usual excitement attendant upon the development of new fields, but work is proceeding in a scientific manner to conserve and intelligently utilize this great source of wealth and power. Abandoned wells supposed to be exhausted are carefully protected against infiltration of water, at the insistence of the state officials. Impervious plugs are inserted against the day when improved methods shall have made it practical to reopen these wells and extract additional oil.

Cash Prizes for Photographs Showing Relative Durability of Copper

As a part of a nation-wide campaign designed to foster the use of more permanent materials in building, the Copper & Brass Research Association has announced cash prizes for the best photographs showing the relative durability of materials which go into the construction of American homes.

Some idea of the cost to this country of the practice of building for speculative profit rather than for use is evidenced by the result of a statistical study just completed by the Copper & Brass association. The fire loss on the 21,000,000 American homes, insured as they are for a total of $91,700,000,000, is about $35,000,000 a year, based on figures for 1918 to 1920, inclusive. The annual rust bill, covering the renewal of sheet-metal work, principally leaders and gutters, plumbing pipe, and hardware, is twenty times that sum.

The effort to show the public the wastefulness of the use of materials which need early and frequent replacement is a part of the present intensive campaign of the copper and brass companies of the country to increase the use of those metals in domestic consumption. The photographic contest is a part of that campaign.

Fourteen prizes ranging from $150 to $10 will be awarded for photographs of copper and brass objects of utility or ornamentation, which, to qualify, must have been in use more than thirty-five years. Included are copper roofs, brass door knockers, old copper cooking utensils, and brass plumbing pipe. Fourteen additional prizes of similar amounts are offered for the best photographs showing the results of using substitutes for copper and brass.

SOCIETIES, ADDRESSES, AND REPORTS

Metallurgical Progress in the Butte District*

Butte owes its start in life as a silver camp to the fact that copper sulphide oxidizes to a sulphate which is soluble in water. The redeposition of the leached copper gave rise to the formation of the huge masses of extremely rich copper ore at comparatively shallow depth, which made the development of Butte as a copper camp a possibility at a time when ore such as is being mined today would have been worthless, and thus hastened the development of the district, and indeed the State of Montana, by many years.

The copper ores which came from the mines in those days were sent, for treatment, to Swansea in Wales, which at that time was one of the great metallurgical centers of the world.

This period, however, was of brief duration and it was not long before works were established here for the treatment of these as well as leaner ores. Many of you probably retain vivid recollections of the days of the roast heaps on the flat below the city, when the air was made almost unbreatheable by sulphur fumes and the fog in the streets was so dense as almost to hide from the view the buildings on the other side.

It is a far cry from the metallurgy of those days to the metallurgy of today, and while some of the processes in present use depend upon the same fundamental principles, others, on the contrary, make use of totally different chemical or physical phenomena.

A most striking example of this is furnished by concentration. The object of concentration is to separate the copper-bearing minerals or sulphides from the worthless rock with which they are mixed in the ore which comes from the mines. The ores which were taken from the enriched zones in the bonanza days were almost pure sulphides and contained only a trifling admixture of earthy impurities and could be smelted directly. The earthy impurities, which were present in the later lower grade ores, had to be removed before the sulphide could be smelted. This was done by taking advantage of the fact that the sulphides are comparatively heavier than the gangue, so that by washing the finely crushed ore with water in suitably constructed machines known as jigs and tables the lighter gangue was washed away, leaving the heavier sulphides containing the copper minerals behind.

While this method served its purpose fairly well, particularly as long as the ores were rich in copper sulphide minerals, its defects became more and more apparent as the ores became lower grade and the minerals and gangue became more and more intimately associated, thus making necessary finer and always finer grinding to free the mineral grains from the adhering rock or gangue particles.

Thus the so-called "slime problem," for long the *"bête noir"* of the mill man, became increasingly troublesome, and although many ingenious machines were thought out and constructed to recover the valuable minerals from the slimes, none of them really solved the problem in a satisfactory manner.

Then quite suddenly came the flotation process and solved the difficulty by making use of an entirely new principle; viz., that of surface tension. By the use of a minute quantity of oil violently churned into a mixture of finely ground ore and water, in such a manner as to entrain air in the pulp, a froth, in appearance much like soapsuds, was produced, and to the bubbles constituting this froth the sulphide mineral particles were found to be attached. The froth, although loaded with mineral, floated on the surface of the pulp and could be skimmed off.

Thus the old concentration process has been reversed, and where in the old-time jig the tailings overflow and the copper concentrate is drawn off beneath, in the modern flotation machine the copper concentrate overflows and the tailings are drawn off beneath.

The smelting of the concentrates from the flotation machines afforded another problem which taxed the ingenuity of the metallurgical engineer. These concentrates are of extreme fineness, and when they are passed through the roasting furnaces, in which a portion of the sulphur contained in them is burned out, and through the reverberatory smelting furnaces, in which they are smelted to slag and matte, much dust is made which blows out of the furnaces. Flue dust is nothing new to the smelter man, and the old furnace men caught it in huge chambers in which the velocity of the dust-laden gas from the furnaces was reduced to such a point that the dust particles were enabled to settle out like the silt out of muddy water in a still pond.

The dust from flotation concentrates, however, was of such excessive fineness as to render futile such comparatively simple and straightforward methods. At the smelting works in Anaconda there are a mile of flues and dust chambers which are utterly unable to catch the excessively fine dust coming from the furnaces receiving flotation concentrates.

Confronted with this dilemma, a new principle had again to be pressed into service, viz., the application of static electricity to the settlement of dust particles—I refer to the Cottrell process.

The dust caught by this process is not only rich in copper, silver and gold, but also contains such comparatively volatile metals as bismuth and arsenic, which the old-time settling processes were quite incapable of catching. These bid fair to prove quite valuable and arsenic is already being recovered from this dust with considerable success. The recovery of bismuth is still in the dream phase, and although theoretically possible, cannot as yet be economically carried through.

I might trace for you the growth of our blast furnaces from the early pigmy stages, when they were called cupolas and were hardly more than four feet in diameter and were charged by hand, to the last furnace to be build in Anaconda, which had a length of 87 ft. and smelted daily almost 3,000 tons of ore and flux.

This was the largest blast furnace ever built and probably the last of its kind since the changes in our methods of ore concentration have almost made the blast furnace obsolete and have brought about the pre-eminence of its old rival, the reverberatory furnace.

Many of you have probably heard reference made to so-called complex ores. Whenever the prospector encountered ore of this character, he generally quit in disgust because he knew that although such an ore might contain good values in the aggregate they were divided among so many different metals that no smelter could recover all of them, and generally the value of the recoverable metals was not sufficient to pay the cost of mining and treating. Such ores always contain much zinc, and this metal, so far from having value, was a source of expense because it made trouble in the furnaces and was therefore penalized by the smelters. The ore when concentrated yielded a concentrate containing only about 30 per cent of zinc, and this was too low grade to permit of its being shipped to the zinc smelter, which required a concentrate assaying about 50 per cent zinc.

The problem was therefore to devise a process for extracting zinc profitably from the concentrates resulting from these ores and thus, by changing the status of zinc from a penalized metal to a revenue producing metal, make the ore sufficiently valuable as a whole to make the mining of it profitable.

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*[illegible] of Mines. [illegible] Copper Min- [illegible]

Eighth Annual Meeting of A.A.E. at Salt Lake City

The American Association of Engineers held its eighth annual convention in Salt Lake City, Utah, June 5, 6, and 7. Headquarters were at the Hotel Utah, and those in charge were J. C. Ullrich, N. G. Harmon, president of the Salt Lake chapter, and C. E. Painter. Special automobile service was arranged for the visiting engineers during their stay, and they were shown points of interest in the city and vicinity. Business meetings were held, and technical subjects discussed. Some minor changes were made in the constitution of the association. A resolution was adopted favoring the passage of the Smith-McNary reclamation bill, now before Congress, and telegrams to that effect were sent to Washington. Officers were elected for the coming year as follows: A. N. Johnson, dean of the College of Engineering of the University of Maryland, president; G. E. Taylor, vice-president; and A. M. Knowles, second vice-president.

Far Eastern Bureau of Mines Established

The Far Eastern Bureau of Mines has been established at Harbin, Manchuria, China, for the purpose of promoting the mining industries in Manchuria and Far Eastern Asiatic Russia, giving information concerning mining enterprises in that part of the world, and endeavoring to attract foreign capital. Many former Russian capitalists are now living at Harbin and have properties in Siberia, in which they are anxious to interest foreign investment. P. I. Zaitzeff is managing director and F. J. Hlebnikoff is assistant mining engineer in the bureau.

MEN YOU SHOULD KNOW ABOUT

D. F. Hewett has returned to Washington after a Western field trip.

Durand A. Hall has returned to San Francisco from La Paz, Lower California.

R. H. Stewart has returned to Vancouver from an examination of mines in Texas.

G. H. Girty and **P. V. Roundy** are in southern Oklahoma on geological investigation.

C. C. Broadwater, of the Merrill Co., has returned to San Francisco from New York.

R. L. Chase, of Denver, has gone to the White Hills district of Arizona on geological work.

C. E. Knox, president of the Montana Tonopah Mines Co., has returned to Berkeley from Tonopah.

Dr. R. C. Wallace, of Winnipeg, is examining a number of properties in the Elbow Lake mineral belt.

Dr. Pentti Eskola, of Finland, will collaborate in the work of the Canadian Geological Survey this season.

Hjalmar E. Skougor, consulting industrial engineer, has moved his office from 150 Nassau St. to 287 Broadway, New York City.

Charles F. Rand was elected president, and **C. Minot Weld** vice-president of Moa Bay Iron Co., at the annual meeting June 7.

D. Dale Condit has returned from India, where he has been engaged in geological work. He will go back to India in August.

J. H. Curle, who returned recently from a journey to Morocco, the Congo, and Southwest Africa, is now on his way to Hudson Bay.

G. M. Butler, of the Arizona School of Mines, has received the honorary degree of Doctor of Sciences from the Colorado School of Mines, at Golden.

Herman Dauth, who has been chief engineer for the Tonopah Belmont Development Co. for several years, has resigned and has moved to Los Angeles.

Dr. F. J. Alcock, of the Canadian Geological Survey, has gone to spend the summer investigating the formations of the Elbow Lake mineral area in northern Manitoba.

Hugh F. Marriott, for many years consulting engineer to the Central Mining & Investment Corporation, has, according to the annual report just issued, resigned his position.

Olaf P. Jenkins is taking charge of geological investigations of the coal in Whatcom and Skagit counties, Washington, for the State Division of Geology, Department of Conservation and Development.

Byron Wilson, formerly of the engineering staff of the Federal Mining & Smelting Co. at Wardner, Idaho, has gone to Willow Creek, Alaska, where he will take over the management of the Rae-Wallace property.

E. L. Gruver is now associated with the newly formed firm of Ward, Gruver & Co., which will take over and continue the stock, bond, and investment business of Keen & Ward. Their offices are at 20 Broad St., New York City.

W. J. Olcott, president of the Oliver Iron Mining Co.; **J. H. McLean**, general manager, and **John Uno Sebenius**, general mining engineer, are making a tour of inspection of the properties of their company on the Mesabi iron range.

James S. Colbath will sail from San Francisco on July 6 for the Philippine Islands, where he will be temporarily engaged by the Benguet Consolidated Mining Co., Baguio, Benguet, as metallurgist in charge of the design and construction of a new plant.

Walter E. Gaby, until recently geologist for the Mexican Corporation, Ltd., directing exploration of a copper-zinc deposit at Teziutlan, Puebla, is returning to Salt Lake City, his home, where he may engage in consulting practice as an engineer and mining geologist.

Dr. R. B. Moore, chief chemist of the U. S. Bureau of Mines, delivered a lecture at the University College of London on May 24. Dr. Moore was introduced by Ambassador Harvey. Dr. Moore's topic was "Commercial Manufacture of Helium by the Government of the United States."

Mining and metallurgical engineers visiting New York City last week included: **U. A. Eilertsen**, of Hancock, Mich.; **William Gretzinger**, of Pittsburgh, Pa.; **Albert S. Walker**, of Buffalo, N. Y.; **T. R. Leighton**, of Cuba; and **J. C. Roberts**, of Golden, Col.

SOCIETY MEETINGS ANNOUNCED

The **Lake Superior Mining Institute** will hold a meeting at Houghton, Mich., during the week Aug. 20-26. Features of the program will be visits to the Calumet & Hecla leaching and reclamation plant at Lake Linden and to the new hoist at No. 2 shaft, Quincy mine.

The **American Institute of Mining and Metallurgical Engineers** will hold a meeting in San Francisco Sept. 25 to 29. The technical sessions will be held at the Engineers' Club, and social headquarters will be maintained at the Palace Hotel. **F. W. Bradley** has invited the members to a reception and buffet supper at his home on the first day. An excursion to the Hetch Hetchy municipal water supply is offered to a party of not more than fifty men, under the guidance of **M. M. O'Shaughnessy**, the City Engineer. Alternative trips are offered to the Selby smelter, the University of California, Stanford University, Mount Tamalpais, Chinatown, and the golf courses of the bay region. Mr. Bradley is chairman of the Committee on Arrangements. Associated with him are **Fletcher Hamilton**, **Charles W. Merrill**, **Frank H. Probert**, and **T. A. Rickard**. The members resident in San Francisco are looking forward with keen pleasure to the opportunity of renewing acquaintance with their friends from other parts of the Union, and promise to do their best to make the meeting interesting and enjoyable.

OBITUARY

W. P. Hassell, who for many years was connected with the Joshua Hendy Iron Works, died suddenly in San Francisco on June 4. He was assistant to the president of the company.

Joseph Durkee died at Reno, Nev., on June 7 aged fifty years. Mr. Durkee was geologist and mining expert in the Land Department of the Southern Pacific Co.

W. E. Harrison, seventy-three years old, formerly metal mines inspector for the State of Utah, died on June 10, at Los Angeles, Cal.

New Books

Far Eastern Iron Deposits

Geology of the An-Shan Iron Mine District, South Manchuria. By [illegible]. Published by the South Manchuria Railway Co.

This [illegible] written little monograph describes an iron district not far [illegible] of Port Arthur, which was worked in a primitive way by the Chinese [illegible] a thousand years ago, but was unknown to the Russians; and was rediscovered in 1909 through a geological survey conducted by the Southern Manchuria Railway Co. Two blast furnaces were completed in 1919, with a capacity of 250 tons each.

The district is sixty kilometers wide, and abounds in iron, although not of high grade. The ores occur in pre-Cambrian hematite-quartz schist, and are unconformably overlain by Cambrian beds. The iron-bearing rock is an intimate mixture of hematite and crystalline quartz, generally containing less than 40 per cent of iron. A limited amount of ore has been concentrated or enriched by natural processes, so as to run over 60 per cent iron. On account of the limited amount of this better-grade ore, experiments are being made in enriching the primary ores by concentrating tables and magnetic concentration. The ore formation is of enormous thickness, and is uniform.

The iron ore of the An-Shan district is held to have many points of similarity to that of the Lake Superior region, in which the lean ores are likewise mixtures of hematite and silica; there is also a suggested similarity between the An-Shan iron-bearing schist and the iron-bearing schist called "itabirite" in Brazil.

The author conjectures as to the origin of the ores that they were precipitated from solution "chemically or by the action of some organisms in the shallow waters, such as swamps or lagoons"—in other words, that they are bog-ores.

The reviewer regards the suggested origin as unlikely, for various reasons. He believes that the iron ores of the Lake Superior region were deposited in marine relatively shallow-water sediments, as iron silicate, through the action of organic matter; and this original iron silicate he was the first to discover, on the Mesabi Range. This iron silicate breaks up into iron oxide or carbonate, and silica, and thus we get the characteristic iron-and-silica banded iron bearing rocks. The iron-bearing rocks of An-Shan, judging from descriptions and plates, are similar, and may well have had a similar origin, though the higher degree of crystallinity indicates conditions more favoring metamorphism than on some of the Lake Superior ranges. According to this view, these iron ores are all ancient greensand deposits. A proponent of the bog-ore theory must point out the stages of alteration to the present type of iron bearing rocks, from known bog-ores; and a theory of an original marine deposition as iron carbonate must show such sediments now being laid down somewhere. Those geologists who are now studying especially the problems of sedimentation, can, if they will, do much to finally establish whether it is not true that some of the sediments which have been theoretically deduced as the original form of the precipitation of iron, in the Lake Superior district, for example, do not, as a matter of fact, occur in nature. J. E. S.

The Best Practice in Oil Firing

Burning Liquid Fuel. By William Newton Best. The U. P. C. Book Co., New York. $5.

This is a revised and enlarged edition of a work first published in 1913. The author dwells on the necessity of thoroughly atomizing the oil and use of a burner that will not carbonize. It is also more necessary than is commonly thought to have a burner that will make a flame to fit the combustion chamber "as perfectly as a drawer fits an opening in a desk." The book is well illustrated with photographs and diagrams, and contains chapters on the following subjects: Liquid Fuel, its origin, production, and analysis; Atomization; Oil Systems; Refractory Material; Locomotive Equipment; Stationary and Marine Boilers; and Low-Pressure Boilers and Hot-Air Furnaces; with separate chapters on the equipment used in the following industries: Commercial Gas, Sugar, Steel Foundry, Heat-Treating Furnace, Foundry, Forge-Shop, Boiler, Copper, Enameling, Chemical, Ceramic, Lime, Cement, Driers and Ore Roasters, Bread and Cracker, Chocolate, Oil and Tar Still, Incinerator, and Glass. The examples given of the use of oil burners in each of these fields are necessarily limited, for, in the 341 pages, the amount of text matter is restricted by the lavish use of cuts.

Information on Mexico for Americans

Mexican Year Book, 1920-1921. By Robert Glass Cleland. Mexican Year Book Publishing Co., Los Angeles, Cal. $7.50.

This is not a government publication and does not partake of the nature of undesirable propaganda. It is issued to meet the demand by the American public for unbiased and systematized information concerning our Southern neighbor. Each section is written by someone well qualified to discuss the subject which he covers: "History and Geography;" "Politics and Government;" "Travel and Transportation;" "Commerce and Manufacturing;" "Natural Resources;" "Public Finances, Currency and Banking;" and "Labor Conditions and Educational Systems." Three maps are included, one a large-scale reference map of the entire country, one showing the mining centers, and one showing the Panuco-Tuxpam oil fields.

Recent Patents

Metallurgy of Tungsten—No. 1,410,584. S. J. Lubowsky, Jersey City, N. J., assignor to Metal & Thermit Corporation, Chrome, N. J. Tungsten ore is roasted with a haloid salt of an alkali metal, the roast digested with a mineral acid, and the solid residue separated.

Concentrate Drier—Canadian patent No. 217,139. J. Norberg, Seward, Alaska. The patent covers an ore-concentrate drier comprising an inclined drier pan, with means for jogging it longitudinally, and a heater beneath.

Sulphur Dioxide—No. 1,417,066. G. C. Howard, Tacoma, Wash., assignor to American Smelting & Refining Co. A method of enriching a gas low in sulphur-dioxide content by vaporizing the gas from a water solution, and passing the vaporized sulphur dioxide into the low-grade gas stream. Patent No. 1,417,067 covers the process of passing a solution of sulphur dioxide counter-current to a mixture of sulphur-dioxide gas and water vapor, and then removing the sulphur dioxide from the solution. Patent No. 1,417,068 covers the manufacture of sulphur from liquid sulphur dioxide by vaporizing the liquid; mixing cold air with the vaporized gas; and reducing the mixture.

Manganiferous Gold Ores—No. 1,417,153. M. F. Fairlie and J. J. Denny, Cobalt, Ont. Manganiferous gold ores are treated with metallic iron and sulphuric acid, followed by cyanidation.

Electric Concentrator—No. 1,417,189. J. B. McCarthy, Copper Cliff, Ont. A rotating magnetic field is provided, through which the ore that it is desired to concentrate is dropped, or in which it is suspended. For experimental purposes, the rotor was removed from a suitable motor, and upon exciting the field and placing a dish of finely ground ore within the apparatus, a marked movement and separation of the mineral was evident.

Flotation Reagent—No. 1,417,261. R. Luckenbach, Brooklyn, N. Y., assignor to Luckenbach Processes, Inc., San Francisco. This covers the use of a reaction product of a bitumen and an alkali, together with sufficient acid to make the pulp non-alkaline but not sufficient to decompose the reagent. Patent No. 1,417,262 covers the use of the reaction product of an alkali and lac. Patent No. 1,417,263 covers the use of an alkali and a liquified, normally unsaponifiable, resin.

Crusher—Canadian patent No. 218,560. O. A. Ellis, San Francisco. A mill composed of a circular bed and saddle and a series of balls interposed between them, the effect being somewhat similar to that of a Chile mill, with balls instead of rollers as the crushing medium.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

IRON MINING in the Lake Superior district has quickened with the setting of ore prices following the recent reduction in freight rates.

Labor shortage is reported at some of the properties in the Michigan copper country. A growing scarceness of skilled workers is said to exist in various camps in the West also.

Nationalization of the Colorado River power project is opposed in the Southwest, prominent among the leaders being A. G. McKenzie.

Road improvements in Alaska depend to a large extent on the availability of funds. The matter has recently been before the Committee on Appropriations.

The Golden Cycle mine, at Cripple Creek, has been sold to the Carlton interests, its former owners. The deal is still to be ratified by the stockholders.

Lake Superior Iron Mining Comes to Life

Ore Prices Now Set Following Recent Reduction in Freight Rates—Labor Scarce in Places

The lowering of the freight rate on iron ore from the mines to upper Lake ports and the reduction in ore prices of 50c. per ton has stimulated shipping from all of the ranges of the Lake Superior district. The Interstate Commerce Commission, acting upon a petition of the shippers, ordered a reduction in ore rates of 10 per cent, effective July 1, but gave the roads the privilege of making the reduction June 19 if they cared to put the rate into effect earlier. Before this time the U. S. Steel Corporation announced a reduction of 10 per cent on its Duluth & Iron Range road and the Duluth, Missabe & Northern line. Most of the roads in the district followed the suggestion of the commission and put the new rates in force June 19. Dock charges have also been lowered 10 per cent at all ports on the upper Lakes.

It was almost an assured fact that the ore prices for 1922 would be lower than those of 1921, and it was generally believed that the cut would amount to 50c. The new schedule ranges from $5.05 for Mesabi non-bessemer to $5.95 for Old Range bessemer, the iron content being set at 55 per cent for bessemer and 51½ for the non-bessemer.

Soon after the new prices were announced, the Cleveland-Cliffs Iron Co., one of the largest of the independent operators, stated that a sale of 300,000 tons had been made. Other large sales have since been reported, and the ore business will be lively from now until the close of navigation in the fall. One Gogebic Range operator has announced that all ore in stock will be moved and that no limit has been placed on the amount to be mined.

There is a shortage of men on some of the ranges, and this condition will become more acute as more mines are opened. It is estimated that the iron ore mining business is now on a basis of about 75 per cent capacity, but this is certain to be increased as new sales of ore are made.

Estimates place the total tonnage to be moved this season at 45,000,000.

Westralian Mine Owners Anxious Over Wage Agreement

By Cable from Reuters to "Engineering and Mining Journal Press."

Melbourne, June 14—The mine owners of West Australia are perturbed by the new three-year basic wage agreement, providing for a reduction in wages of only a shilling a day. It is feared that the award may react seriously on the industry.

Golden Cycle, at Cripple Creek, Returned to Carlton Interests

Sold by Vindicator to United Gold Mines Co.—Deal Subject to Stockholders' Approval

The sale of the property at Cripple Creek, Col., of the Vindicator Gold Mining Co., which includes the old Golden Cycle mine, to the United Gold Mines Co., a Carlton enterprise, has been announced, pending comfirmation of the stockholders of the Vindicator company. It is not known at this time whether the sale of this property is precedent to the liquidation of the Vindicator company, as it has holdings in other mining districts. The Golden Cycle mine comes back to the Carlton interests after having been separated from them since 1915, when it was sold to the Vindicator people. Cripple Creek mining men believe that the transaction will be followed by extensive low-level development of the property.

Labor Shortage Now Noticeable in Copper Country

Copper Range and Quincy First Affected—Automobile Manufacturing Centers Attracting Men

In the Michigan copper country, the Copper Range and Quincy companies are experiencing a labor shortage, but conditions in the north end of the Lake district are more favorable. Mohawk and Wolverine manage to keep their forces intact, while Calumet & Hecla, which is operating at less than 50 per cent capacity at the mine, has had no difficulty lately in filling all places. Ahmeek also has been able to increase its underground crew.

Copper Range, which has been hit harder than Quincy, will temporarily make up the difference in production caused by its labor shortage by transferring men from development work to mining. The exodus of labor from the mines is more pronounced than usual at this time of the year, owing to the prosperity in the automotive industry, which has attracted many men to Detroit and other industrial centers in Michigan. Though there have been rumors of wage increases, it is stated on reliable authority that wages cannot be advanced on 14c. copper.

Ray Hercules Cleaning Up

Men have been put to work cleaning up and making repairs underground at Ray, Ariz., by the Ray Hercules Mines Inc., this company being the reorganization of the Ray Hercules Copper Co.

Transvaal Gold Output for May

By Cable from Reuters to "Engineering and Mining Journal-Press."

London, June 19—The Transvaal Chamber of Mines advises that the gold output in the Transvaal during May totaled 629,786 ounces.

News from Washington

By PAUL WOOTON
Special Correspondent

Coal Miners' Position Improved

Pressure Being Brought on Administration to Arrange for Arbitration of the Strike

The time element is working in favor of the miners, insofar as the coal strike situation is concerned. The point is being reached where the Lake season must start. There are signs that some of the operators in Lake territory are weakening. The position of the strikers has been made much more tenable by the unpromising outlook for any early settlement in the anthracite fields. It is already apparent that there will be a shortage of anthracite coal next winter. It requires 260 working days as a minimum to meet the demands. There are only 240 working days left at the time of this writing.

Pressure already is being brought on the administration to arrange for the arbitration of the strike. Most of this pressure has its origin in the Northwest. That seems to be the only section of the country in which any nervousness is developing.

War Minerals Commissioner Recommends Two Awards

Subject to the approval of the Secretary of the Interior, the War Minerals Relief Commissioner has recommended the following awards: Ashby, Long and Staples, West Montrose, Colo., $1,450.39; H. C. Stiles, Cartersville, Ga., $101.85 (additional award).

Disallowances were recommended as follows: Richard J. Fledderman, Yreka, Cal., no net loss; W. H. Weller, Jr., Birmingham, Ala., not commercial; Cia. Minera de Julinicum, Havana, Cuba, no reason for modifying former decision; Cia. Nacional de Cobre, Havana, Cuba, no reason for modifying former decision; Grant Chrome Co., Inc., Prairie City, Ore., not commercial; Casey, Brown and Saunders, Batesville, Ark., request for demand not established; Manganese Products Co., Modesto, Cal., no change in previous decision; J. T. Dobbins, Salt Lake, rehearing denied.

"Blue-Sky" Bill Deferred

Because of pendency of other legislation in the Senate, the Senate Committee on Interstate Commerce has decided to defer until the next session consideration of the Denison "blue-sky" bill recently passed by the House.

Snake Creek Tunnel Case Up Next Fall

The case of the Snake Creek Mining & Tunnel Co. (of Utah) vs. The Midway Irrigation Co., involving the right to percolating waters, was not reached by the U. S. Supreme Court during the term just closed. It will come up for consideration in October.

Abolish Discovery Requirement, Says Winchell

Give Locator Abundant Time to Find Ore—Prospector's Opportunites Limited Today—Mining Languishing in Northwest

From the stenographer's transcript of the recent hearing at which Horace V. Winchell appeared before the Committee on Mines and Mining of the House of Representatives, the following extract from the colloquy between Representative Rhodes, the chairman of the committee, and Mr. Winchell, is taken:

THE CHAIRMAN. In your opinion are the majority of the mine operators of the great mining Northwest in favor of this bill?

MR. WINCHELL. Decidedly and markedly so. The prospector objects to it simply because he is suspicious and uninformed, but the operators of experience are unanimously in favor of it. The operators are opposed to extralateral rights, and they recognize the futility of requiring a discovery before location.

THE CHAIRMAN. In speaking of opposition by the so-called prospectors, how do you estimate the weight of that opposition as compared with the opinions of those who favor the proposed law?

MR. WINCHELL. Numerically, so far as I have any record of their views, the prospector is multitudinous and the average mine operator has not said much about it. As a matter of fact, there is not one prospector now to ten a few years ago.

THE CHAIRMAN. That is the idea I had in mind and upon which I wanted your opinion. In truth and in fact, are there many real prospectors at this time?

MR. WINCHELL. I am in the country constantly. Whereas I used to spend night after night in the mining camps and talk with as many as thirty or forty prospectors, now I find only one or two or three in camp.

THE CHAIRMAN. Then, in your opinion, the old-time, bona fide prospector has to a very large extent disappeared in the mining regions of the great Northwest?

MR. WINCHELL. Yes, sir; because the opportunity for the discovery of mines by his own unaided efforts is largely a thing of the past. Today the prospector must be supported by a company or syndicate that is willing to spend a great deal of money to permit him to dig holes, run tunnels, etc. The prospector's knowledge, as a general rule, is not sufficient to support such a campaign of exploration.

THE CHAIRMAN. Is it your opinion that because of the universality with which prospecting has been carried on in the Northwest that there is no real, living necessity for the old-time mine prospector?

MR. WINCHELL. I am sorry to say that his opportunities today are limited as compared with twenty years ago.

THE CHAIRMAN. Are we justified in assuming that practically all discoveries have been made, and for that reason there is little left for the prospector to do in discovering surface outcroppings and other evidence of mineral deposits?

MR. WINCHELL. You are. There are within my acquaintance perhaps twenty exploration companies who have raked this country north, south, east, and west, from Alaska to the Rio Grande, searching for more mining. They started with the determination to examine everything and anything anybody could put up to them with a chance of discovering some mineral, but they have been unable to find anything.

THE CHAIRMAN. As a mining engineer, in your opinion, in what does the future success of our mining operations in this country lie—in the more rich vein deposits or in the larger and leaner deposits of mineral-bearing ores that carry a very low ore percentage?

MR. WINCHELL. In the latter, unquestionably, in a prepondering degree.

THE CHAIRMAN. If it is a fact that our future possibilities lie in the direction of developing the low-grade ores, then does the necessity for the old-time mining prospector still exist or has he practically accomplished his purpose?

MR. WINCHELL. Except as to Alaska his function has largely been exercised and used up.

THE CHAIRMAN. On the question as to the nature of our mineral deposits and their development, we take it that you are qualified to speak from the practical as well as the professional standpoint. What is the condition of the mining business in the Northwest today as compared with the period of, say, five years ago—are we going forward or backward?

MR. WINCHELL. As for exploration and the exploring of new mines, with the exception of very small and exceptional districts, we are languishing. The mining industry has made very little progress. Very few mines have been discovered within the last five or ten years.

THE CHAIRMAN. To what do you attribute that situation, to the exhaustion of the deposits or is it due to economic conditions?

MR. WINCHELL. No, sir; not wholly to one or the other, but very largely to the fact that the prospector has run over the country and cannot find anything more. And, moreover, the large companies hesitate to engage in a program of extensive and expensive investigation where the title is insecure. I have in mind a very valuable and promising placer deposit in Montana. The early mining in Montana was entirely placer mining and the gravel deposits passed underneath. Locations have been put on top of lava, which may be 200 ft. deep. Lawyers and capitalists came to Butte from the East and were prepared to undertake to develop and work those gravels which undoubtedly exist beneath that lava; however, after receiving advice from good, experienced mining men they went back home without investing.

THE CHAIRMAN. You have made a very important statement and one, I think, that deserves careful consideration. You state that the mining industry of the great Northwest is languishing; what, if anything in your judgment, can be done by legislation to stimulate the mining industry?

MR. WINCHELL. Abolish the requirement of a discovery, and give the locator an abundance of time to discover ore. Do not limit the prospects to one claim. I would extend the five-year limit to at least seven years.

MR. SUTHERLAND. Do you not think that would serve for a wealthy organization in the East to get and hold, say, a whole county?

MR. WINCHELL. There is nothing in the present law to prevent it. You are not required to make a discovery.

MR. SUTHERLAND. The agitation of the community brings that about, does it not? A man who attempts to hold ground without sinking on it and making some demonstration is so unpopular that he finally has to do something.

MR. WINCHELL. Let me tell you—I have been to Alaska many times——

MR. SUTHERLAND. Yes, I know of your splendid reputation as a mining engineer and geologist.

MR. WINCHELL. Take camps like the one at Ely, Nev., where the Nevada Consolidated mines are. I happen to know that for twenty years there was a group of locators and prospectors that sat there upon that camp each year. They would shift around all the time. Bill Jones would locate No. 1 this year and Sam Smith would locate No. 2 this year. Next year Sam Smith would locate No. 1 and Bill Jones would locate No. 2. As a matter of fact they did not do anything to develop that camp. They just retarded the development of some of the largest copper mines.

THE CHAIRMAN. What, in your opinion, could be done by legislation to revive the mining industry? I infer that what you have said applies to the pending bill. In your opinion would the passage of the Arentz bill accomplish that purpose?

MR. WINCHELL. Yes, sir.

THE CHAIRMAN. That is the thing the committee is anxious to hear you on.

Gilsonite Land Bill Introduced

A bill providing for the location, entry, and patenting of lands in the former Uncompahgre Indian Reservation, in Utah, containing gilsonite or other like substances, has been introduced in the House by Representative Colton, of Utah. It provides that the lands and the mineral therein in the reservation which were specifically reserved for future action of Congress in the Act of March 3, 1903, as containing gilsonite, asphaltum, elaterite, or other like substances, which by the Act of 1903 were authorized to be sold and disposed of in tracts not exceeding forty acres, shall, unless otherwise reserved, be immediately open to settlement, location, occupation, and entry under all land laws, according to the character of the lands or of the mineral deposits in them.

Government's Silver Purchases

Purchases of silver by the Bureau of the Mint during the week ended June 17 amounted to 201,750 fine ounces. This brings the total purchases under the Pittman Act to 114,380,506 fine ounces.

Silver Export Association Draws Comment

H. N. Lawrie Discusses Possibility of Breaking British Control of Market

The proposal to establish a silver export association has aroused considerable discussion in the silver camps, as is indicated by communications reaching the American Gold and Silver Institute. As the time grows nearer when the silver reserve, sold to Great Britain during the war, will have been replaced, attention is turning more and more to the problem of a more orderly marketing of the silver produced in the United States. One widely known mining engineer, in a letter to H. N. Lawrie, the managing director of the Gold and Silver Institute, speaking of the export association, says: "The object is worthy, but Britain controls India and the East. Her hold on silver is too tight to be broken."

In reply, Mr. Lawrie says:

"We have no precedent to guide us as to what the result would be in breaking the British control of the market by an organized effort in this country to control the sale of newly produced silver. We have, however, an example which occurred during the war which demonstrates that the holder of the silver controls the price.

"To satisfy an immediate need England came to the United States to secure the 208,000,000 oz. of silver, which was shipped to India. Had Great Britain failed in her efforts to satisfy this demand, there probably would have resulted an uprising in India which would have entailed a very heavy expense in money and lives and would have embarrassed Great Britain in her conduct of the war.

"As you know, the Pittman Act resulted from this condition and practically is a tri-partite contract between Great Britain, the United States, and the silver producers of the United States. The price of the silver sold to Great Britain under the terms of the Pittman Act was fixed by Congress only after consultation with the silver producers in the United States.

"It should be pointed out that Great Britain could obtain this large volume of silver in no other way than from the silver reserves in the United States. The conclusion, therefore, may be drawn from this incident that the buyer of silver could not exert so extensive a control over the price of silver should the bulk of the newly produced silver be marketed through a central organization which was properly financed, so that the silver could be held in storage awaiting the more active demands of the buyer, rather than forced upon the market because of the producer's need for immediate liquidation.

"The problem, therefore, is largely a question of the demand for silver, regardless of the channels through which silver may be shipped. Admitting that London is the world's financial center through which a large part of the Indian and Chinese trade is cleared, it still would be necessary for buyers to obtain newly produced silver wherewith to settle adverse trade balances in the Orient and to satisfy other currency demands."

Proposal to Pay Potash Bounty Acceptable to Producers

Senate Adopts Duty on Tungsten and Tungsten Products

Opposition from the farmers to the proposed duties on potash has been an important factor in inducing the Finance Committee of the Senate to revise further the tariff bill by placing potash on the free list and bringing in a proposal for a bounty which would offer a financial encouragement to the American industry equivalent to the protection carried in the bill passed by the House.

Chairman McCumber of the Finance Committee pointed out that if the bounty were made effective today, nothing would be paid out, as there is no potash being produced domestically. Even during the height of the war, when potash rose to $450 per ton, the maximum production was 54,000 tons, he pointed out. If the domestic production were to reach 50,000 tons a year during the five-year period over which the bounty would apply, Senator McCumber said, bounty payments would not exceed $2,500,000 for the first year; $2,500,000 for the second year; $2,000,000 for the third year; $1,500,000 for the fourth year, and $1,000,000 for the fifth year.

The representatives in Washington of the domestic industry seem to be entirely willing to accept the bounty proposal, but it is predicted in some quarters that the attitude of the potash producers will change. This is based largely on the experience with the sugar bounty. A direct payment of public money to an industry seems to arouse much greater resentment than does the payment of even a larger amount of tax at the custom house.

The Senate has adopted a duty of 60c. per lb. on the tungsten content and 25 per cent ad valorem on ferrotungsten, metallic tungsten, tungsten powder, tungstic acid, and other compounds of tungsten.

During the debate Senator Walsh, of Montana, inquired why a duty had not been placed on chrome ore. Senator Smoot, of Utah, said this is due to the fact that chrome ore production is scattered and because the American product is inferior to the imported ore.

Voluntary reductions in the duties on molybdenum and manganese alloys were offered by Chairman McCumber and Senator Smoot, for the Senate Finance Committee, and adopted. The duty on ferromanganese was cut from 2⅛ to 1⅞c. per lb., based on the metallic manganese content. Ferromanganese was defined as iron manganese alloys containing 30 per cent or more of manganese. The duty on manganese metal, silicon, boron and ferromanganese, and spiegeleisen containing not more than 1 per cent of carbon was fixed at 1⅞c. per lb. on the manganese content and 15 per cent ad valorem, instead of 20 per cent, as originally recommended by the committee.

News by Mining Districts

London Letter

The Zinc Corporation's Report—National Mining Corporation to Reorganize—South American Copper Syndicate's Smelter Ready This Fall

By W. A. Doman

London, June 9—The Zinc Corporation's report for the calendar year 1921 is, to some extent, one of regret. [illegible] operations were restricted to the zinc-treatment department, mining being impossible except at a loss, owing to low prices ruling for lead and to a continuance of the unfavorable labor conditions at Broken Hill. The directors also regret the resignation of J. A. Agnew on his acceptance of a directorship on the board of the New Consolidated Gold Fields. The financial policy adopted in the past has proved beneficial, for the cost of the tailings dumps having been written off, the profit earned from their treatment was more than sufficient last year to meet the fixed preference dividends. All arrears of the fixed preferential dividends have now been paid off. In the balance sheet the balance of claim against Aron Hirsch & Sohn stands at £62,206, but has since been settled for £25,000.

The total income of the corporation was £426,160, and the expenses were £304,659, leaving a working balance of £121,501. Appropriations, which included taxes, £22,232; preference dividends, £49,138; capital expenditure, £30,000; and depreciation, £10,000, amounted to £111,370, leaving a surplus on the year of £10,131.

Little work was done in the way of development, and this particularly applies to Nos. 11 and 10 levels, but [illegible] feet on No. 9 level averaged 11.4 per cent lead, 2.2 oz. silver, and 10.3 per cent zinc, over an average width of 5.5 ft. No mining having been done, the ore reserves remain as before, 2,115,700 tons, averaging 14.6 per cent lead, 2.6 oz. silver, and 9.4 per cent zinc, excluding the zinc lode. In the zinc concentrator 380,040 tons of tailings and slimes was treated and yielded 104,215 tons of zinc concentrate, 9,969 tons of lead concentrate, and 9,166 tons of zinc slime. The zinc concentrate, which was 27.4 per cent of the weight of ore, contained 82.1 per cent of the zinc, 51.4 per cent of the silver, and 39.9 per cent of the lead. The costs averaged 12s. 10d. per ton treated, against 14s. 7d. in 1920.

The National Mining Corporation has, so far, had a disastrous career. Its issued capital is £1,238,572; its investments have cost £1,055,629, and the balance sheet made up to Dec. 31 last shows a depreciation of £639,110. This is not all loss, and part of it will be recovered. Meantime, it is necessary to reorganize the capital, and it is proposed to cut down the nominal value of the shares from £1 to 8s, with 4s. paid, thus reducing the liability from 10s. to 4s.

The Mount Elliott position is still far from clear. Contradictory statements have been made from time to time concerning the provision of fresh capital. "First they would, and then they wouldn't." Now, owing to failure to find new money, brokers in Paris who had speculated on the expansion of operations have got into difficulties, and have had to be helped. It is not easy to arrive at the true position.

A long report upon the property of the South American Copper Syndicate, Ltd., by Charles H. Stewart, has been issued to the shareholders. The report states that within the company's forty square miles of freehold, the known orebodies occur in a zone three and one-half miles long, but all of the present workings are within an area of less than one square mile, of which the Main Area mine has been developed and partly expoited over a total length of 2,220 ft. The computation of "probable" ore, 603,350 tons, deals only with the most southerly 1,200 ft.

The new smelter is expected to be in operation in September, and an output and treatment of 6,000 tons of 5-per cent ore per month is estimated to yield, with copper at 13.15c. per lb. net, a monthly profit of £7,211. Each variation of 1c. in price represents £1,286 per month on this output, facilities for increasing which are to be provided.

JAPAN

March Output of Metals Reported by Department of Commerce

Tokyo, May 9—The total output of metals during March, according to the returns of the Department of Agriculture and Commerce, was as follows:

Classes	*March*	*First Three Months 1922*
Gold	189,689 *momme* (a)	505,290 *momme* (a)
Silver	1,169,146 *momme* (a)	8,169,339 *momme* (a)
Copper	7,478,163 *kin* (b)	20,086,623 *kin* (b)
Iron	3,252 tons	8,119 tons
Coal	3,211,734 tons	6,155,971 tons
Petroleum	141,264 *koku* (c)	408,582 *koku* (c)

(a) *Momme* = 0.1325 oz.; (b) *Kin* = 1.325 lb.; (c) *Koku* = 39.7033 English gallons.

Compared with the returns for the corresponding period of the preceding year these figures show an increase of 15.4 per cent in gold, and of 0.5 per cent in coal, and a decrease of 8.8 per cent in silver, 7.1 per cent in copper, 19.6 per cent in iron and 12.7 per cent in petroleum.

Mount Lyell's Nodulizing Plant Burned

By Reuters Agency

The nodulizing plant of the Mount Lyell Mining & Ry. Co., Ltd., Mount Lyell, Tasmania, was destroyed by fire June 3. The loss is not expected to affect smelting operations seriously, as the erection of the new Dwight Lloyd sintering plant was completed May 20 and is now in operation.

Johannesburg Letter

Testimony on Conditions Taken by Mining Industry Board

By John Watson

Johannesburg, May 9—The feature of the week has been the continued sittings of the Mining Industry Board. In the course of these, Errol Hay, technical adviser to the General Mining and Finance Corporation (the "Albu" group) said that the Albu group controls six producing and four non-producing mines. If the price of gold fell to normal without any corresponding reduction of costs, only one mine, the Meyer and Charlton, would be able to continue work, and the remaining mines, which employed 994 whites, would have to close down. Even at the present price of gold, 93s. 6d., and under December costs, three of the mines, employing 596 whites, would be unpayable, and a fourth (the Aurora West) would show only a nominal profit.

The statement given in the following table, prepared by the Witwatersrand Native Labor Association, was handed in by the Chamber of Mines, showing the total number of natives employed, exclusive of natives re-employed at the same mine on the expiration of their original contracts:

	East Coast (Portuguese Territory)	British South Africa	Total
1917	57,296	153,260	210,556
1918	56,796	141,170	197,966
1919	63,144	167,286	230,430
1920	76,439	134,216	210,655
1921	64,577	149,487	214,064

Among the natives who came to the mines under indenture the average period of indenture of East Coast "boys" is 313 shifts, and the average period among British South African natives is only 166 shifts.

A fall of rock in the Battery section of the West Rand Consolidated on May 2 injured sixteen natives.

A fire recently broke out in the Kimberley shaft of the Roodepoort United Gold mine.

The Transvaal gold output for April was declared by the Chamber of Mines on May 10. Thirty-eight mines on the Rand and a smaller number in the outside districts have produced 511,388 oz. of fine gold of a value of £2,352,155. As compared with December 1921, the latest previous complete month worked, the April return shows a decrease of nearly £1,000,000 in value. Among the largest individual mines, Government Areas produced 47,283. Crown Mines 43,988, and New Modder, 28,801 oz.

It is satisfactory to note that natives are returning freely to the gold mines, the net gain for the first ten days of May being 7,900. For April, the net gain was 13,741. Roughly speaking, for every ten natives employed underground one white man is engaged in supervision.

ONTARIO

Dome Doubles Dividend Rate—Lake Shore Showing Well

Cobalt — Nipissing's cash in banks, bonds and bullion at June 10 were $4,510,129.20. During May the Nipissing mined ore of an estimated net value of $197,715 and shipped bullion of an estimated net value of $250,750. The month's silver production was valued at 72c. per oz. Underground work was heavier than usual, and the mill treated more than an average tonnage of good ore.

The shaft on the J. B. 4 La Rose Extension claim is dewatered almost to the 350 level, where considerable exploration work will be done.

The O'Brien mine, which sent a car of 64,000 lb. of ore to the Deloro smelter, was the only shipper in the week ended June 9.

Kirkland Lake—The sinking of the Bidgood shaft to 600 ft. is now proceeding.

The Lake Shore mine continues to show excellent results, and it is understood that its treasury contains $350,000, as operations so far this year have been profitable and no dividends have been paid as yet this year.

Porcupine—Dome's dividend rate has been doubled to $2 per share a year. The increase was announced at the annual meeting of the shareholders, on June 13 in Toronto. The new rate will be effective with the next dividend, which is payable July 20. Two dollars per share yearly will mean the disbursement of $953,334 in dividends. Each dollar repayment of capital calls for $476,667, and shareholders are assured of $1 capital repayment during the fiscal year, and good prospects of another $1. Last year's net profit was $1,244,000 and the present net profits are running at the rate of $2,000,000 yearly. It was reported at the annual meeting that the net profit in May was $183,548, with recovery of $11.11 per ton.

It is stated by a director of the Porcupine V. N. T. that no arrangements have been made for refinancing of that property.

BRITISH COLUMBIA

Work Resumed at Rock Candy Mine

Grand Forks—Operations are being resumed at the Rock Candy flourspar property of Consolidated Mining & Smelting Co. The plant has been inactive for some months, but it is understood that a contract has been entered into for disposal of the product, which insures operation for a considerable period, and it may be that production will be maintained indefinitely.

Sandon—The Noble Five property has been examined lately. It is reported that negotiations for its sale are being conducted.

Kaslo—One of the leasers working in the upper levels of the old Whitewater mine has opened up a splendid showing of high-grade zinc ore. Although the discovery has been made only recently, the tonnage now in sight is estimated as being in excess of 2,000. Samplings over a 7-ft. face give returns of 58 per cent zinc, the highest grade of zinc yet met at any mine in the Slocan or Ainsworth Mining Divisions, with the possible exception of the Lucky Jim, which long held the record as being the highest grade zinc property in British Columbia.

New Denver—Following the announcement that the Consolidated zinc plant at Tadanac is in a position to accept custom zinc ores, a considerable tonnage of that material is beginning to move from various properties in the district. Most of this is an accumulation of concentrate turned out over two years ago. An instance of this is furnished by the Silversmith mine, at Sandon, which has had about 2,000 tons of zinc concentrates piled up for some time awaiting a market. The Rambler-Cariboo, above Three Forks, and the Bosun, near this point, have also had accumulations. While the returns from such material will not reach a high figure per ton, realization of some income from this source will prove an acceptable aid to finances after the period of prolonged depression.

Nelson—On account of claims made that the act incorporating professional mining engineers of this province has been a handicap to prospectors and small operators, the Mining Association of the Interior of British Columbia has asked the provincial government to amend the act of incorporation so that mining, milling and smelting operations should not come under its provisions.

MEXICO

Money Reported to Be Still Scarce in Republic

No pronounced improvement can be noted in general conditions in Mexico in the last thirty days, says Assistant Trade Commissioner Bushnell in a cable despatch to the Department of Commerce. The banks report that collections remain only fair and deposits have not increased during the month. Money is still scarce, with no relief in sight.

Consul Thomas D. Bowman, at Monterey, reports that money is still scarce in that district. As an example, a mining company recently sold its notes bearing 12 per cent interest at 80c. on the dollar in an effort to obtain capital to finance the reopening of the mine, which is a proven property of value. The banks in the Monterey district are practically limiting their operations to dealing in exchange. In Guadalajara, the money situation is much the same, according to Consul Andrew J. McConnico. In some cases, interest rates are as high as 3 per cent per month, whereas, ordinarily, the rates vary from 18 to 24 per cent a year.

The banks are having difficulty there in making collections and for that reason are not eager to grant loans. It is asserted by some persons that fully eighty per cent of the outstanding loans of the Guadalajara sector have been granted extensions, owing to the inability of the debtors to discharge their obligations, which in turn is due mainly to the prevailing low prices of all farm produce.

A contributing cause to the scarcity of money is the general hoarding of gold. Many of the more conservative depositors have withdrawn their funds from Guadalajara banks and have refused to redeposit them. The sudden changes in the money market in Mexico City which have occurred shortly before the monthly period for the payment of oil taxes will be avoided, it is hoped, by a recent circular issued by the Mexican Treasury Department requiring payments, heretofore made on the 25th of each month, in three installments, thirty per cent on the 10th of each month, thirty per cent on the 20th, and forty per cent on the 25th.

The demand for merchandise has not yet been stimulated, so that importers are placing orders for only the most necessary replacements.

Durango

Bacis Company Working 300 Men—Knotts Tests Gardenia Claim at Guanacevi

By Alberto Terrones

Santiago Papasquiaro — The Bacis country is reported quiet. The Bacis Gold & Silver Mining Co. had to stop work during the revolution. It resumed early in 1917. W. R. Bawden is in charge as general manager. At present 300 men are working at the mines and mill. The property is equipped with a 200-hp. low-pressure turbine, and is short of power, owing to the dry weather. The mill is being remodeled, and new machinery is on the way. Forty stamps and Wilfley tables are in use. The sands are leached and the slimes treated by cyanidation. The capacity of the mill, after the improvements are finished, will be 3,000 tons per month. The mill products are turned into bullion and shipped in the form of silver bars, about thirty bars being shipped every month. The mill extraction ranges from 85 to 90 per cent, and the milling cost is 6 pesos per ton. The Bacis ores are not amenable to flotation. The mine is 1,500 ft. above the mill, and the ores are transported by cable to the mill. The mining cost is 5 pesos per ton. No timbering is required and the mine is dry. The average grade of ore is 13 oz. of silver per ton.

Guanacevi—Gerónimo Elizondo is working the Mexican mine where a bonanza was recently discovered. He has already invested 80,000 pesos in development work.

E. F. Knotts and Manuel González Peña will undertake bore-hole prospecting on the Gardenia claim, west of the Soto Group, to determine the nature of the deposits in the western part of San Pedro.

ARIZONA

Nationalization of Colorado River Power Project Opposed by A. G. McGregor

Phoenix—A. G. McGregor is [illegible] the proposed nationalization of the Colorado River water resources and hydro-electric development opportunities. He is making a campaign throughout Arizona in favor of a plan by which the state is expected to finance the great works needed and to benefit especially from the sale of power. He estimates that the necessary funds could be secured by means of state bond issues, with low interest charges, these issues backed by Arizona power consumers. It happens that these power consumers mainly would be mining corporations, which now are paying anywhere from $50 to $[illegible] per horsepower per year. Up to [illegible] hp. Mr. McGregor figures that profit could be secured at $25 per hp. a year. Up to 500,000 hp. he would start the cost at $15 and from there up to [illegible],000 hp. at $12. At such cost, he expresses belief that electric current profitably might be used for the reduction of ores and in metal manufactures, as well as in ordinary mechanical and manufacturing industries. He disclaims any intention, however, of confining the benefits to Arizona, and suggests that power users in California or other states might join the power users' association. It is proposed to create an association that would market the bonds, do the engineering, provide and market the power and pay the costs, including interest, until the enterprise should become productive. It is assumed that under this plan the state eventually would be paid out and would have the water power works as a continuing asset of tremendous value.

Mr. McGregor believes the Lee's Ferry dam site, now claimed by the Edison Co., to have features superior to those of the Boulder Canyon dam site, which is favored by the Reclamation Service. He estimates that at least 6,000,000 hp. can be secured within the Grand Canyon, though the process of its utilization would be a continuous one as necessity arose for generation of power.

Globe—Inspiration is employing more men (about 2,000) than ever before in its history. Miami has a payroll of 1,300 men and Old Dominion about 750. The total number employed in the two camps is about 5,000.

Arizona Commercial is operating at about three-quarters capacity and producing smelting ore and concentrates at the rate of 750,000 lb. a month.

Inspiration is starting a new town for its employees near its main shaft, about three miles from Miami.

Ray—There is a local report that the mill of the new Ray Hercules Mines, Inc., successor to the Ray Hercules Copper Co., is to be enlarged to 1,800 tons' capacity and the process changed somewhat.

CALIFORNIA

Conditions in the Dredging Districts—North Star Producing Steadily—Randsburg Continues Active

San Francisco—Gold dredging on the Trinity River, Trinity County, is in a more or less stationary condition. Two new dredges are under construction. One is being erected by L. Gardella on a bar on the south side of the Trinity a mile and one-half below Lewiston. The other dredge is being erected by the Lewiston Dredging Co. at the Martin Ranch above Lewiston. The pit has been excavated, derrick erected, and hauling of the machinery and hull materials is under way. The area to be dredged is approximately 700 ft. wide and a mile long. The Valdor dredge has been dismantled and its parts are to be used in the construction of the new dredge. The only dredge in operation is the 11-ft. boat of the Trinity Dredging Co. operating about five miles above Lewiston.

The **Pacific** Dredging Co., a subsidiary of the Yukon Gold, has shut down its all-steel dredge at Carrville and will dismantle it preliminary to shipping it to the Federated Malay States for use in tin dredging. The Estabrook dredge at Trinity Center has been shut down for a considerable period and may be started again within several months. Thus one dredge is in operation, one is being dismantled, one is shut down, and two dredges are under construction. In the Shasta County center near Redding, L. Gardella has two dredges operating on Clear Creek, and the American Gold Dredging Co. has one dredge in operation on the Sacramento River not far from Redding.

Small operations in Siskiyou, Shasta, and Trinity counties continue. In the Washington mine, at French Gulch, a rich strike has been reported. L. W. Vaughn has located six copper claims on the Pit River, twenty miles from Copper City, in the Canyon Creek mining district. The Gold Dollar Mining Co. has been incorporated to work a mine near the old town of Shasta.

At Grass Valley, the North Star is reported to be producing at the rate of $100,000 per month. At the Alcalde mine a drift is being driven and a shaft will soon be sunk. At the Bath mine, in the Rough and Ready district, a 500-ft. adit has been started to intersect the orebody at a depth of 700 ft. below the present workings. A new ledge has been struck in the Finney mine, near Downieville.

The Red Wing mine, near El Dorado, will be put in operation. The plant is being put in condition.

The California Rand Silver Co. extended its development 1,572 ft. and mined 9,330 tons of ore during May. The capacity of the mill is to be increased to 200 tons per day. During May, 172 tons of concentrate were shipped to the smelter. Twenty cars of ore and four cars of concentrates are expected to be shipped in June.

NEVADA

Rochester Silver's May Profits About $10,000

Peavine—In the Standard Metals mine the vein has been cut on the 400 level and drifted on, along the foot wall, for 35 ft. in ore of $20 grade. The oreshoot is said to be showing up better on the 400 than on the 300 level.

Rochester—The May bullion production of the Rochester Silver Corporation was $48,903, and net profits will be about $10,000. Tonnage treated was 4,615, of an average value of $13.32 per ton. The Rock tunnel has cut the footwall branch of the West vein 70 ft. below the nearest workings, and where cut the vein shows 3 ft. of ore of better than milling grade.

Eureka—Work has been resumed in the Eureka Holly and Bullwhacker workings of the Eureka Holly Consolidated company. Repair and development work has been started and a 100-ton ore shipment is to be sent to an Idaho plant which uses the oil flotation process similar to the one which the Eureka Holly Consolidated Company expects to use in its new mill, now under consideration.

The Eureka Croesus has resumed work after a shutdown of about three weeks due to hoist troubles.

Pioche—The Bristol Silver Mines Co. is to increase its underground operations materially. The shaft is completed; also the 380-ft. tunnel which makes connections with the old 100 level on which there still remains a large tonnage of silver-copper ore. About sixty tons daily is being mined from the 900 level.

The Amalgamated Pioche M. & S. Corporation has recently completed the shipment to the Garfield smelter of 400 tons of iron concentrates stored from prior operations at the mill. The material was shipped to the A. S. & R. at Garfield, Utah.

The Highland district is active owing to the increased shipments from the Mendha mine, now producing about fifteen tons daily. High-grade silver-lead ore is being loaded for shipment from the Comet district, where considerable new work is being done. Properties now working include the Stella, the Lyndon, and the Panaca mines.

COLORADO

U. S. G. S. to Survey Ashcroft-Woody Section—Operations at Cripple Creek

From Our Special Correspondent.

Aspen—G. F. Loughin, of the U. S. Geological Survey, together with several assistants, will arrive in Aspen soon, to begin a survey of the section between Ashcroft and Woody preliminary to mapping the district. Special attention will be given the Richmond Hill and Aspen districts.

The investigations are for the purpose of completing the Spurr survey of what is generally termed the Aspen district, but was discontinued at a point a little north of the Little Annie. Much importance is placed upon developments awaiting a more complete knowledge of geological conditons of Richmond Hill, on which are located the Hope, Little Annie, Hurricane, and other important mines, as well as the territory south to Ashcroft, including the Mount Hayden section.

Cripple Creek—The following is a list of the principal producing mines in the Cripple Creek district. Practically all those operating and producing some ore: Ajax, Cresson, Granite, Modoc, Dr. Jack Pot, Mary McKinney, Portland, Vindicator, Rose Nicol, United Gold Mines, Jerry Johnson, Isabella, Stratton Cripple Creek Mining & Development Co., Gold Sovereign, and Dante.

The tonnage at the Golden Cycle mill has increased from 19,000 tons to a present average of 22,000 tons per month.

The Independence mill of the Portland Gold Mining Co. has been treating from 20,000 to 30,000 tons of low-grade ore per month. There is also quite a good deal of activity in the way of surface prospecting and leasing in general. The Cresson production at present is about 10,000 tons per month.

UTAH

Utah Metal & Tunnel Co. May Resume Operations Soon

From Our Special Correspondent.

Eureka—Ore shipments from the Tintic district for the week ended June 10 amounted to 150 cars, compared with 168 cars the week preceding, this falling off being due to the temporary suspension for repairs at the Tintic Standard mill, and, at the Grand Central, for repairs to the cable. Shippers were: Chief Consolidated, 52 cars; Tintic Standard, 36; Iron Blossom, 11; Eagle & Blue Bell, 10; Victoria, 9; Colorado, 9; Grand Central, 6; Gemini, 4; Mammoth, 4; Centennial-Eureka, 2; Bullion Beck, 2; Dragon, 1; Sunbeam, 1; Swansea, 1; Julia Lane, 1.

Park City—Shipments for the week ended June 10 amounted to 4,299 tons, compared with 2,505 tons the week preceding. The large tonnage is due to heavy shipments from the Ontario tailings dump. Shippers were: Ontario, 2,044 tons; Silver King Coalition, 888; Park-Utah, 870; Judge, Daly, and Daly West, 497. Now that the new mill of the Silver King Coalition is operating, the mining of high-grade ore from the new oreshoots is less hampered by accumulations of milling ore in the mine. During the period when no ore could be milled, there was stored in the mine about 6,500 tons of low-grade ore.

At the Park-Utah's annual meeting, held in New York, directors elected were: G. W. Lambourne, G. D. Blood, J. S. Bransford, W. M. Bransford, Moylan C. Fox, Otto Luedeking, and Edward Rosenbaum.

Bingham—According to a recent statement by the Utah Metal & Tunnel Co. this company may resume operations as soon as there is prospect of profitable operation.

MICHIGAN

Calumet & Hecla Tonnage Increasing—Developments in Mayflower-Old Colony More Encouraging

By M. W. Youngs

Houghton—Through the practice of close selection, Calumet & Hecla rock is averaging almost 40 lb. to the ton, which is considerably better than in 1921 or 1920. Tonnage from the conglomerate shafts is slowly but steadily increasing. Eight shafts are hoisting rock.

Extensive repairs which have been under way for more than a year in No. 1 shaft, North Kearsarge branch of the Osceola Consolidated, are nearing completion. No decision, however, has been reached as to the resumption of mining.

Allouez remains idle, but the mine is being kept fairly dry and could be put in readiness within a few weeks' time.

Developments in Mayflower-Old Colony are more encouraging at present than for some time. The favorable mineralization in the 1,400 and 1,700 level drifts continues and it would appear that many of the difficulties encountered in the faulting of the ground have been largely overcome. At the bottom level a drift is proceeding north in a well-defined vein, well charged with copper.

Ahmeek is averaging about 1,600 tons a day from its operating shafts, Nos. 2 and 4. Nos. 1 and 3 shafts are still held in reserve.

Isle Royale now has some miners on contract and since the adoption of this system the rock tonnage has increased, enabling the mill to operate on schedule, four days and nights each week.

Menominee Range

Caspian Mine Working—Homer Closed—Chapin and Aragon Shipping

Iron River—Operations have been resumed at the Caspian mine of Pickands, Mather & Co. This is the largest underground mine in the Iron River field.

A shortage of men is reported in Iron River and in some of the other mining towns in the Michigan district. Many departed during the dull period and few have returned.

The Homer mine, operated by the Buffalo Mining Co., has been closed because of litigation started by the fee holders. It is claimed that the ore has been improperly mined, and that sand has been allowed to mix with it so that a large quantity now in stock is almost unsalable. The miners have been transferred to the company's Cardiff property, in the same district.

Iron Mountain—Shipments from stockpile and pocket have been started at the Oliver Iron Mining Co.'s Chapin and Aragon mines. The company is also shipping from all of its other mines in Michigan.

Crystal Falls—The M. A. Hanna Co. has suspended all work at the Carpenter mine. The dull condition of the ore market is given as the reason.

MINNESOTA

Vermilion Range

Chandler Mining Co. at Full Capacity—Armstrong Bay to Make First Shipment

Ely—The Chandler Mining Co., operating the Chandler No. 1 mine, has started production at capacity by additional crews. It is expected that the daily hoist will be approximately 1,000 tons per day.

The employment situation has practically reversed itself, and the companies are seeking labor for their underground and pit crews. At present approximately 9,000 men are employed, compared with 16,000 men in normal times.

Tower—The Chippewa Iron Mining Co. expects to make its initial shipment this season from its Armstrong Bay property. The mine is practically ready for production and the four and one-half mile spur from the Duluth & Iron Range R.R. is almost completed.

Mesabi Range

Hibbing—The Oliver Iron Mining Co. has increased its ore operations in this district. At present three shovels are loading ore in the Hull-Rust pit, one in the Sweeney pit, one in the Morris pit, one in the Sellers pit and two in the Kerr pit.

The Pickands, Mather Co. has also started underground operations at the Albany and Utica mines. The Utica is one of the largest underground mines on the range.

The Webb mine, operated by the Shenango Furnace Co., has started to hoist ore. The company has also put its screening plant in operation.

Operations have been curtailed at the Leetonia mine, of the Interstate Iron Co. owing to the inability of the furnaces to which it ships, to obtain a sufficient quantity of coke due to the coal strike. This is the first known instance where the coal strike has affected operations on the Mesabi Range.

Nashwauk—The York mine, which is operated by the Coates & Tweed Co. has started ore shipments from its open pit. The concentrator has also been started.

Bovey—The Pickands, Mather & Co. has started work at its Danube property, both in the open pit and at its washing plant. Two steam shovels are now loading ore, which is being sent to the concentrator for treatment.

Coleraine—The Canisteo and Holman pits have again been placed in operation by the Oliver Iron Mining Co. Two steam shovels have been placed in the ore at both of the properties. To handle the wash ore from the properties in this district, two units of the large Trout Lake concentrator have been put in operation.

Eleveth—The Bowe-Burke Iron Co. has started shipments from its stock piles at the Mariska and Burns properties. Regular production from underground operations has not begun.

THE MARKET REPORT

Daily Prices of Metals

June	Copper N. Y. net refinery* Electrolytic	Tin 99 Per Cent	Tin Straits	Lead N. Y.	Lead St. L.	Zinc St. L.
15	13.50	30.75	31.50	5.75	5.60	5.375@5.40
16	13.50	30.875	31.50	5.75	5.55@5.60	5.375
17	13.50	30.875	31.50	5.75	5.55@5.60	5.35@5.375
19	13.50	30.50	31.125	5.75	5.55@5.60	5.35
20	13.50	30.75	31.50	5.75	5.55@5.60	5.35
21	13.375@13.50	30.75	31.375	5.75	5.50@5.60	5.35

*These prices correspond to the following quotations for copper delivered: June 15 [illegible] June 21, 13.625@13.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

June	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic	Tin Spot	Tin 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
15	61⅞	62⅛	69	151¼	152¼	24⅜	23⅜	27¾	27¾
16	61⅞	62⅛	69	152½	153½	24⅝	23½	27⅞	27¾
17	...	...		....	....	...	...	...	...
19	62¼	62½	70	152⅝	153¾	24⅝	23⅝	28	27⅞
20	62⅛	62½	69	152⅜	153⅜	24½	23⅝	27⅞	27¾
21	61¾	62⅛	69	152⅜	153⅜	24¾	23⅝	27¾	27⅝

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

June	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London	June	Sterling Exchange "Checks"	Silver New York Domestic Origin	Silver New York Foreign Origin	Silver London
15	447¼	99⅝	71⅞	36	19	440½	99⅝	70⅞	36⅛
16	446¾	99⅝	71⅛	35¾	20	439¾	99⅝	70⅝	36⅛
17	443	99⅝	71	36	21	442	99⅝	70⅜	35¾

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths of a cent premium.

Metal Markets

New York, June 21, 1922

The week has again been a quiet one, with a tendency toward price recessions. Without a doubt, the continuance of the coal strike is having the effect of making consumers whose fuel supply is not assured somewhat hesitant in providing for future requirements. The general industrial condition of the country continues favorable, and metal is going well into consumption.

Transatlantic freight rates continue unchanged at $4 per long ton to the principal European ports with the exception of Antwerp and Rotterdam, to which the rate is $3.50. Transpacific rates to Hongkong and Kobe are $8.

Copper

Domestic buying has been on an extremely small scale during the week, this being responsible for the decline in prices. Some producers with little copper to sell are continuing to maintain the 13⅞c. delivered price, but most selling agencies have quoted and obtained 13.75c., at least up to Monday night. Some consumers have been actively scouting for 13.5c. copper, but so far we have no reports of any producer or dealer willing to come to that level where the average freight rate applies. Yesterday and today, however, at least one producer was willing to come to the 13.625c. delivered price, and some sales have been made at that figure. There is no particular pressure on the market and the reaction is not likely to carry the price much below present levels.

Export demand has been fair at prices from 14⅛c. c.i.f. received by the Copper Export Association to about three-eighths cents less, obtained by outside interests.

Lead

The official contract price of the American Smelting & Refining Co. continues at 5.75c., New York.

Lead has continued in good demand, and the price quoted by the leading interest has generally obtained in the East. Corroding grades have been held at one-tenth of a cent premium, and several sales of good tonnages have been made. In the middle West the price has shown a tendency to sag. Most of the business has been booked at about 5.60c. St. Louis and 5.70c. Chicago, though one producer was willing to sell at 5.55c. St. Louis up till yesterday, and did some business at that level. Today lead might be obtained at 5.50c. in this direction, but other quotations as high as 5.60c. are still being made.

Some excitement was caused by the reported arrival of 700 tons of lead from Liverpool on the "Adriatic" Monday. However, this was really remelted shrapnel balls, and it is said that it should have been listed as antimonial lead or type metal.

Zinc

The market has been quiet, with one of the leading interests exerting some pressure to sell. The price therefore has declined somewhat, though the statistical position of the metal is excellent and a decline of any proportions is not to be expected. High-grade continues to be quoted at 6.25c. delivered in the East, and New York prices on Prime Western are 35 points in advance of the St. Louis quotations.

Tin

Violent fluctuations in sterling exchange have had an unsettling effect on the tin market during the last few days. Consumers have not been buying actively, but business has been of fair proportions, especially between traders. Tin for actual spot delivery has been closely held at premiums of from one-eighth to one-quarter cent over what metal for shipment in a few days has brought. Electrolytic has brought the same prices as Straits. Tin for forward delivery (three months) has been quoted at approximately the same prices as those asked for near-by, though a discount of one-eighth cent has, in some instances, been made.

Arrivals of tin, in long tons: June 15th, London, 250; Straits, 25; 17th, Straits, 2,475; 19th, Liverpool, 125.

Gold

Gold in London: June 15th, 92s. 4d.; 16th, 92s. 3d.; 19th, 93s. 6d.; 20th, 94s 5d.; 21st, 93s. 3d.

General stock of money in the United States, June 1, 1922: Gold coin and bullion, $3,774,470,231; standard silver dollars, $378,371,851; subsidiary silver, $271,658,822; United States notes, $346,681,016; Federal Reserve notes, $2,511,810,960; Federal Reserve Bank notes, $87,607,400; National Bank notes, $755,900,702; total, $8,126,500,982. Circulation per capita, $48.78. The gold and silver reserves increased $15,000,000 in the last month, and the outstanding notes decreased $50,000,000.

Foreign Exchange

Sterling has fluctuated widely during the last week, following the political news from Europe. On Tuesday, June 20, francs were 8.71c.; lire, 4.89c.; marks, 0.3175c.; and Canadian dollars, 99.04c.

Silver

Silver prices continued downward last week on account of the fall in sterling and Chinese exchange rates. The market has been featureless, but the tone is steady despite lower prices. This steadiness, however, is due more to lack of offerings than to the strength of the demand for silver.

Mexican Dollars — June 15th, 55; 16th, 54⅝; 17th, 54¼; 19th, 54¼; 20th, 54; 21st, 53⅞. These quotations refer to the old Mexican peso or "Mexican Sun Dollar." The current silver peso contains only 12 grams of silver and is worth about 27c. when silver is 70c. per oz. Quite a large quantity of the old pesos are still being received in the New York market from the Mexican border.

Other Metals

(Quotations cover large wholesale lots unless otherwise specified.

Aluminum — 20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17.25@18.25c. for 98@99 per cent virgin grades.

Antimony — Chinese and Japanese brands, 5.10@5.125c. W.C.C., 5.75@6.25c. Cookson's "C" grade, spot, 8.75c. Chinese needle antimony, lump, nominal, 3.5@4c. per lb. Standard powdered needle antimony (200 mesh) nominal at 5¾c. per lb. White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, 6.75@7c.

Bismuth—$2@$2.10 per lb.

Cadmium—$1.20@$1.25 per lb.

Iridium—Nominal, $150@$170 per oz.

Nickel—Standard market, ingot and shot, 36c.; electrolytic, 39c. Outside market quiet at 29@32c. per lb.

Palladium—$55@$57.50 per oz.

Platinum—$87.50 per oz.

Quicksilver—$55 per 75-lb. flask. San Francisco wires $55.30.

The prices of **Cobalt, Magnesium, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten** are unchanged from the prices in the issue of June 3.

Metallic Ores

Lake Superior Iron Ore—Mesabi non-bessemer, $5.05, f.o.b. Lake Erie docks.

Chrome, Magnetite, Manganese, Molybdenum, Tantalum, Titanium, Tungsten, Uranium, Vanadium, and Zircon ore are unchanged from the quotations published June 3.

Zinc and Lead Ore Markets

Joplin, Mo., June 17.—Zinc blende, per ton, high, $33.85; basis 60 per cent zinc, premium, $34; Prime Western, $33@$32.50; fines and slimes, $32@$30; average settling price, all grades of blende, $31.54. Calamine, 40 per cent zinc, $15@$18; average, $17.98 per ton.

Lead, high, $77.20; basis 80 per cent lead, $78@$80; average settling price, all grades of lead, $74.53 per ton.

Shipments for the week: Blende, 11,850; calamine, 71; lead, 1,164 tons. Value, all ores the week, $461,870.

Around 2,000 tons of reserve lead was purchased in midweek on the basis of $80 per ton, continuing in strong demand. Shortage of Western production is placing a heavy toll on this district and Southeast Missouri to supply a growing demand.

Zinc blende was advanced another half dollar on practically all grades, and purchases are up to the average, with the demand continuing strong.

Platteville, June 17.—Blende, basis 60 per cent zinc, $35 per ton. Lead ore, basis 80 per cent lead, $77.50 per ton. Shipments for the week: Blende, 325 tons; lead ore, none. Shipments for the year: Blende, 7,270 tons; lead ore, 977 tons. Shipped during the week to separating plants, 766 tons blende.

Non-Metallic Minerals

Feldspar—Canadian feldspar, 13 per cent K_2O and 65 per cent SiO_2, continues at $10 per net ton, f.o.b. Quebec quarry.

Graphite—Ceylon lump, first quality, 7@10c. per lb., f.o.b. N. Y.; chip, 5@6.5c. per lb.; dust, 4@5c. per lb.; amorphous crude, $18@$70 per ton; flake, 6@9c. per lb.

Talc—High-grade foundry talc, $20 per ton, or $18 in carload lots, f. o. b. Virginia mills.

Asbestos, Barytes, Bauxite, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Gypsum, Limestone, Magnesite, Mica, Monazite, Phosphate, Pumice, Pyrites, Silica, Sulphur, and Talc are unchanged from the prices published June 3.

Mineral Products

Arsenious Oxide (White Arsenic)—7.25@7.50c. per lb.

Copper Sulphate — 6.25c. for large crystals. Prompt shipment scarce.

Sodium Nitrate—$2.50 per 100 lb. ex vessel, Atlantic ports.

Potassium Sulphate and Sodium Sulphate are unchanged from quotations of June 3.

Ferro-Alloys

Ferromanganese — Domestic, 78@82 per cent, $67.50 per gross ton, f.o.b. furnace. English, $67.50, c.i.f. Atlantic seaports. Spiegeleisen 19@21 per cent, $36, f.o.b. furnace; 16@19 per cent, $35.

Ferrosilicon— 10 to 15 per cent, $38@$40 per gross ton, f.o.b. works; 50 per cent, $58@$60; 75 per cent, $115@$120.

Ferrocerium, Ferrochrome, Ferromolybdenum, Ferrotitanium, Ferrotungsten, Ferro-uranium, and Ferrovanadium are unchanged from the prices published June 3.

Metal Products

Copper Sheets—New York base, 20.50c. per lb.; wire, 15.75c.

Nickel Silver—26.75c. per lb, for 18 per cent nickel Grade "A" sheets.

Yellow Metal—Dimension sheets, 17.75c.; rods, 14.75c. per lb.

Lead Sheets and Zinc Sheets are unchanged from the quotations published in the June 3 issue.

Refractories

Bauxite Brick, Chrome Brick, Chrome Cement, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick, and Zirkite are unchanged from the prices appearing in the issue of June 3.

The Iron Trade

Pittsburgh, June 20, 1922—The turnover in the steel market, in point of tonnage, has continued to decrease, and the market is quiet. In the general market situation an outstanding feature is the firm attitude the Steel Corporation occupies against further price advances, now that prices are at a fair level relative to production costs. The latest illustration is the opening of the American Sheet & Tin Plate Co.'s books on June 15 for August and September sheet business at unchanged prices, based on 3.15c. for common black.

Steel ingot production is at the rate of about 39,000,000 tons a year, against a rate of 35,000,000 tons April 1, when the coal strike started, and production of less than 20,000,000 tons in 1921. Non-union strikers in the Connellsville region are now returning to work in greater numbers, while there is expectation that efforts will soon be made to start some of the union mines in the Pittsburgh district.

Pig Iron—The market remains stagnant. Prices are unchanged, but have become more or less nominal, at $25 for bessemer and basic and $24 for foundry, f.o.b. valley furnaces.

Coke

Connellsville Coke—Furnace, $7@$7.25; foundry, $7.50@$7.75.

COMPANY REPORTS

Utah Copper Co.

During the first three months of the year 1921, operations of the Utah Copper Co., at Bingham Canyon, and Magna and Arthur mills, near Salt Lake City, were conducted at about [illegible] per cent of capacity; on April 4 the properties were closed down for the remainder of the year.

The consolidated statement of assets and liabilities of the Utah Copper Co. and the Bingham & Garfield Ry. Co. is as follows:

ASSETS

	Dec. 31, 1921		Dec. 31, 1920	
[illegible]	$29,670,247		$29,678,350	
[illegible]	6,913,894		6,904,423	
[illegible]	7,520,307		6,289,408	
		$29,063,834		$30,293,366
[illegible]		5,837,860		5,837,860
[illegible]		9,943,260		9,861,569
[illegible]		977,936		
[illegible]				
[illegible]	$4,123,350		$1,964,392	
[illegible]	822,634		354,731	
[illegible]	7,199,918		10,148,370	
[illegible]	201,118		425,881	
[illegible] on hand and in [illegible]	3,350,695		10,597,103	
[illegible] and supplies	3,674,093		3,707,630	
		19,371,808		27,198,108
		$65,194,696		$73,190,902

LIABILITIES

[illegible] outstanding		$16,244,900		$16,244,900
[illegible]				
[illegible]	$257,340		$880,758	
[illegible]	62,920		1,126,012	
[illegible] taxes, etc.	2,189,979		2,186,439	
		2,510,238		4,193,208
[illegible]		8,290,620		8,290,620
Surplus from operations..		38,148,938		44,462,173
		$65,194,696		$73,190,902

The statement of operations for the year 1921 follows:

[illegible]		
[illegible]—24,511,593 lb. @ 12.929c.	$3,169,057	
[illegible]—7,040.7 oz. @ $20	140,815	
[illegible] 65,929 oz. @ 99.646c.	65,695	
		$3,375,568
[illegible]		
[illegible] stripping	$612,162	
[illegible]—mine to mill...	234,455	
Milling...	1,440,753	
[illegible] freight and refining	806,341	
[illegible]	23,954	
		3,117,666
[illegible] operations		$257,902
[illegible]		524,187
[illegible]		
[illegible]	$1,124,726	
[illegible]	1,019,758	
[illegible]	214,842	
[illegible] and miscellaneous charges	480,871	
		2,840,197
[illegible]		$2,058,109

SURPLUS FROM OPERATIONS

[illegible] 1920	$44,177,423
[illegible] of depletion	2,058,109
	$42,119,314
[illegible]	4,061,225
[illegible] 31, 1921	$38,058,089

Distributions were made to stockholders during the year aggregating $2.50 per share, or $4,061,225, which brings the total so distributed to Dec. 31, 1921, to $115,570,887.50.

The cost of producing copper, applying credit for precious metals but making no allowance for depreciation, was 11.57c. per lb., compared with 12.21c. for the preceding year. Total ore milled amounted to 1,220,700 tons.

Copper Range Co.

The directors of the Copper Range Co. present the following consolidated statement of the operating companies (Copper Range Co., Champion Copper Co., Trimountain Mining Co., Copper Range R.R. Co., and Atlantic Mining Co.) for the year ended Dec. 31, 1921:

31,753,738 lb. of copper sold for		$4,205,558 72
916,000 lb. unsold, estimated at 13c		119,080 00
32,669,738 lb. produced. Average price 13.238 c. per lb.		$4,324,638 72
Interest		127,395 45
Atlantic Mining Co. income from rents, and interest		5,271 81
		$4,457,305 98
All expenses		3,683,752 77
		$773,553 21
Taxes paid by mining companies		301,679.65
		$471,873.56
Operating income, Copper Range R. R. Co.	$240,800.84	
Less interest on bonds	114,000 00	
		126,800 84
		$598,674.40
Deduct one-half of net mining profit of Champion Copper Co. which belongs to the St. Mary's Mineral Land Co.		363,489.11
Operating income		$235,185.29

ASSETS:

Cash		$299,528.72
U. S. Liberty Loan bonds		1,979,000.00
Federal Land Bank bonds		54,000.00
Copper delivered and not paid for		378,023.12
Copper on hand		2,129,499.65
Copper Range R. R. Co. bonds		870,000.00
Michigan Smelting Co. stock		340,000 00
Balance due from U. S. Government account railroad guaranty		92,966.29
Supplies at mines	$546,767.14	
Cash at mines	71,955.55	
		618,722.69
Accounts receivable		247,412.39
Insurance prepaid		1,251.65
Miscellaneous securities		47,743.62
		$7,058,148.13

LIABILITIES:

Current indebtedness at mines	$142,497.40	
Accounts payable	19,340 06	
		161,837.46
		$6,896,310 67
Less one-half Champion		1,220,855 95
Net excess of assets		$5,675,454.72

The Copper Range Co. now holds in its treasury 97,231 shares Atlantic Mining Co. stock; 99,690 shares Trimountain Mining Co. stock; 50,000 shares Champion Copper Co. stock; and 42,443 shares Copper Range R.R. Co., the entire stock issued.

A comparative statement of operations covering Baltic, Trimountain, and one-half of Champion, which the Copper Range property embraces, is as follows:

	1921	Average for Ten Years, 1912 to 1921 Inclusive
Tons of ore stamped	604,878	890,368
Lb. refined copper produced	22,310,085	26,290,697
Lb. refined copper per ton stamped	36.88	29.52
Cost of copper per lb., cents	12.74	11.87
Price received per lb., cents	13.19	19.75
Profit per lb., cents	0.45	7.88
Cost of mining, smelting, freight, marketing	$2,842,196.77	$3,118,377.84
Net earnings Copper Range Co.	$235,185.29	$2,104,890.49

No dividends were paid in 1921. Total dividends to date, $26,998,345, payments being made in every year from 1905 to 1920 inclusive, except in 1914. Operations were on a profitable basis during the last half of 1921, and conditions are continuing to improve according to the report. The annual report includes the financial details of the operations of the subsidiary companies.

Michigan Copper Mining Co.

All operations at the property of the Michigan Copper Mining Co., at Rockland, Mich., continued suspended throughout the year 1921. Assets and liabilities as of Dec. 31, 1921, were as follows:

ASSETS		
Cash	$566 18	
Treasury stock	2,922 00	
Cash and supplies at mine	28,553 87	
Accounts receivable	6,766 10	
Unexpired insurance	417 54	
		$39,225 69
LIABILITIES		
Indebtedness at mine	$22,477 95	
Accounts payable	32,140 71	
Loans	355,000 00	
		409,618 66
Excess of liability		$370,392 97

The stockholders will again be asked to formulate a plan of refinancing.

Income for the year totaled $7,095.16 and expenses, $44,833.46.

Candelaria Mines Co.

The financial statement of the Candelaria Mines Co., with general offices at Candelaria, via Mina, Nev., as stated in the annual report for 1921, is as follows:

ASSETS			
Current assets			
Cash on hand and in banks		$46,482.32	
Accounts receivable		203 61	
Construction and boarding-house supplies		2,134 61	
			$48,820 54
Prepaid charges			228 03
Deferred charges—discount on note payable			50,000 00
Capital assets			
Mining properties, claims and leases		$2,028,473 09	
Plant and equipment	$59,577 68		
Office furnishings	1,086 78		
	$60,664 46		
Less depreciation	9,592 14		
		51,072 32	
Mill construction, begun Dec., 1921		1,863 93	
Development, sampling, and experiments, administrative and general expense		260,913 93	
			2,342,323 27
			$2,441,371 84
LIABILITIES			
Current liabilities			
Wages payable		$557.33	
Accounts payable		9,194 12	
Operating funds advanced		1,529 39	
Note payable, due Nov. 1, 1922		23,700 00	
			$34,980 84
Accrued interest on note due Nov. 1, 1922			237.00
Deferred credits—suspense			265.00
Fixed liabilities			
Note payable, due November, 1924			100,000 00
Capital stock authorized, 3,000,000 $1 shares		$3,000,000 00	
Less unissued stock of which 369,111 $1 shares are under option at $1 per share for three years to the Rochester Silver Corporation		694,111 00	
			2,305,889 00
			$2,441,371 84

Money was secured from interests closely associated with the Rochester Silver Corporation, for the purpose of putting the Candelaria property into production. The total cost to Candelaria will be $400,000, payable in three years from Nov. 15, 1921, with no interest for the first eighteen months, and thereafter at 6 per cent. A share option was also given as mentioned above.

A 300-ton milling plant is now being constructed and is expected to be completed in July, 1922. The engineers estimate 610,000 tons of milling ore available, sufficient to last six years and pay a profit of $1,600,000. The report discusses geological conditions and other topics of interest in more detail than usual. In fact, it is stated that it will be the policy of the present directorate to see that shareholders are kept fully and correctly informed, at frequent intervals, of all matters connected with the operations. This warrants our publishing the directors' names, *cum laude:* C. D. Kaeding, president, of San Francisco; S. Rossiter, vice-president, of New York; F. M. Manson, of Reno; O. W. Jones, of Chicago; and J. C. Peebles, assistant secretary and treasurer, of Reno.

Round Mountain Mining Co.

During 1921, the lode mining operations of the Round Mountain Mining Co., operating in the Round Mountain district, sixty miles northeast of Tonopah, Nev., were carried on by lessees, but 110,700 cu.yd. of placer gravel was hydraulicked by the company. This yielded 9,009 oz. of bullion, having a value of $120,845. The total operating costs were $65,650 and the net realization, $55,195. The gross value recovered represented $1.09 per cu.yd., production cost was 59c. per cu.yd.; and realization, 50c. per cu.yd.

The balance sheet as of Dec. 31, 1921, is as follows:

ASSETS	
Properties, water rights and titles	$1,508,142 82
Mine and milling plants, equipment and buildings	12,633 76
Hydraulic pipe lines, dams and placer equipment	121,814 15
Stocks owned	33,901 36
Store supplies on hand	22,618 19
Cash on hand	6,038 68
	$1,705,148.96
LIABILITIES	
Capital	$1,500,000 00
Profit and loss	113,527 72
Bills payable	60,000 00
Accounts payable	31,621.24
	$1,705,148 96

The lode lessees mined and milled in the company's mill, 1,936 tons of ore averaging $49.91 per ton; tailings averaged $1.47; and the net value $48.44, representing an extraction of 97.06 per cent. Total mining costs were $42.15 per ton, made up of labor, $33.58; milling and marketing, $4.20; and supplies, compressor, insurance, and miscellaneous items, $4.55. The company received in royalties, $11.24 per ton, and for use of the company mill, $1 per ton.

The operating profit before depreciation and depletion was $45,768.10. Not less than 200,000 tons of gravel should be hydraulicked this year, according to the report, and at a less cost per yard than in any previous year. The company is managed by the same men who are at the head of the Fairview Round Mountain company, 20 per cent of the issued stock of the Fairview company being held by the Round Mountain company. Louis D. Gordon, is president, and Gibson Berry, general superintendent.

Magma Copper Co.

The balance sheet of the Magma Copper Co., operating at Superior, Ariz., as of Dec. 31, 1921, was as follows:

ASSETS		
Mining claims and development		$927,755 30
Mining and milling property		563,927 99
Investments in Magma Ariz. Ry. Co., Patagonia-Superior Copper Co., Apache Powder Co., and Sacaton Copper Co.		385,326.57
Current and working assets		
Refined copper at 17.25c. per lb.	$1,379,217.36	
Raw ore—cost of extraction	8,794 48	
Supplies at book value	159,585.14	
Cash, accounts receivable, and notes	34,985 04	
		1,582,582 02
Deferred assets		53,703.92
Deferred expenses		128,541.36
		$3,641,837 16
LIABILITIES		
Capital stock		
Authorized, 300,000 $5 shares	$1,500,000	
Less unissued 60,000 shares	300,000	
		$1,200,000 00
Current and accrued liabilities		929,695.26
Contingent reserve for claims		82,180 02
Surplus		
Balance, Jan 1, 1921	$1,730,439 63	
Adjustments for prior years	647.78	
	$1,729,791.85	
Deficit for 1921	299,829 97	
		1,429,961 88
Total		$3,641,837 16

The net cost of producing copper during the three months that the company operated, not including depletion, but including depreciation and all overhead charges and deducting gold and silver credits, was 14.91c. per lb. The ore mined amounted to 21,445 tons, and the net smelter production was 2,028,889 lb. of copper, 59,794.48 oz. silver, and 818.88 oz. gold. The reasonably assured copper sulphide ore now amounts to 1,505,000 tons, averaging 5.6 per cent copper, 3 oz. silver, and 0.025 oz. gold.

MINING STOCKS

Week Ended June 17, 1922

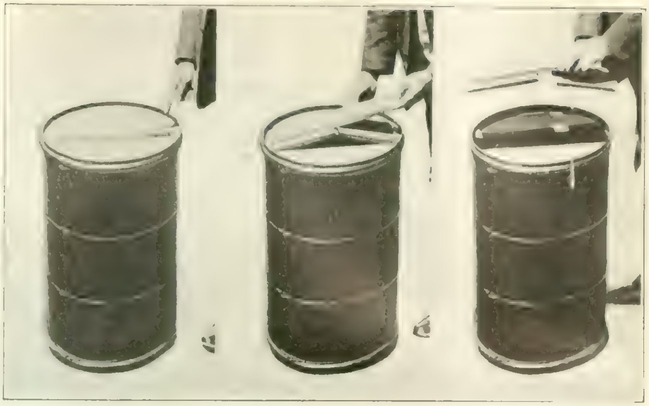
Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Ahmeek	Boston	63½	60½	60½	Sept. '20, Q	$0.50
Alaska-Br. Col.	N. Y. Curb	4½	3½	3¾	..	..
Allouez	Boston	26	25	26	Mar. '19	1.00
Anaconda	New York	52¾	50	51	Nov. '20, Q	1.00
Arcadian Consol	Boston	4¼	3¾	3¾		.
Ariz. Com'l	Boston	9¾	9	9½	Oct. '18, Q	0.50
Big Ledge	N. Y. Curb	*19	*16	*18		.
Bingham Mines	Boston	15½	15½	15½	Sept '19, Q	0.25
Calumet & Arizona	Boston			65½	Mar '22, Q	0.50
Calumet & Hecla	Boston	275	270	270	June '20, Q	5.00
Canada Copper	N. Y. Curb	*36	*30	*30		.
Centennial	Boston	11	10	10	Dec. '18, SA	1.00
Cerro de Pasco	New York	37½	35⅛	35½	Mar '21, Q	0.50
Chile Copper	New York	21	19	19⅛		.
Chino	New York	30⅛	28	28⅝	Sept. '20, Q	0.37½
Columbus Rexall	Salt Lake	*28½	*28½	*28½	..	
Con. Arizona	N. Y. Curb	*5	*3	*3	Dec. '18, Q	0.05
Con. Copper Mines	N. Y. Curb	1⅛	*45	*60		.
Copper Range	Boston	45	43½	43½	Mar '22, Q	1.00
Crystal Copper	Boston Curb	1 9/16	1 7/16	1½		
Davis-Daly	Boston	8½	7½	7½	Mar '20, Q	0.25
East Butte	Boston	11	10¼	10½	Dec '19, A	0.50
First National	Boston Curb	*75	*75	*75	Feb. '19, SA	0.15
Franklin	Boston	2⅜	2 1/16	2⅜	... .	.
Gadsden Copper	Boston Curb	*95	*81	*81	.	.
Granby Consol	New York	29⅝	27⅜	29	May '19, Q	1.25
Greene Cananea	New York	32¼	30¼	30½	Nov. '20, Q	0.50
Hancock	Boston	†3½	†2¼	3	..	
Howe Sound	N. Y. Curb	3¼	3	3¼	Jan. '21, Q	0.05
Inspiration Consol	New York	41¼	39½	39½	Oct '20, Q	1.00
Iron Cap	Boston Curb	†8½	†7½	8	Sept. '20, K	0.25
Isle Royale	Boston	24	23	23	Sept. '19. SA	0.50
Kennecott	New York	35⅛	32⅝	33	Dec. '20, Q	0.50
Keweenaw	Boston	2⅜	2½	2½	....	....
Lake Copper	Boston	4⅞	4½	4⅝	....	....
La Salle	Boston	1¾	1½	1¾	...	.
Magma Copper	N. Y. Curb	30	28⅛	30	Jan. '19, Q	0.50
Majestic	Boston Curb	*12	*10	*10	....	.
Mason Valley	Boston	1¾	1¾	1¾	..	
Mass. Consolidated	Boston	3½	3⅛	3¼	Nov. '17, Q	1.00
Miami Copper	New York	29⅞	27½	28⅛	May '22 Q	0.50
Michigan	Boston	3¼	2¾	3¼	.. ..	
Mohawk	Boston	65	62½	62½	Feb. '22, Q	1.00
Mother Lode Coa.	N. Y. Curb	9½	9⅜	9½	..	..
Nevada Consol	New York	17¼	16½	16⅜	Sept. '20, Q	0.25
New Cornelia	Boston	19	18¼	18½	May '22, K	0.25
North Butte	Boston	13¼	12¼	12¼	Oct. '18, Q	0.25
North Lake	Boston			½	. . . ..	..
Ohio Copper	N. Y. Curb	*8	*8	*8	. ..	
Old Dominion	Boston	27	24	26	Dec '18, Q	1.00
Osceola	Boston	35	33¼	33¼	June '20, Q	0.50
Phelps Dodge	Open Mar.	†185	†175	.	Apr '22, Q	1.00
Quincy	Boston	45¾	44	44	Mar. '20, Q	1.00
Ray Consolidated	New York	17	16¼	16⅜	Dec. '20, Q	0.25
Ray Hercules	N. Y. Curb	2	1¼	1¾	..	
St. Mary's Min. Ld.	Boston	47½	45	45	Apr. '22, K	2.00
Seneca Copper	Boston			14	..	
Shannon	Boston	1	*85	*85	Nov. '17, Q	0.25
Shattuck Arizona	New York	10½	9⅝	9⅞	Jan. '20, Q	0.25
South Lake	Boston	†1¼	†1	1⅛	. ..	....
Superior & Boston	Boston	1 11/16	1½	1½	.	..
Tenn. C. & C. cfs.	New York	11¾	10¼	11	May '18, I	1.00
Tuolumne	Boston	*70	*65	*68	May '13,	0.10
United Verde Ex.	Boston Curb	29	27	29	May '22, Q	0.25
Utah Consol.	Boston	3¼	3	3	Sept '18,	0.25
Utah Copper	New York	65⅜	62	62⅛	Mar '22, Q	0.50
Utah Metal & T	Boston	1¼	1⅛	1 3/16	Dec. '17,	0.30
Victoria	Boston	1½	1½	1¼	....	...
Winona	Boston	2	1⅞	2	....	....
Wolverine	Boston	14	11½	13	....	....
NICKEL-COPPER						
International Nickel	New York	17	16	16¼	Mar. '19,	0.50
International Nickel, pfd	New York	81	79	81	May. '22, Q	1.50
LEAD						
National Lead	New York	94½	90½	91	Mar. '22, Q	1.50
National Lead, pfd	New York	†113	†109½	109⅜	June '22 Q.	1.75
St. Joseph Lead	New York	15	14⅝	14¾	Mar. '22, Q	0.25
QUICKSILVER						
New Idria	Boston	*30	*25	*25	....	....
ZINC						
Am. Z. L. & S.	New York	18¼	16	16	May '20,	1.00
Am. Z. L. & S. pfd	New York	44	42	42	Nov. '20, Q	1.50
Butte C. & Z.	New York	7½	7	7	June '18,	0.50
Butte & Superior	New York	28½	26	27	Sept '20,	1.25
Callahan Zn-Ld	New York	8½	8	8½	Dec '20, Q	0.50
New Jersey Zn.	N. Y. Curb	144½	142	142	May '22, Q	2.00
Yellow Pine	Los Angeles	*51	*51	*51	Sept '20, Q	0.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra.

Toronto quotations courtesy Hamilton B. Wills, Spokane, Pohlman Investment Co., Salt Lake, Stock and Mining Exchange, Los Angeles, Chamber of Commerce and [illegible] Colorado Springs, The Financial Press, N. Y.

Stock	Exch.	High	Low	Last		Last Div
GOLD						
Alaska Gold	New York	⅝	⅝	⅝	....	....
Alaska Juneau	New York	1½	1⅛	1¼	....	....
Atlas	Toronto	*25	*19	*24	....	
Carson Hill	New York	12	12	12	..	..
Cresson Consol. G.	N. Y. Curb	2⅝	2½	2½	Apr '22, Q, X	$0.10
Dome Mines	New York	30	27¼	28	Apr. '22, Q	1.00
Florence Goldfield	N. Y. Curb	*18	*18	*18	.. ..	.
Golden Cycle	Colo Springs	*81	*81	*81	June '21, Q	0.02
Goldfield Consol.	N. Y. Curb	*6	*6	*6	Dec. '19,	0.05
Gordon Murray	Toronto	*31	*29	*30	....	..
Hollinger Consol.	Toronto	9.25	9.05	9.20	June '22,	0.05
Homestake Mining	New York	71	69½	69½	May '22, M	0.25
Keora	Toronto	9¼	8	8¼	.	
Kirkland Lake	Toronto	*42	*38	*39	....	....
Lake Shore	Toronto	2.25	2.16	2.16	Nov. '21, K	0.02
McIntyre-Porcupine	Toronto	18.00	16.50	16.25	May '22, K	0.05
Porcupine Crown	Toronto	*21½	*20	*20	July '17,	0.03
Porcupine V. N. T.	Toronto	*23	*21	*22	....	....
Portland	Colo Springs	†*30	†*23	*25	Oct. '20, Q	0.01
Schumacher	Toronto	*68	*63½	*67	....	....
Silver Pick	N. Y. Curb	*17	*17	*17	....	....
Teck Hughes	Toronto	*47	*44	*45½	....	....
Tom Reed	Los Angeles	*51	*49½	*50	Dec. '19,	0.02
United Eastern	N. Y. Curb	1 11/16	1 9/16	1⅝	Apr. '22, Q	0.15
Vindicator Consol	Colo Springs	*6	*6	*6	Jan. '20, Q	0.01
White Caps Mining	N. Y. Curb	*8	*7	*7	...	.
Wright-Hargreaves	Toronto	2.75	2.50	2.75	Apr '22,	0.02½
Yukon Gold	N. Y. Curb	1	*80	*89	June '18,	0.02½
SILVER						
Batopilas Mining	New York	1¼	1	1	Dec. '07, I	0.12½
Beaver Consol.	Toronto	*30½	*27½	*30	May '20, K	0.03
Coniagas	Toronto	1.25	1.25	1.25	May '21, Q	0.12½
Crown Reserve	Toronto	*15	*12	*15	Jan. '17,	0.05
Kerr Lake	N. Y. Curb	3¾	3⅛	3⅝	Apr. '22, Q	0.12½
La Rose	Toronto	*33½	*31½	*31½	Apr. '22,	0.10
McKinley-Dar.-Sav.	Toronto	[illegible]		*25	Oct. '20, Q	0.03
Mining Corp. Can.	Toronto	1.04	.95	1.00	Sept. '20, Q	0.12½
Nipissing	N. Y. Curb	6⅜	6⅛	6⅛	Apr. '22, Q, X	0.30
Ontario Silver	New York	8	8	8	Jan. '19, Q	0.50
Ophir Silver	N. Y. Curb	.	.	*12	Jan. '12,	0.10
Temiskaming	Toronto	*29½	*20	*29½	Jan. '20, K	0.04
Trethewey	Toronto	*4¼	*3½	*4¼	Jan '19,	0.05
GOLD AND SILVER						
Boston & Montana	N. Y. Curb	*17	*15	*15	....	....
Cash Boy	N. Y. Curb	*6	*6	*6	....	....
Dolores Esperanza	N. Y. Curb	2¼	1⅞	2⅛	....	....
El Salvador	N. Y. Curb	*4	*4	*4	....	.
Jim Butler	N. Y. Curb	..	.	*6	Aug. '18, SA	0.07
Jumbo Extension	N. Y. Curb	..	..	*5	June '16,	0.05
MacNamara M.&M.	N. Y. Curb	*8	*7	*8	May '10,	0.02½
Tonopah Belmont	N. Y. Curb	1⅞	1 11/16	1 11/16	Apr. '22, Q	0.05
Tonopah Divide	N. Y. Curb	*79	*76	*78	...	.
Tonopah Extension	N. Y. Curb	1¾	1 9/16	1⅝	Apr. '22, Q	0.05
Tonopah Mining	N. Y. Curb	1⅞	1 11/16	1¾	Apr. '22, SA, X	0.07½
West End Consol.	N. Y. Curb	1⅛	1	1 1/16	June '22, SA	0.05
SILVER-LEAD						
Caledonia	N. Y. Curb	*7	*7	*7	Jan. '21, M	0.01
Cardiff M. & M.	Salt Lake	*95	*95	*95	Dec. '20,	0.15
Chief Consol	Boston Curb	5 1/16	4¾	5 1/16	May '22, Q	0.05
Consol. M. & S.	Montreal	22½	22	22	Oct. '20, Q	0.62½
Daly Mining	Salt Lake	†2.00	†1.40	..	July '20, Q	0.10
Daly-West	Boston	1¾	1¾	1¾	Dec. '20, Q	0.25
Eagle & Blue Bell	Boston Curb	†3½	†3	3½	Apr. '21, K	0.05
Electric Point	Spokane	8¼	5	5	May '20, SA	0.03
Federal M. & S.	New York	11	11	11	Jan '09,	1.50
Federal M. & S. pfd.	New York	50	45	45	June '22, Q	1.25
Florence Silver	Spokane	*22½	*22½	*22½	Apr. '19,	0.01½
Grand Central	Salt Lake	†*62	*60	*60	Jan. '21, K	0.01
Hecla Mining	N. Y. Curb	6⅜	6¼	6⅜	Mar. '22, Q	0.15
Iron Blossom Con.	N. Y. Curb	*30	*27	*27	Apr. '22, Q	0.02½
Judge M. & S.	Salt Lake	†2.50	†2.20	2.60	Sept. '20, Q	0.12½
Marsh Mines	N. Y. Curb	*28	*18	*22	June '21, I	0.02
Prince Consol	Salt Lake	*5¼	*4¾	*5¼	Nov. '17,	0.02½
Rambler-Cariboo	Spokane	*6½	*4½	*6½	Feb. '19,	0.01
Rex Consol	N. Y. Curb	*9	*7	*8	.....	.
Standard Silver-Ld.	N. Y. Curb	*10	...	*20	Oct. '17,	0.05
Stewart Mines	N. Y. Curb	...	*8	*9	Dec. '15,	0.05
Tamarack-Custer	Spokane	2.62	2.50	2.60	Jan. '21, K	0.04
Tintic Standard	Salt Lake	2.12½	2.12½	2.12½	Dec. '21, Q	0.05
Utah Apex	Boston	3	2⅝	2⅝	Nov. '20, K	0.25
Zilbert Mining	N. Y. Curb	. .	.. .	*2	Nov. '17,	0.01
VANADIUM						
Vanadium Corp.	New York	48½	42½	44½	Jan. '21, Q	1.00
ASBESTOS						
Asbestos Corp	Montreal	.	.	57½	Apr. '22, Q	1.50
Asbestos Corp. pfd.	Montreal	76	75½	75½	Apr. '22, Q	1.75
SULPHUR						
Freeport, Texas	New York	24¼	21⅝	22⅛	Nov. '19, Q	1.00
Texas Gulf	New York	47	44¼	44¾	June '22, QX	1.00
MINING, SMELTING AND REFINING						
Amer. Sm. & Ref.	New York	61⅜	57⅜	57⅞	Mar. '21, Q	1.00
Amer. Sm. & Ref. pf.	New York	98	97	98	June '22 Q	1.75
Am. Sm. Sec. pf. A.	New York	†95½	†91	93⅝	Apr. 22, Q	1.50
U. S. Sm. R. & M.	New York	41½	40	40¼	Jan. '21, Q	0.50
U.S. Sm. R. & M. pf.	New York	†49¾	†46	47⅜	Apr. '22, Q	1.75

NEW MACHINERY AND INVENTIONS

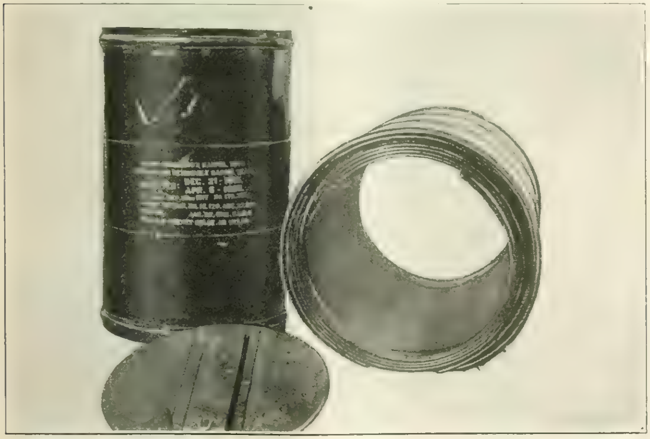


Knock-down metal barrel and method of opening

A Knock-Down Barrel Which Is Useful in Transporting Bulky Products

Recently there has been developed a knock-down metal barrel for use in transporting all sorts of bulky materials. The barrels are suited to a great variety of purposes where the package cost can be reduced by returning the barrels and re-using them. In the mining industry they will be found useful in transporting ores, concentrates, and mattes, and also where goods are carried on animals. A keg is made specially for this purpose with an inside measurement of 11x17 in. and a total weight of 9¼ lb. Barrels are also made for carrying lime, cement, and asphaltum.

The principal feature of the barrel is the locking barrel head, which permits inserting or removing the head of a barrel in the croze without expanding the croze of the barrel. The barrel consists of a thin sheet of black iron or galvanized iron, according to the products the barrel is to contain, which is fastened with wires that are easily detachable. After being used to transport materials the barrels can be knocked down by cutting or opening the small tie wires holding the wire hoops. The heads and wires of seven barrels may be placed in the eighth barrel while the seven metal sheets are nested for return.



Sheets of seven barrels nested for shipment. Upright barrel contains heads and wires for seven barrels

In assembling, the forms are put on a mandrel the exact size of the inside of the barrel. Clamps close the sheet in place, the joint is made, wire hoops are put on, and the head is put in place. The barrel is manufactured by the Knapp Metal Barrel & Package Co., 812 Hearst Bldg., San Francisco, Cal.

A New Radio-Phone Receiver

There has recently been produced and placed on the market, under the trademark name "Audiophone," a loud speaker horn for receiving radio concerts. Although this device is a comparatively new development in the radio field, it is stated to be the result of thirty years' experience in the development and manufacture of precision recording and indicating instruments and six years' research work in sound reproduction. The result of this research produced a loud speaker which gives a large volume of amplified sound, and yet faithfully reproduces the original.

The audiophone is of a compact and artistic design finished in bronze. The bell of the horn is 15 in. in diameter. The complete design of the bell, neck, and electrical characteristics of the receiver box, together with materials used, is such as to produce a loud speaker. Songs, speeches, announcements, conversation, and instrumental music are reproduced by it with a clearness and audibility which has not been possible with the majority of radio receivers. It is rugged and simple in construction, thus insuring durability. It requires no separate storage battery for magnetizing current. To make the horn suitable for all types of radio amplifier circuits, a transformer is mounted in the base which provides the impedance about equal to that of the vacuum tube amplifier, into the plate circuit to which the horn is connected. When connected to a third stage of amplification operating on 100 v. or over, the volume of sound is great enough to be easily heard in a room seating 500 persons. For smaller rooms good results are obtained from the audiophone when connected with a two-stage amplifier.

One watt is required by the audiophone to give full volume. Therefore, the amplifier must be so designed as to have a high voltage in at least the last stage, or, better still, to operate with high voltage on all tubes. The device is manufactured by the Bristol Co., Waterbury, Conn.

Associations To Meet at Chemical Exposition

Several leading associations of the chemical industry have definitely arranged to meet at the Eighth National Exposition of Chemical Industries which will be held during the week of Sept. 11-16, at the Grand Central Palace, New York. The special meetings which have already been scheduled to be held at the Grand Central Palace during the week of the exposition include a meeting of the American Ceramic Society, the Technical Association of the Pulp and Paper Industry, and the Salesmen's Association of the American Chemical Industry. Other technical and commercial groups connected with the chemical and allied industries are also expected to meet at the time of the exposition, but definite arrangements have not as yet been made.

Small Steam Turbines for High Temperature and High Pressure Steam

Small steam turbines, as used for [illegible] plant auxiliaries, such as [illegible] circulating pumps, hot well [illegible] feed pumps, coal crushers, fans, and stokers, ordinarily require, and should demand, little attention. They should also be able to [illegible] at high pressure and superheat, and for their size, should develop the maximum amount of work from the steam, even though the latter is subsequently utilized in feed water heaters or for industrial purposes.

A velocity stage turbine has been designed to meet these requirements. It is built in sizes up to 1,200 hp., and can be directly connected to high head centrifugal pumps, blowers and compressors, to alternators and to small direct-current generators, or by means of speed-reducing gears, to medium size alternators and direct-current generators, to large centrifugal pumps and blowers, to belt pulleys and rope sheaves, and to other slow and moderate speed machinery.

To adapt it for operation with steam of high pressure and superheat, the steam chest and nozzles are placed in the casing cover, so that the bearings are not subjected to high temperatures. As the steam is completely expanded in the nozzles, the turbine case contains steam at exhaust pressure only. For all steam temperatures above 450 deg. F. and for steam pressures above 210-lb. gage, the steam chest, governor valves, emergency governor valve casing and strainer casing are made of steel.

The wheel carries two or more rows of buckets, depending upon the speed and steam conditions. The buckets are drop-forged from materials best suited to resist the corrosive and erosive action of steam, and are secured to the rim of the wheel by bulb shanks in such a way that individual buckets can be removed without disturbing others. The steam discharged from the first row of buckets passes through guide vanes, which direct it upon the succeeding row. These guide vanes are held in removable steel segments attached to the nozzle plates, so that it is a comparatively simple matter to replace them if damaged or worn by long use with wet steam.

The admission of steam to the steam chest is controlled by a speed governor, which acts upon a double-seated valve. Where the volume of steam to be handled is large, or the speed is high or close speed regulation is desired, the governor is of the Jahns type, mounted on a vertical spindle, which is driven by turbine shaft through a worm gear.

This turbine is being placed on the market by the De Laval Steam Turbine Company of Trenton, N. J., primarily to meet the demand for reliable and efficient auxiliary turbines where high steam pressures and superheats are used.

TRADE CATALOGS

Iron Ores — The Lake Superior Iron Ore Association, Kirby Building, Cleveland, Ohio, have issued a fifty-page pamphlet containing the average cargo analyses of Lake Superior iron ores for the season of 1921. These include ores shipped by the operators on the Cuyuna, Baraboo, Mayville, Gogebic, Marguette, Menominee, Mesabi, Vermilion, Michipicoten, and Sudbury districts.

Concentrating Machinery.—Cottrell Engineering Co., 207 Mesnager St., Los Angeles, Cal., illustrates and briefly describes in a 6-pp. leaflet a 3 x 3 ft. continuous-feed type ball mill, wet and dry concentrators, an improved Blake type crusher, and the Cottrell vibrating screen. The dry concentrator shown occupies 3 x 8 ft. floor space and has a capacity of thirty to thirty-five tons per day.

Steam Engines.—The Stumpf Una-Flow Engine Co., Inc., 206 E. Genesee St., Syracuse, N. Y., has issued in "Lefax" form a 4-pp. leaflet descriptive of the una-flow engine which claims a reduction of the following losses common to other reciprocating steam engines: cylinder condensation, volume of clearance, throttling, friction, leakage of valves and pistons, heat radiation, and incomplete expansion.

CONSTRUCTION NEWS

Granby Consolidated Planning 1,000-Ton Concentrator

Plans for the construction of a 1,000-ton mill for the Granby Consolidated Mining, Smelting & Power Co., of British Columbia, are being prepared, according to the company's annual report. Surrounding the several orebodies of the Hidden Creek mine, states the report, are envelopes of siliceous ore merging from high into low-grade reserves. Such ores are said to be not suitable for economic semi-pyritic smelting, but are recoverable at a profit through methods of concentration which have been worked out in the company's pilot mill, and definite flow sheets have been established for the particular ore in question. Ability to mine at one time and separately treat the two classes of ore encountered will effect economies not obtainable by divided operations.

Georgia Copper Co. Will Add to Present Plant

The Georgia Copper Co., of Lincolnton, Ga., states that it has resumed operations and that it expects to erect a smelter in the near future. It also intends to install a ball mill.

Iron Ore Washing Plant for Tod-Stambaugh Co.

The Tod-Stambaugh Iron Co. is considering the building of an ore washing plant at its Billings mine on the Mesabi Range, Minn., in the near future. The upper part of the orebody consists of washable ore, this having been demonstrated by experiments. The lower part of the deposit is a direct shipping ore, which is being developed.

Construction of Argonaut Mill Begun

Active construction of a mill at the Argonaut mine, east of Kirkland district, Ontario, was begun June 10, and its completion well before the year is out will add a new producer to the list of Ontario gold mines. The property is operated by the Argonaut Gold Mines, Ltd., Royal Trust Building, Montreal, Quebec.

Eureka Holly Plans Remodeling of Mill

The Eureka Holly Consolidated Mining Co., Eureka, Nev., whose workings include the Eureka Holly and Bullwhacker, is planning to remodel the Eureka Holly mill. Installation of flotation is being considered. A test shipment was recently sent to an Idaho plant.

Erection of Two Gold Dredges Under Way

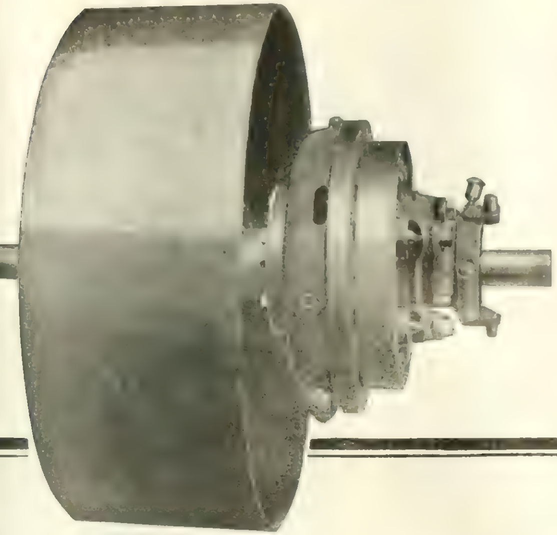
Two new gold dredges are under construction on the Trinity River, in Trinity County, California. One is being built by L. Gardella on a bar on the south side of the Trinity, one and a half miles below Lewiston. The Lewiston Dredging Co. is erecting the other at the Martin Ranch, above Lewiston. The dredge pit has been excavated, the derrick erected, and hauling of the machinery and hull materials is progressing.

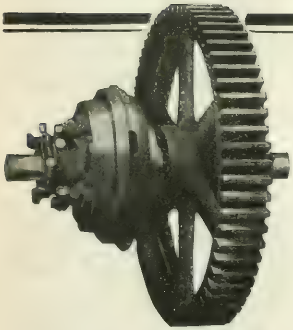
Candelaria Mill to Be Finished in July

About seventy-five men are employed by the Candelaria Mines Co., of Candelaria, Nev., and the 300-ton plant should be completed in July, as originally planned. The electric power line from Mina will be finished at about the same time. Underground workings are being put into condition for production and development.

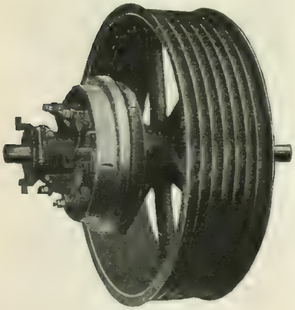
Empire Consolidated Installs Marcy Rod Mill

In addition to the large installations made by the Phelps Dodge Corporation, the Empire Consolidated Mining Co., at Empire, Col., has installed a rod mill of the open-end discharge Marcy type for crushing to 40 mesh. This mill, though not manufactured by the Mine & Smelter Supply Co., is made under license from that company and according to Marcy specifications.





Dodge Split Clutch with Dodge Spur Gear mounted on sleeve.



Dodge Split Clutch with Rope Sheave mounted on sleeve.

Individualize your mill units with Dodge Friction Clutches

Conservation of power and money by the segregation of machines or groups is economically accomplished in a Dodge installation by the use of friction clutches or cut-off couplings. This makes possible individualization of machines or departments with relation to the central power plant—eliminates shut-down losses due to one machine break-downs.

Thousands of these clutches have more than paid for themselves during their first year of operation.

The selection of type (solid or split) except where conditions specifically demand a certain type is largely a matter of preference. However, when the selection is made on a quality and efficiency basis the choice must invariably be Dodge.

Dodge equipment costs less to operate and replace than non-mechanical equipment—the reuse value is unusually high because they are built for use on any lineshaft and not as a specially designed unit for a single machine.

Dodge Friction Clutches are stock products which can be purchased from your local dealer on the immediate delivery basis.

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Power Transmission Machinery-Elevating and Conveying Equipment-Heavy Oil Engines

EMPLOYMENT SERVICE

[illegible] qualified [illegible] may be [illegible] has been [illegible] for many [illegible] as a [illegible] permission [illegible] book [illegible] protection [illegible] well [illegible] Strictly [illegible] 308 Lockwood Building, New York.

POSITIONS WANTED

[illegible] Graduate Class A School. One [illegible] internship. Eight months [illegible] work. Four years' mining [illegible] in Mexico. Speak Spanish [illegible] Address Dr. B. O Thrasher, 607 North Oregon Street, El Paso, Texas.

[illegible] engineer thor[illegible] experience in construc[illegible] of mine and mill [illegible] operation of power plant [illegible] handle men, location any[illegible] Eng. & Min Journal-Press.

ENGINEER, accountant, expert account[illegible] years' experience in mine account[illegible] statistical work, 9 years' general mining experience, graduate mining engineer, fully acquainted with construc[illegible] work and installation of cost, statistical and accounting systems, at present employed but will be open for new engagement soon. PW 453, Eng. & Min. Journal-Press, Old Colony Bldg., Chicago, Ill.

FOREMAN or shift boss, Mexico or Southwest; 14 years' experience in Mexico and Central America; a hustler, reliable and trustworthy; references by wire or mail; will be available July 1st. PW 455, Eng. & Min. Journal-Press, Rialto Bldg., San Francisco, Cal.

GRADUATE engineer 8 years' experience in ore concentrating and leaching processes; 10 years' in active charge of metal mining properties in Missouri and Rocky Mountain districts. PW-440, Eng. & Min. Journal-Press, Old Colony Bldg., Chicago, Ill.

MASTER mechanic and chief electrician. 41, married, three years' technical training sixteen years' general experience. Capable of taking entire charge of mine mill or smelter machinery, at present employed in Central Mexico available on thirty days notice. PW-438, Eng. & Min. Journal-Press, Old Colony Bldg., Chicago, Ill.

EXECUTIVES

Engineers and men of proven ability seeking positions, find our service satisfactory. Our Mr H. H. Harrison can confidentially negotiate for you suitable connections, as he has successfully done for thousands of others since 1909. Inquiries invited.

The National Business Bourse, Inc.
Confidential Negotiators
Association Bldg., Chicago

METALLURGIST—Wide experience operation, organization and in developments of new plants and processes. Best education, 15 years' executive wishes leading position pioneer work or old problems, chemical or metallurgical nature. PW-390, Eng. & Min. Journal-Press.

METALLURGIST, technical graduate, single, desires position as mill superintendent or ore testing engineer; 10 years' experience milling and flotation; 3 years in research laboratory large copper smelter, testing oils and ores for flotation. PW-454, Eng. & Min. Journal-Press, Rialto Bldg., San Francisco, Cal.

MILL superintendent or general foreman wishes new connection, 13 years' experience cyanidation, concentration, flotation; married, age 32; technical training; Mexico experience; references. Box 7, Pearce, Ariz.

MILL superintendent, metallurgist, with long, varied experience milling, cyanidation, gold or silver ores, foreign practice, desires charge of plant; expert ball-mills and counter-current decantation; graduate, unmarried, Spanish. PW-442, Eng. & Min. Journal-Press, Rialto Bldg., San Francisco, Cal.

MINING engineer, with many years' experience in mine and mill operation, construction and examination, wants suitable position. PW-451, Eng. & Min. Journal-Press, Rialto Bldg., San Francisco, Cal.

MINING executive, technical graduate; 12 years' broad mining experience, at present superintendent; speaks Spanish; salary $500. PW-423, Eng. & Min. Journal-Press, Old Colony Bldg., Chicago, Ill.

MINING engineer; experience covers engineering, shift boss, mine foreman, underground superintendent and assistant mine superintendent; available on thirty days' notice to present employers; speaks Spanish. PW-424, Eng. & Min. Journal-Press, Old Colony Bldg., Chicago, Ill.

MINING engineer, now managing small mine, desires greater field for capabilities; $400 per month up, according to conditions; might take interest in attractive enterprise. PW-452, Eng. & Min. Journal-Press, Rialto Bldg., San Francisco, Cal.

MINING engineer, 20 years' as engineer, superintendent and manager in United States and Latin-America desires position. Wide experience in construction, development and operation. PW-439, Eng. & Min. Journal-Press, Real Estate Trust Bldg., Phila., Pa.

SUPERINTENDENT, mine or mill, competent, dependable, eighteen years' experience Western States and Alaska in mining, milling, cyanidation and flotation of gold, silver and allied ores; last two years with mica; available now; A1 references from past employers. Reply PW-456, McGraw-Hill Co., Colorado Building, Washington, D. C.

POSITIONS WANTED

SUPERINTENDENT or manager. Position desired by technical graduate, seventeen years' experience, development and operation of mining properties; Western States and Mexico. Contact and vein deposits. Spanish spoken. PW-444, Eng. & Min. Journal-Press, Old Colony Bldg., Chicago, Ill.

EXTRA WORK WANTED

AMERICAN engineering draftsman, mech.-struct., desires extra work in designing and detailing building or special machines, San Francisco resident. EWW-450, Eng. & Min. Journal-Press, Rialto Bldg., San Francisco, Cal.

Mining Property for Lease

Valuable silver-lead mining property belonging to A. E. Reynolds estate and located mainly in Colorado will be leased on reasonable terms and royalties to responsible parties for operation.

Full particulars on request. This estate controls over ten thousand acres of the recognized most valuable mining properties in Colorado.

A. E. REYNOLDS, *Estate*
1555 Sherman Street, Denver, Colo.

PRECIOUS METAL ORES

Wanted—ores containing silver, gold or platinum to be recovered by means of an entirely new process. We are also interested in galena, copper and iron pyrite.

Great opportunity for mine owners or owners of mineral rights. Give price per ton and full particulars as to quantity and quality.

Address Station D. Box 74,
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A MINERAL COLLECTION WITH EVERY IMPORTANT MINERAL

125 specimens in collection, good sized, each specimen with label attached giving name, chemical nature and locality. An ideal collection for a study and display, $28.50 delivered. Booklet of collection gladly sent.
I purchase beautiful and interesting mineral specimens.

GEORGE S. SCOTT
20 Nassau Street, New York

MACHINERY FOR SALE

CENTRIFUGALS—60, 44, 40 and 32-in iron basket; 48, 40 and 26-in. copper basket

COOKERS—24 ½ x 7 ½ ft., 5 x 16 ft., 3 x 16 ft., with stirrer and steam jacket.

DRYERS—Direct-heat rotary dryers, 3 x 25 ft., 3 x 30 ft., 3 ½ x 25 ft., 4 x 30 ft., 4 ½ x 30 ft., 5 x 35 ft., 5 ½ x 50 ft., 5 ½ x 60 ft., 6 x 50 ft. and 7 x 50 ft.; double shell dryers, 3 x 16 ft., 4 x 20 ft., 4 ½ x 26 ft., 5 x 30 ft. and 6 x 35 ft
Drum Dryers—40 x 48 in., 5 x 12 ft., 3 x 10 ft.; 4 x 9 ft. Twin Rolls
Steam Heated Air Rotary Dryers—4 x 30 ft., 6 x 30 ft.
Steam Jacketed Dryers with Stirrers—5 x 15 ft., 3 x 7 ft., 2 ½ x 5 ft. and 2 ½ x 6 ft
Rotary Vacuum Dryers—4 x 10 ft., 5 x 15 ft. and 5 x 30 ft
Vacuum Drum Dryers—4 ½ x 10 ½ ft. and 3 ½ x 5 ft.
Vacuum Shelf Dryers—6, 12, 17 and 20 shelf; 13, 17, 20 and 26 shelf, double doors.

EVAPORATORS—1—Single effect, all copper; 1—Quadruple and 1—Triple effect with copper tubes. 1—Double and 1—Triple effect, all copper. 1—Double and 1—Triple effect, all iron.

FILTER PRESSES—1—No. 1100, 3—No. 850, 3—No. 650, 2—No. 450, 1—No. 250, No. 150, No. 30 Kelly's, No. 20, No. 9, No. 7, No. 5 and No. 4 Sweetlands, 6 x 4 ft., 6 x 6 ft., 6 x 12 ft. and 8 x 8 ft. Oliver's; 2—6 x 6 ft., 1—6 x 4 ft. and 4—6 x 3 ft. Industrial rotary filters; 1—4 x 4 ft. Industrial dewaterer; plate and frame presses of wood and iron.

HYDRAULIC PRESSES—600, 350, 200, 100 and 65-ton hydraulic presses; one Anderson expeller; 200 and 125-ton knuckle joint scrap presses

KETTLES—400-gal. fusion kettles; 250, 350, 500, 2000 gal. jacketed kettles; 300, 400 and 500-gal. Dopp kettles; 80, 150 and 250-gal. jacketed copper kettles.

KILNS—Rotary kilns, 8 x 125 ft., 6 x 70 ft., 5 x 50 ft., 4 x 40 ft. and 3 x 20 ft

MILLS—22 and 20-in. Schutz O'Neill mills; No. 18 and No. 36 American ring roll pulverizers; No. 0, No. 00, No. 000, No. 0000, 3, 4 and 5 roll Raymond mills; 6 x 8 ft., 6 x 5 ft., 5 x 4 ft., 3 x 3 ½ ft., 24 x 18 in. pebble and ball mills; 3 ft. and 2—8 ft. Marcy mills; 33 and 24 in. Fuller Lehigh mills; 4 ½ x 20 ft., 5 x 20 ft., 5 ½ x 22 ft., 6 x 16 ft., and 6 x 20 ft. tube mills; 15 x 24 in., 12 x 26 in., 10 x 16 in., 6 x 20 in., 9 x 12 in., 7 ½ x 13 in., 7 x 10 in., 2 x 6 jaw crushers; 2—No. 3 Williams deck sweeper type; 1—"Infant"; 1—No. 0, 1—No. 2, 2—No. 3, No. 4 Williams and 1—Jeffrey E-8 swing hammer mills; 1—Kent type "G" mill; 2—36 in. and 1—40-in. cage mills; 1—8 ft., 1—6 ft. 3—4 ½ ft. and 2—3 ft. Hardinge conical mills; 12 x 12 in., 18 x 12 in., 20 x 12 in., 30 x 18 in., 32 x 10 in., 36 x 16 in., 42 x 14 in. roll crushers; No. 0, No. 1, No. 2 and No. 3 Sturtevant ring roll mills; one No. 3 Telsmith breaker; 36 in. Coggswell mill and 1—36-in. Sturtevant emery mill; 1—9 ft. dry pan; No. 1 and No. 2 Mead mills; 1—20-in. Monarch burr stone mill; 42-in. burr stone mill.

NITRATORS—2,000 gal., 1,600 gal., 700 gal., 600 gal. and 300 gal.

RETORTS—6—Buflokast 3100-gal. nitric acid; 1500-gal. acetic acid retorts.

STILLS—Copper stills and iron stills with dephlegmators, condensers and fractionating columns; 25 to 60 in. diameter for solvent recovery or alcohol or ether manufacturing; 250, 500 and 2,000-gal. C. I. stills with stirrers; 8 x 3 ft. beta naphthol still; 50 gal. copper stills; 8—300-gal. steel jacketed stills.

VACUUM PANS—1—9 ft., 1—7 ft. 6 in., 2—4 ft. 6 in., all copper.

VACUUM PUMPS—Dry, 8 x 16 x 12 in., 12 x 22 x 18 in., 12 x 12 in., 8 x 12 x 12 in., 6 x 6 in., 8 x 10 x 10 x 10 in., 7 x 10 x 10 in., 5 x 4 in. Wet, 10 x 16 x 12 in., 12 x 14 x 16, 12 x 14 x 18 in., With jet condensers, 10 x 14 x 12 in., 8 x 14 x 12 in., 6 x 8 x 10 in.

SPECIALS—1—McDougal and 1—Wedge mechanical furnaces; automatic package and bag filling and weighing machines; bag sewing machines; jigs; 1—drag line excavator; 6 x 8 ft., 6 x 5 ft., 6 x 3 ft. Newaygo and 1—3 unit Sturtevant super-vibrating screens; 1—Leschen aerial tramway; automatic cement scales; 1—Briquetting press; 8 x 10-ft. Emerick air separators; glass lined tanks; pasteurizers.

All this equipment is complete and in good condition

W. P. HEINEKEN, 95 Liberty St., New York. Telephone: Cortlandt 1841

SALESMEN AVAILABLE

SALES engineer graduate engineer and full member A. S. M. E., at present representing large mining machinery concern seeks similar opening, fourteen years on construction and operation in leading capacity, with past three years on sales work, have developed broad acquaintance in West, Southwest and Mexico; can offer highest grade representation; also consider exclusive agency for reputable line this territory. SA-448, Eng. & Min. Journal-Press, Old Colony Bldg., Chicago, Ill.

BUSINESS OPPORTUNITIES

Producing Silver Mine

Wanted parties to promote producing silver mine. Equity-Creede Mining Co., 501 Thatcher Bldg., Pueblo, Col.

The undersigned desires to interest capital in a valuable semi-developed

COPPER PROPERTY

examined and reported on favorably by eminent engineers. Convenient location. Owing to natural features copper production should not cost to exceed 8c. per lb. An exceptional opportunity to secure control of a substantial copper property on very reasonable terms. Engineers' reports of mine and mill tests available.

BO-449. Eng. & Mining Journal-Press,
1570 Old Colony Bldg., Chicago, Ill.

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SILVER MINING PROPERTY

In Austin, Nevada, consisting of approximately 1200 acres, one-half of which are patented. Last owned by Austin-Manhattan Consolidated Mining Co. Includes old mines of the MANHATTAN MINING CO., with record production of over TWENTY MILLION DOLLARS. None of the old mines are deep.

WM. A. MARSHALL
Resident Agent, Austin, Nevada.

WANTED

HARDINGE CONICAL MILL

Second hand, 4½ ft. x 16 in. to rent for period four months with privilege of buying if satisfactory. Will pay freight and give ample protection.

J. CARSON ADKERSON, Mining Engineer,
Woodstock, Virginia.

Narrow Gauge Cars and Locomotives

Hundreds of narrow gauge cars, all types, including push cars, flat cars, dump cars, coal cars and ash cars. Several hundred pair of wheels, 36-in. gauge.

50—Electric Storage Battery Locomotives, both broad, narrow gauge.

Write for Special Bulletin No. 12 giving complete information.

NASHVILLE INDUSTRIAL CORPORATION
Jacksonville, Tennessee

STEAM PUMPS

200 New and used. Simplex and Duplex steam pumps—5½ x 3½ x 5, 6 x 4 x 6, 7½ x 4½ x 10, 6 x 2½ x 6, and other sizes.

All offered at a bargain.

NASHVILLE INDUSTRIAL CORPORATION
Jacksonville, Tennessee

PIPE

From Old Hickory Powder Plant, at Bargain Prices
14,000 ft.... 16 inches 11,000 ft.... 14 inches
Walls ⅜ in. thick. Either plain end or fitted with Van Stone flanges.
Thousands of feet smaller sizes.
Thousands of feet hydraulic pipe.
Pipe was installed above ground, covered and protected but never used

NASHVILLE INDUSTRIAL CORPORATION
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DOUBLE DECK BUNKS

For Construction Camps, Mine Bunk Houses, Etc.

Width 30 in., height from floor 58 in., weight 90 lbs. heavy steel fabric springs. 6,000 bunks available for quick sale at low prices.

30-in. Cotton Top Mattresses, used, but in good condition and thoroughly fumigated.

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FOR SALE

Silver-Lead Mining Property

Near Ainsworth, British Columbia, consisting of 340 acres Crown granted, concentrator, compressor, water power, buildings, tools, equipment, timber, transportation the best, exceptional opportunity. D. H. Nellis, owner, Ainsworth, British Columbia.

For Sale by the

CENTRAL EUREKA MINING COMPANY

at Sutter Creek, Cal.

1—Double drum geared hoisting engine in fairly good condition. Drums 8 ft. 0 in. dia. by 30 in. face; cylinders 18 in. dia. by 28 in. stroke. Hoisted a two ton load from the 4100 ft. Level with 80 lbs. steam until displaced by the new winder last month.

2—H. T. Boilers—Two 52 in. by 16 ft. and one 66 in. by 16 ft., good for 100 and 140 lbs. steam pressure respectively, the latter being practically a new boiler equipped with automatic oil burners, feed water regulators and oil feed pumps, two stacks and all steam piping and fittings necessary to run the above hoist.

3—90 in. sheaves, with shafts and bearings for 1-in. rope.

1—Norfolk belt driven compressor, with cylinders 16 in. and 9½ in. by 18-in. stroke, in good condition.

Price—$6,500 net for all as it stands at mine. Hoist alone cost $8,000 when new.

FOR SALE

One size No. 4 Myers-Whaley

Shoveling Machine

Thoroughly overhauled and in first-class operating condition.

For particulars address:

Copper Range Company
John M. Wagner, ***Purchasing Agent***
P. O. Drawer 30, Houghton, Michigan

FOR SALE

Two New Lake Superior Shuveloders

Never been uncrated
Will Sacrifice for Quick Sale
HUTTIG LEAD & ZINC CO.
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Rebuilt Machinery

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HOISTS—Electric

1—112 hp. Double Drum Hoist with 3 ph. motor
1—75 hp. Single Drum Hoist with 500 v. D.C. Motor
1—22 hp. Single Drum Hoist with 3 ph. motor

HOISTS—Steam

1—10 x 24 [illegible] Double Drum
1—10 x 12 H. & B. Double Drum
1—14 x 18 Lidgerwood Single Drum
1—11 x 15 Gates Single Drum
2—10 x 11 Davis Single Drum
1—10 x 12 Vulcan Single Drum
[illegible]—8 x 10 Vulcan Single Drum
1—[illegible] x 8 McFarlane, Single Drum
4—6 x 8 Double Friction, Single Drum
1—5 x 6 Davis, Single Drum
1—Anaconda Prospectors Hoist

COMPRESSORS—Belt Driven

[illegible] x 8 Bury, Single Stage
[illegible]—10 x 8 Franklin, Single Stage, 11[illegible] c. f.
[illegible] x [illegible] x 11 Franklin 2 Stage, 314 c. f.
1—[illegible] x 10 x 12 Ingersoll 2 Stage, 410 c. f.
1—1[illegible] x 10 x 18 Leyner 2 Stage, 481 c. f.
1—16 x 18 Ingersoll Single Stage, 505 c. f.
1—25½ x 14½ x 14 Ingersoll 2 Stage 1100 c. f.
1—22 x 13 x 36 Riedler 2 Stage, 1400 c. f.
6—15 x 26 x 24 Laidlaw 2 Stage, [illegible] c. f.

COMPRESSORS—Steam Driven

1—6 x 6 x 6 Ingersoll Single Stage, 29 c. f.
1—14 x 14 x 22 Rand Single Stage, 391 c. f.
2—14½ x 16 x 10 x 17 Leyner 2 Stage 427 c. f.
1—14 x 16 x 9½ x 1[illegible] Norwalk 2 Stage, 5[illegible]8 c. f.
1—16 x 18 x 11 x 22 Leyner 2 Stage, 648 c. f.
2—9 x 17 x 15 x 9½ x 12 Laidlaw 2 Stage, 623 c. f.
1—18 x 30 x 26 x [illegible] x 24 Laidlaw 2 Stage, 1314 c. f.
2—9 x 17 x 15 x 9½ x 12 Laidlaw 2-Stage, 1400 c. f.
1—8 x 8 x 4½ x 2¾ x 6 Clayton Co., 2 Compressor.

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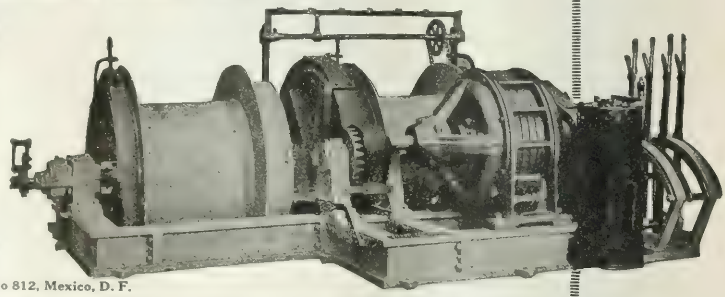

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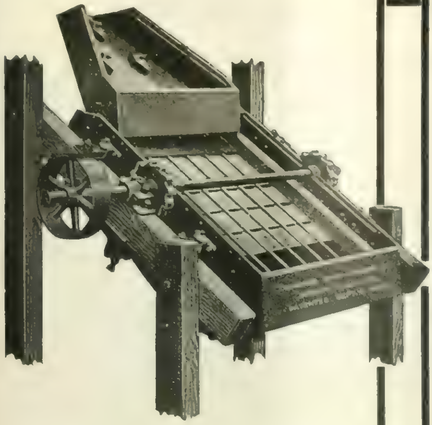

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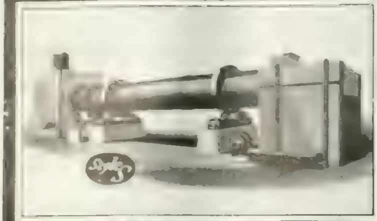

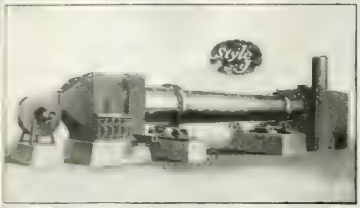

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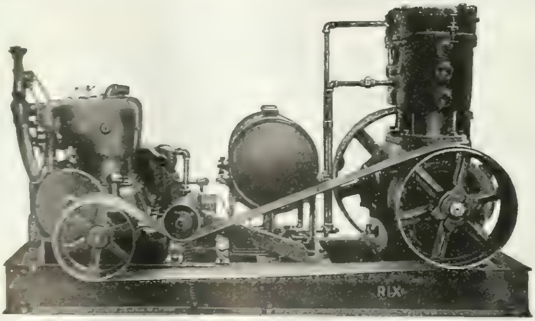

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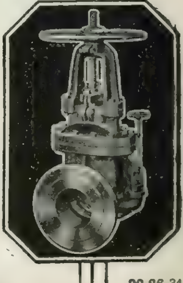

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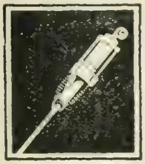

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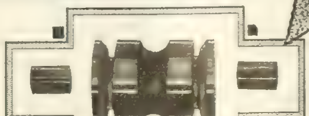

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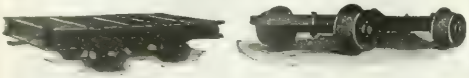

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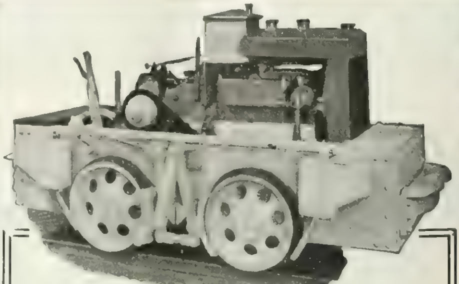

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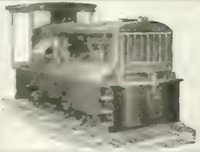

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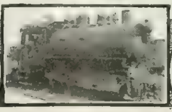

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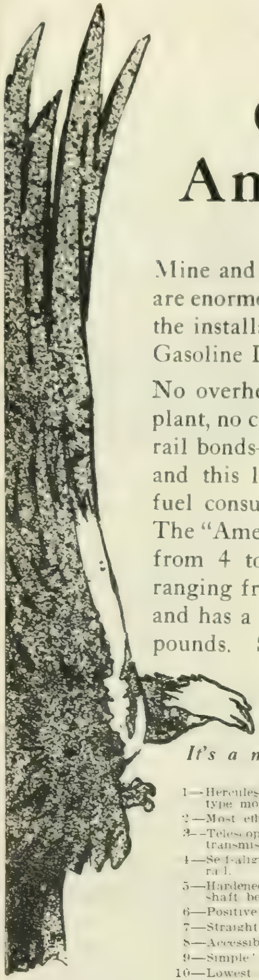

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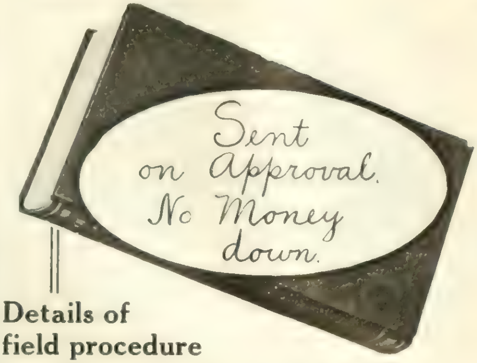

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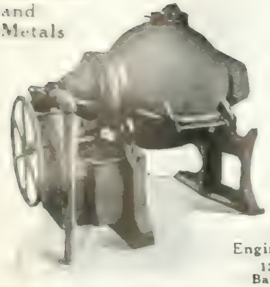

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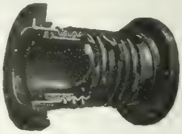

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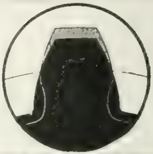

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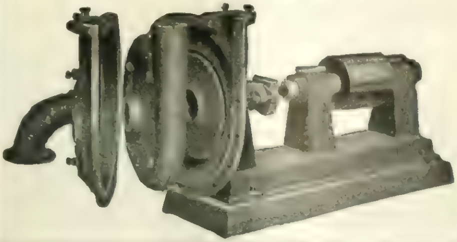

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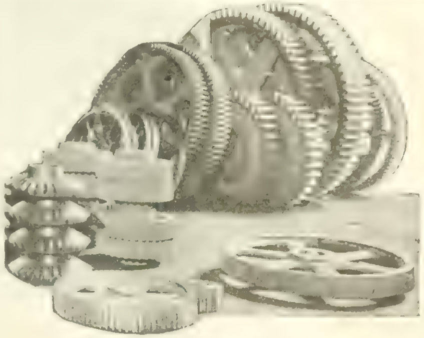

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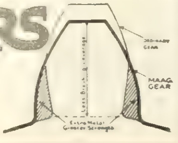

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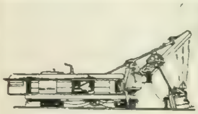

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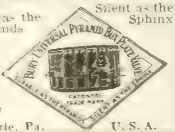

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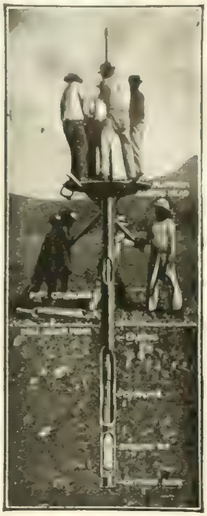

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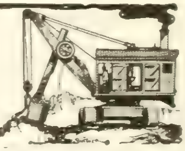

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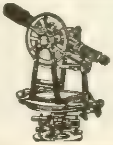

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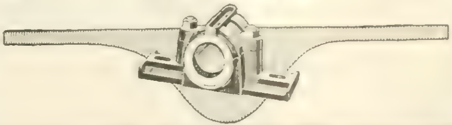

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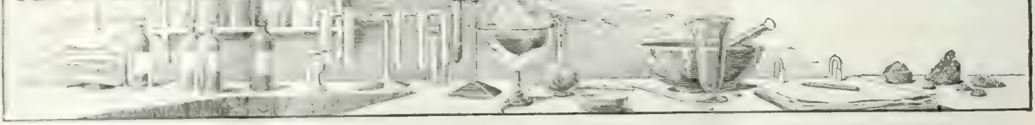

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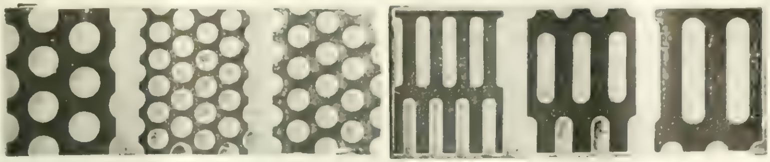

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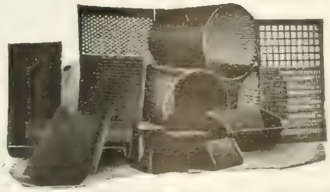

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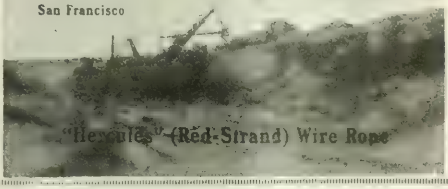

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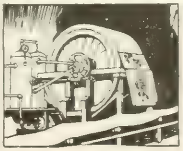

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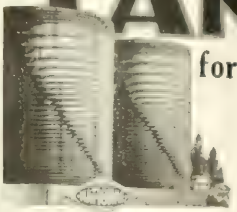

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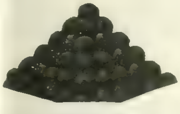

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